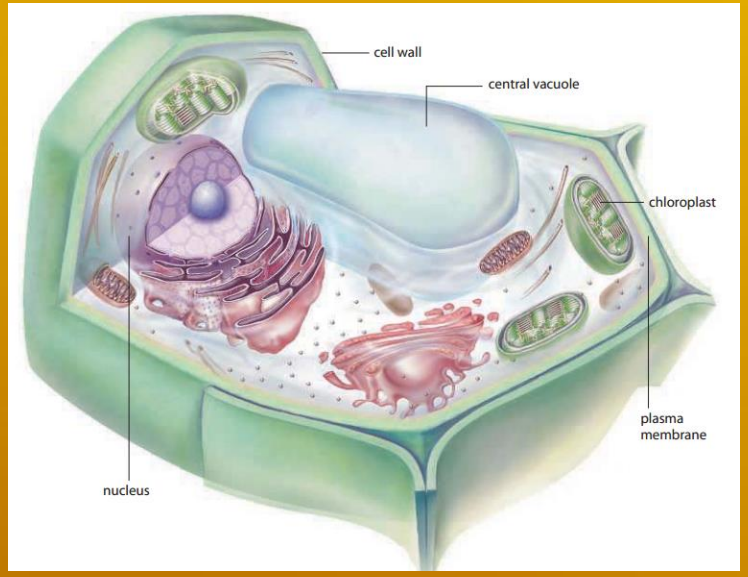
Biology 2201: Unit 3 - Maintaining Homeostasis

Chapter 11: Plants and Homeostasis

Mr. Gillam - Holy Heart

Plant Cells

- Recall that plant cells have a cell wall that provides support to the plant.
- Plant cells also have cell membranes, which control substances moving into and out of the cell.
- The nucleus of the cell contains the genetic material of the plant and acts as a control centre, directing cellular activities.
- Chloroplasts contain pigments that absorb light energy that a plant uses to carry out photosynthesis.
- Plant cells have a large central vacuole that is used to store food, enzymes, and other materials needed by the cell.



Vascular Plant Systems

- Vascular plants have two organ systems: an above-ground shoot system and an underground root system.
- The shoot system is made up of the stems, leaves, and flowers, three of the four organs in plants.
- The root system is made up of the roots of the plant, and it anchors the plant by penetrating into the soil. The root system absorbs the water and mineral nutrients that the plant needs.

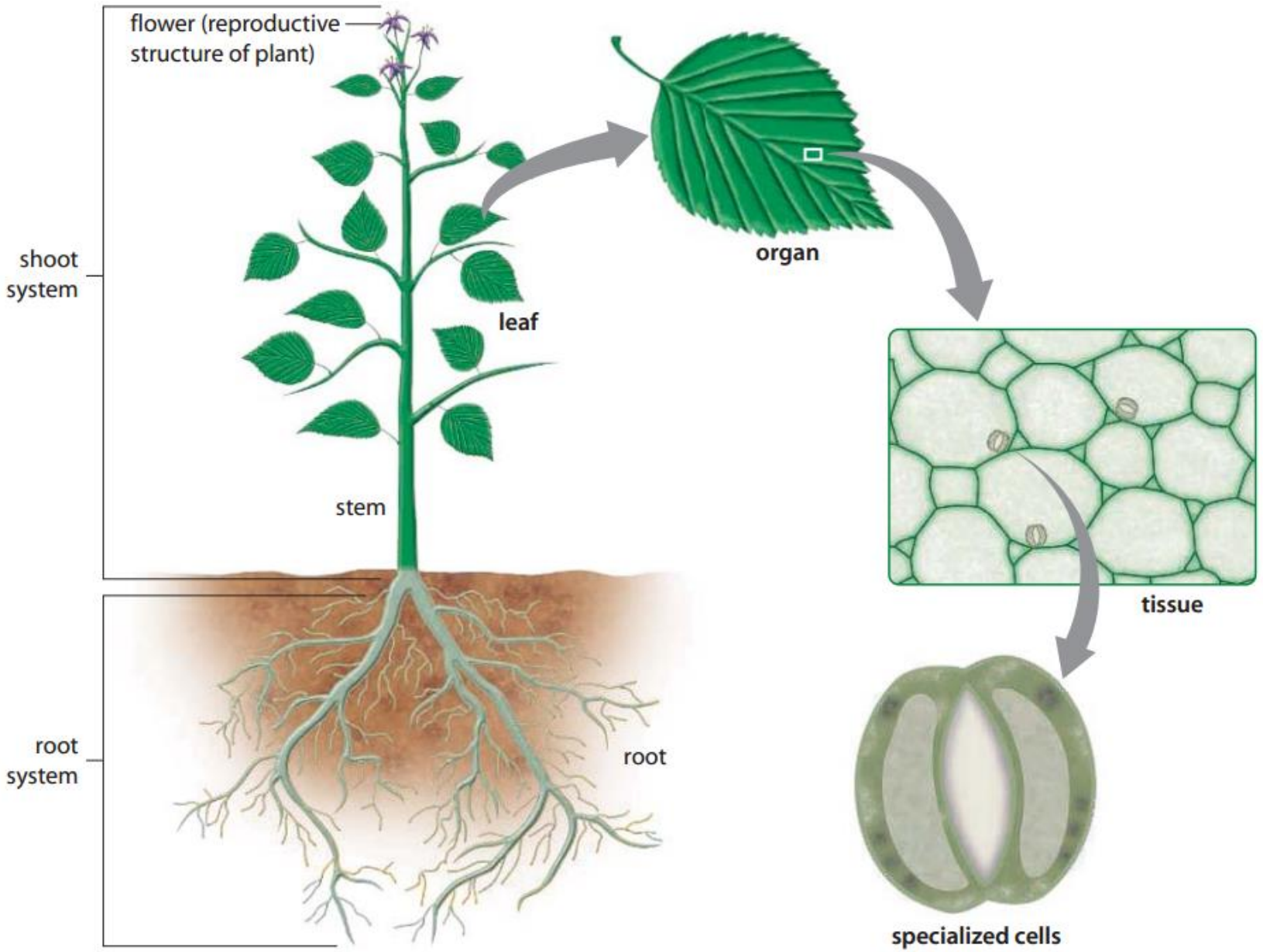


Figure 11.2 The body of a vascular plant consists of a root system and a shoot system. The organs of a plant—the leaves, stems, flowers, and roots—are made of tissues. Tissues are groups of specialized cells that work together to perform a function.

Plant Tissues

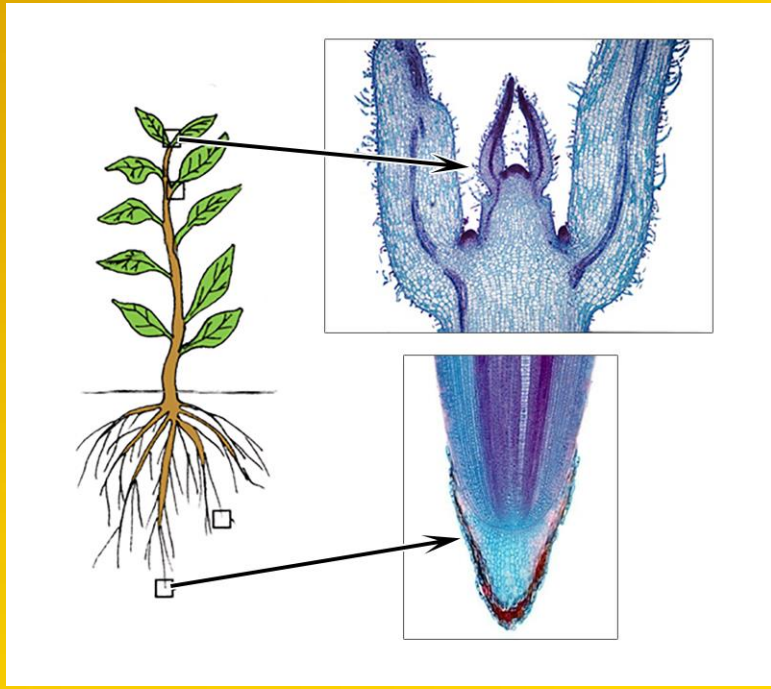
- Plants have four main types of tissue:
- meristematic tissue, which is where new cells are produced
- dermal tissue, which forms the outer covering of the plant; it includes epidermis and periderm
- ground tissue, which has many functions and which makes up most of the inside of a plant
- vascular tissue, which transports water, minerals, and other substances throughout the plant and provides support; it includes xylem and phloem

Meristematic Tissue

- undifferentiated embryonic plant tissue from which all other plant tissues develop

- meristems—areas of rapidly dividing cells.

As these cells mature, they can develop into different types of specialized plant cells.



Dermal Tissue

- Dermal Tissue the outer layers of cells that form a protective covering for the plant; includes epidermis and periderm
- The epidermis is a single layer of dermal-tissue cells that forms a protective covering over the body of non-woody (herbaceous) plants and young woody plants.
- Older woody plants also form dermal tissue called periderm, which is produced as part of secondary growth. It replaces the epidermis to form cork in woody stems and roots.

Epidermal Tissue: Guard Cells

- Guard cells a specialized epidermal cell; functioning
- in pairs, they regulate the opening of stomata

- Stomata a small opening, usually in the leaf, that allows gas exchange to occur

- Guard cells control the size of the stomata. When stomata are open, gas exchange can occur.
- During the day, carbon dioxide diffuses in through the stomata and oxygen diffuses out.
- Water in the form of gaseous water vapour also diffuses out of the plant and into the atmosphere through stomata.

Figure 11.3 Guard cells regulate the size of stomata. On hot and/or dry days, stomata are closed in order to avoid too much water loss.

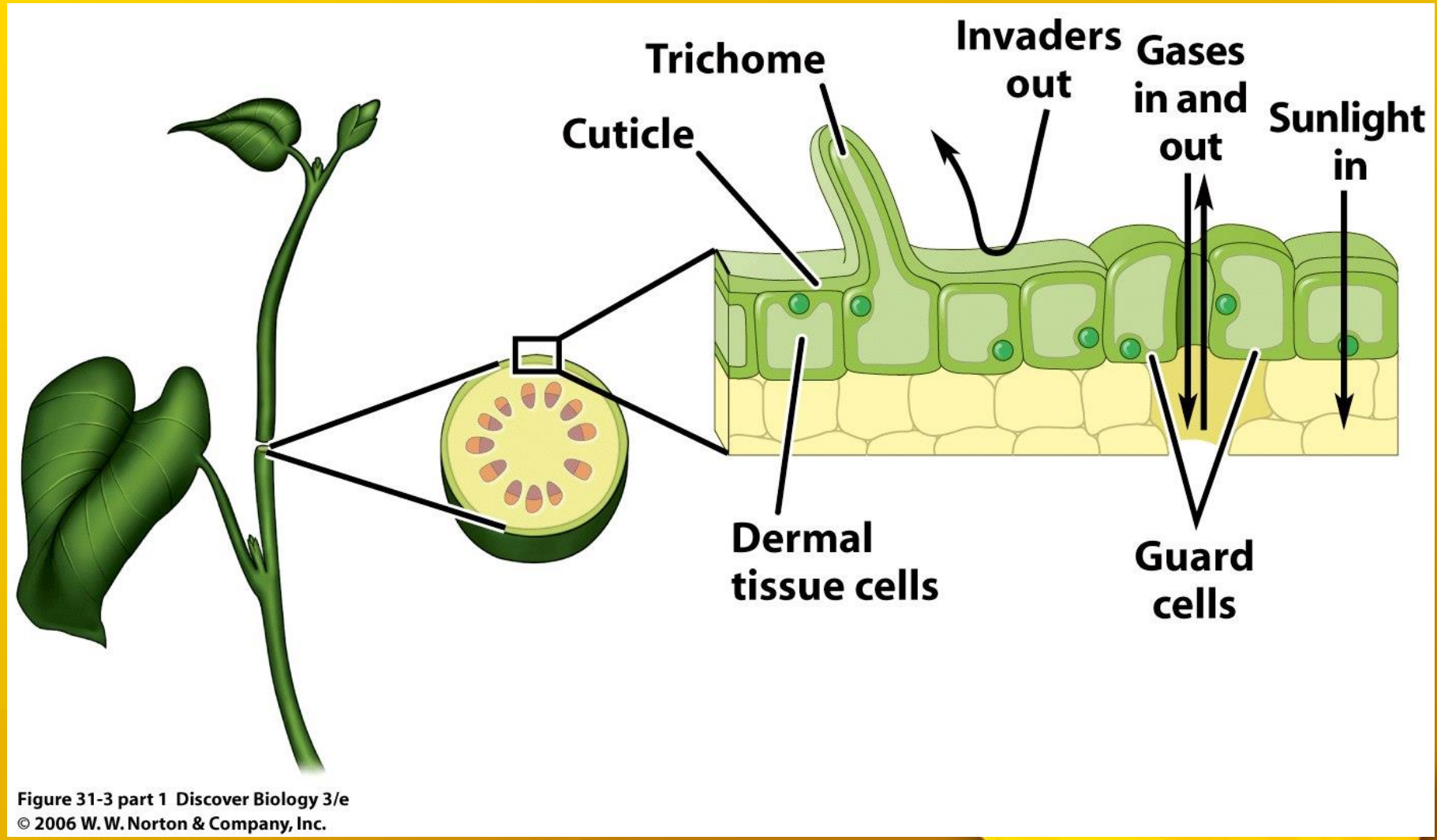


Figure 31-3 part 1 Discover Biology 3/e

Epidermal Tissue: Root Hairs

- root hair the fine, hair-like structures that cover the surface of the root of a plant; they increase the surface area available for gas exchange and the absorption of water and nutrients

Ground Tissue

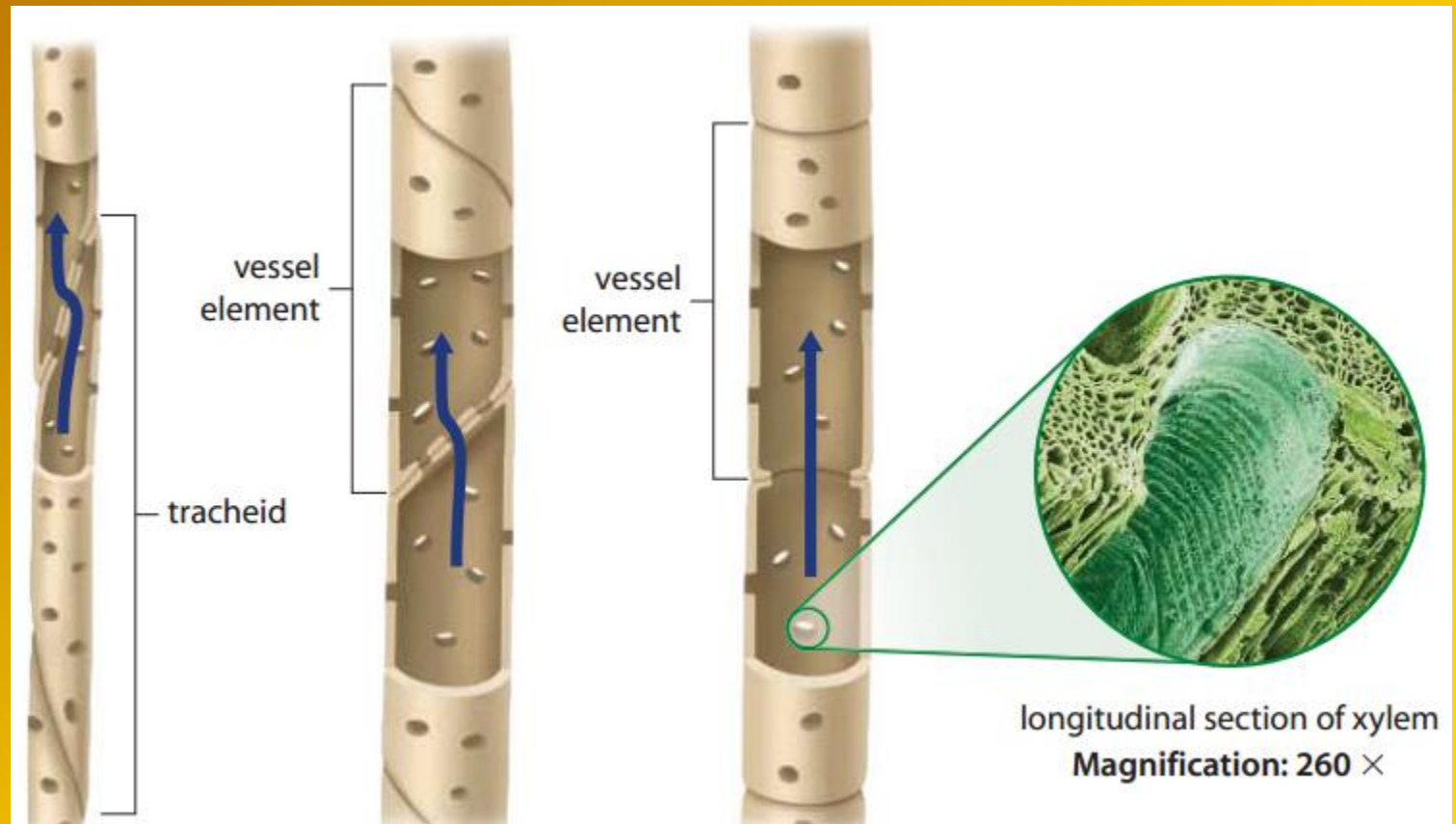
- ground tissue a plant tissue that has multiple functions and that makes up most of the inside of a plant
- Functions: photosynthesis, storage, and support.
- In some stems, roots, and seeds, the cells of ground tissue store starch and oils.
- Ground tissue also provides support for the plant when it grows between other types of tissue.

Vascular Tissue

- Vascular tissue is an internal system of tubes that run lengthwise throughout the stem of a plant, connecting the roots and the leaves.
- The function of vascular tissue is to transport water and dissolved substances throughout the plant.
- There are two types of vascular tissue: xylem and phloem.

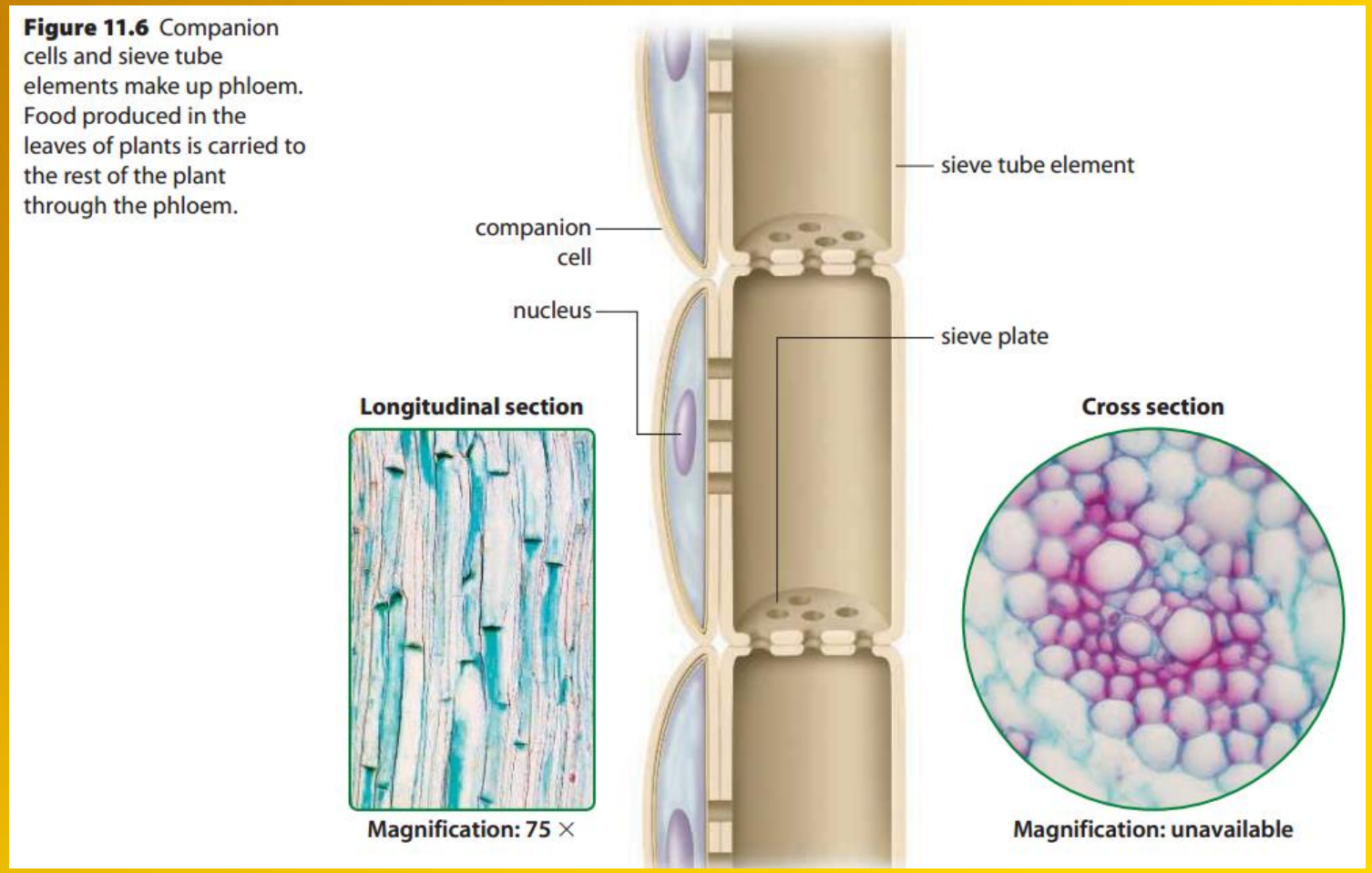
Vascular Tissue

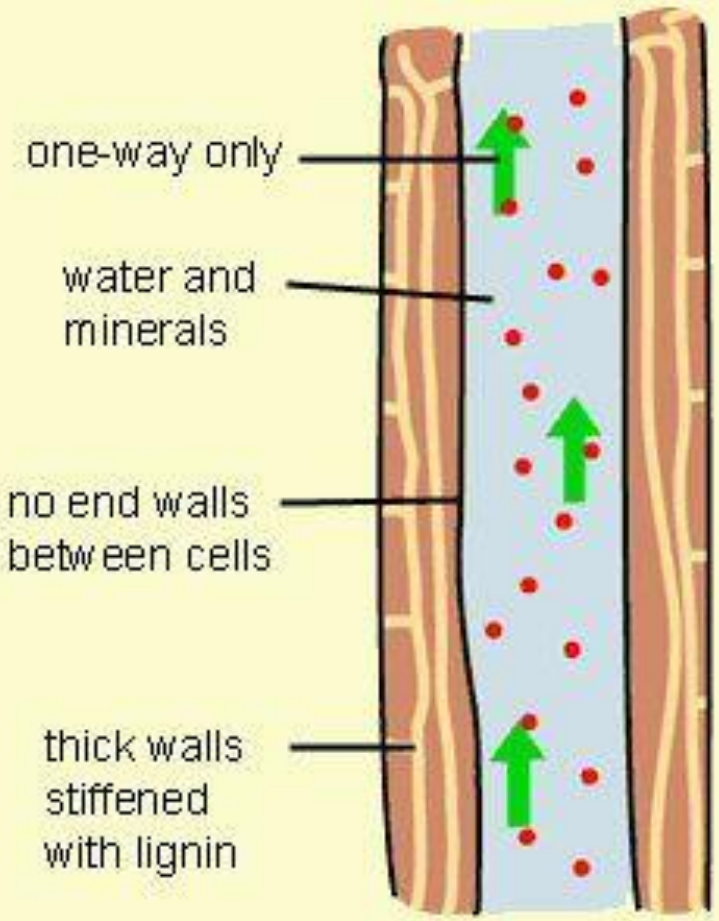
- xylem vascular tissue that transports water and minerals from the roots to the leaves



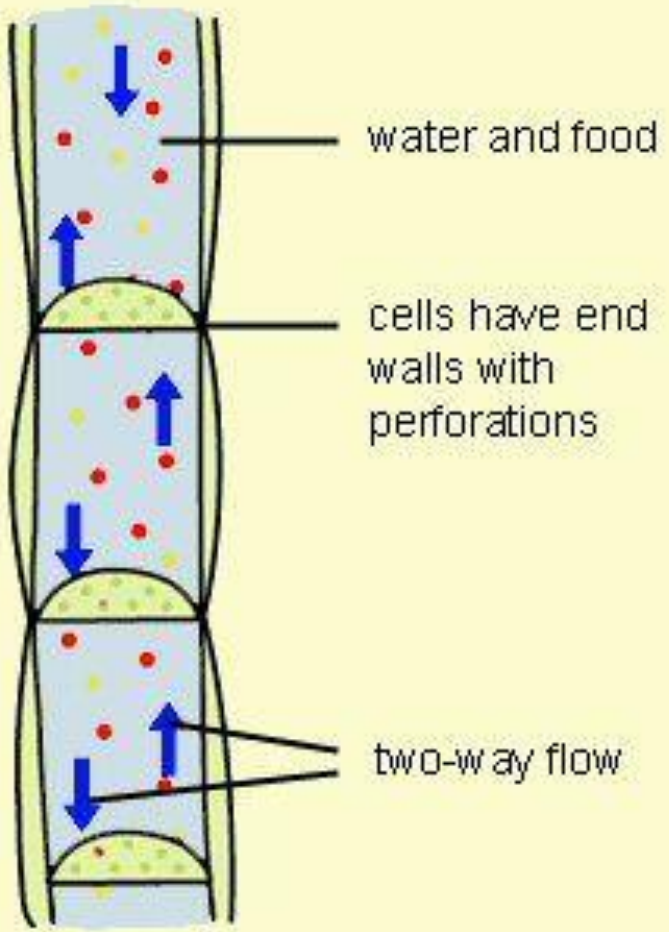
Vascular Tissue

- phloem vascular tissue that transports organic nutrients, often from the leaves to the roots, but also from roots and mature leaves to new leaves

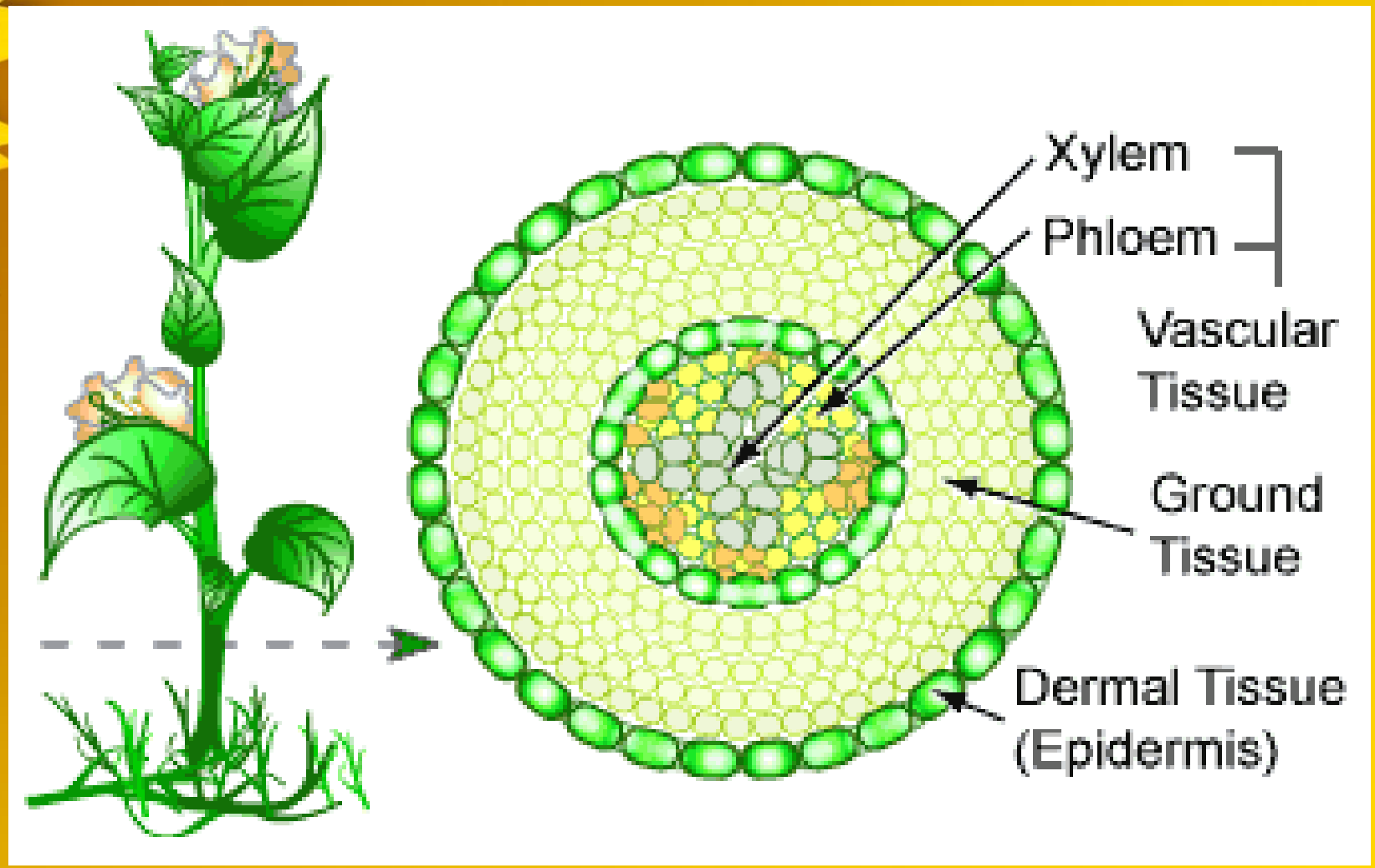




xylem vessel



phloem vessel


Xylem
Phloem
Vascular Tissue
Ground Tissue
Dermal Tissue (Epidermis)

Plant Organs and Their Functions

- Roots

For most plants, roots serve three functions:

1. Roots take in water and dissolved minerals that get transported to the rest of the plant.

2. Roots anchor the plant in soil or to some other plant or object, supporting the plant.

3. Roots store the carbohydrates that are produced by photosynthesis as well as water and other nutrients.

Pla

Table 11.1 Types of Roots

Type	Example	Function
taproot		• anchors plant • absorbs water and minerals • food and water storage
fibrous root		• anchors plant • absorbs water and minerals
modified root		• food and water storage

Plant Organs and Their Functions

- Stems

- The main function of a stem is to provide support for the plant's leaves and flowers, a plant's reproductive structures.

Figure 11.10 Annual growth rings form in the stems of woody plants. This pattern occurs because seasonal variations in moisture and other environmental conditions influence the production of new vascular tissue.

Stems

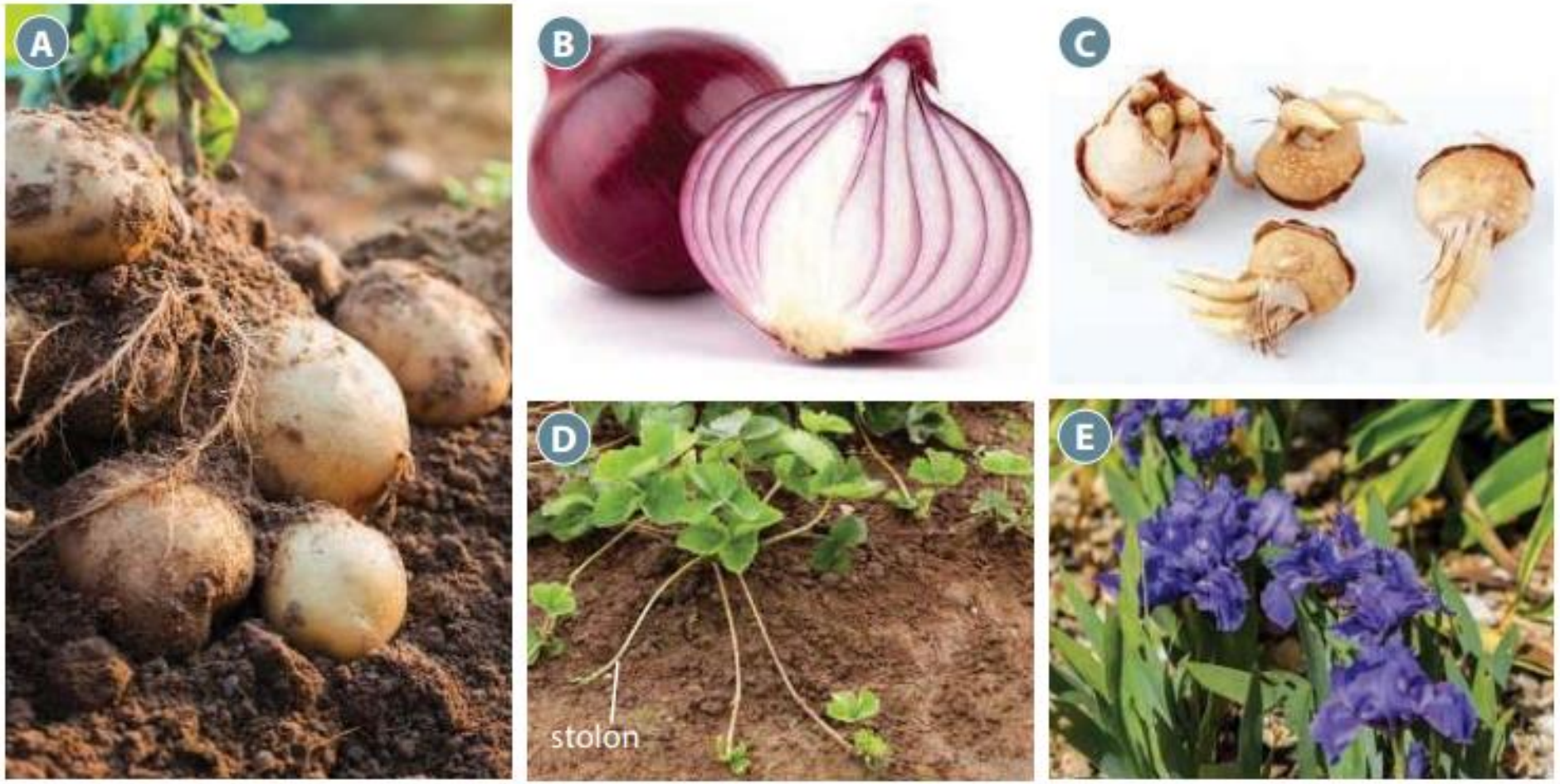


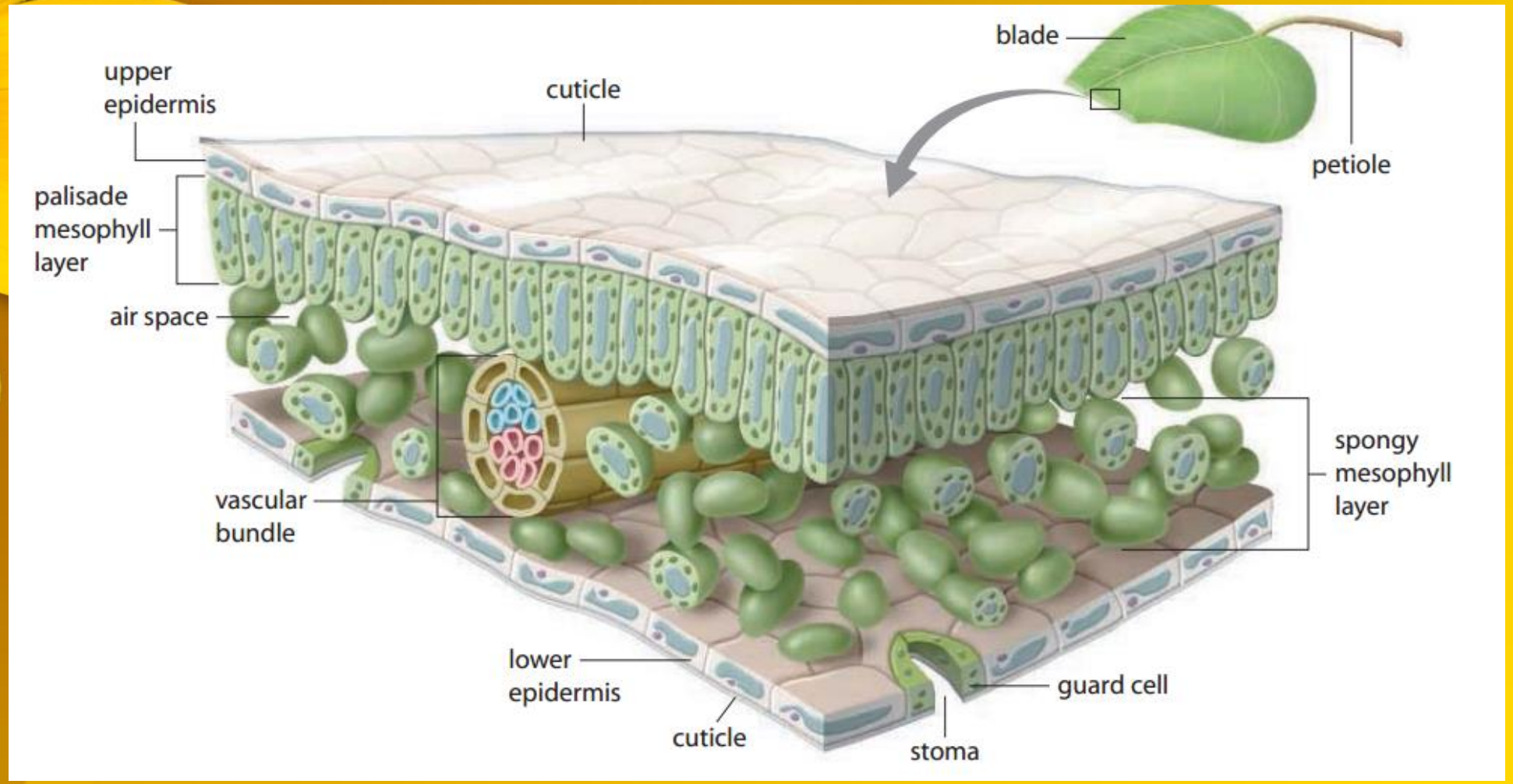
Figure 11.11 There are several different types of stems. **(A)** The potato is a tuber. **(B)** The onion is a bulb. **(C)** Crocuses are corms. **(D)** Strawberry plants have above-ground runners, or stolons. **(E)** Irises are plants that have rhizomes.

Plant Organs and Their Functions

- Leaves
- The main function of all leaves is to convert the light energy from the Sun into the chemical energy of food through the process of photosynthesis.

- cuticle a waxy layer on the epidermis that is secreted by epidermal cells

Leaves



Transport in the Xylem: Diffusion and Osmosis

1. The root cells contain a higher concentration of dissolved nutrients than the surrounding soil, so water moves into the roots by osmosis.

2. Water enters the xylem.

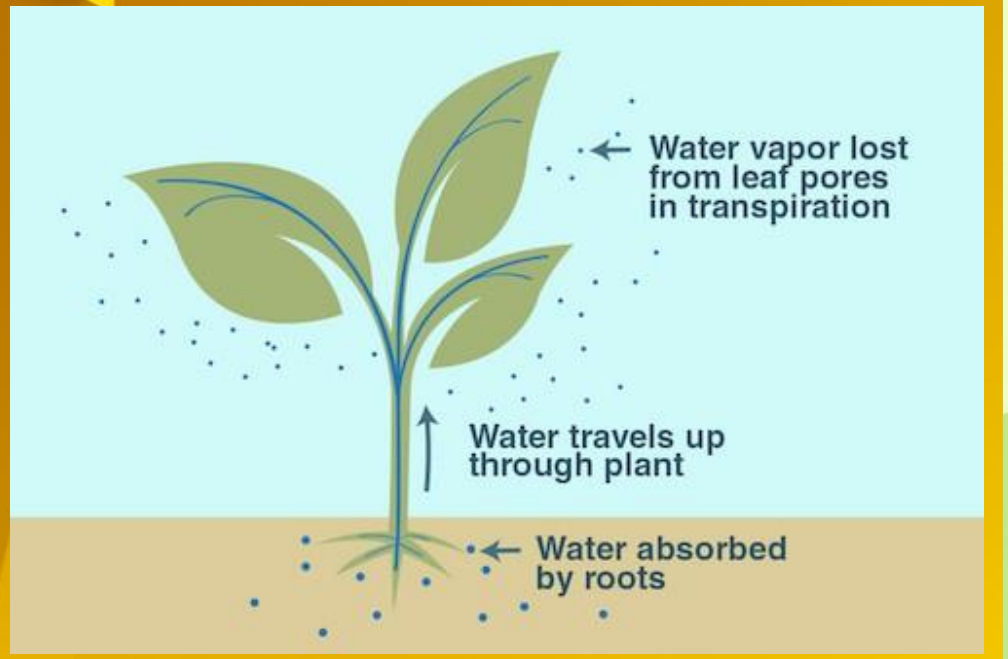
3. Within the stem, water moves by diffusion into other tissues of the plant.

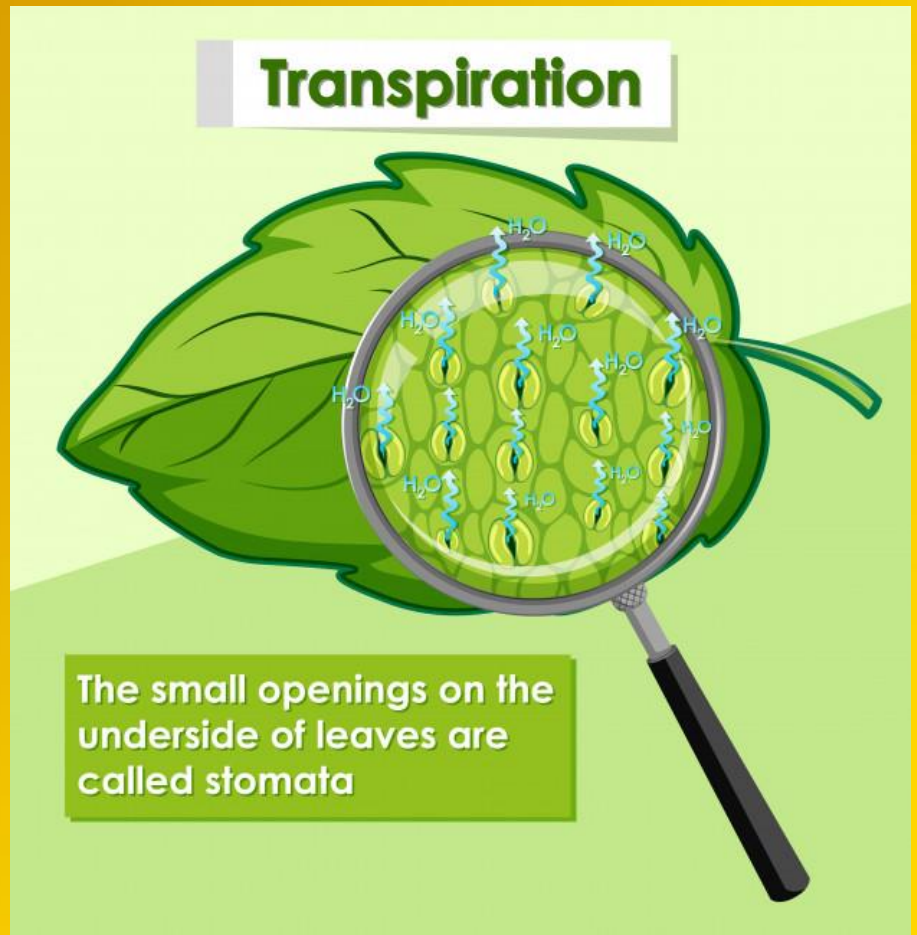
4. Conducting vessels branch into the numerous veins. From the end of each vein, water and minerals can diffuse into the cells of the leaf. 90% of water may be lost through transpiration

NOTE: Minerals usually move across cell membranes through active transport.

Transpiration

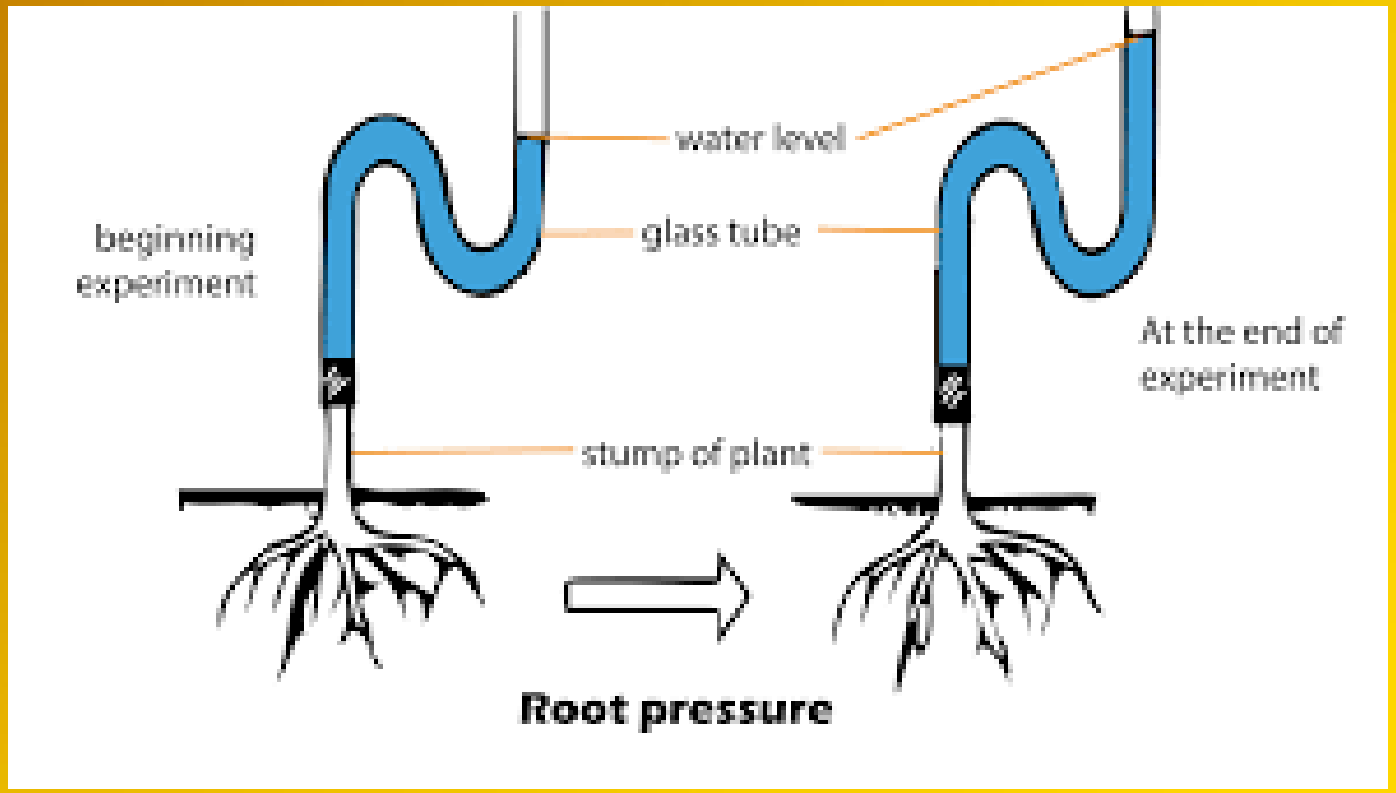
- the process in which water evaporates from the inside of a leaf to the outside through the stomata





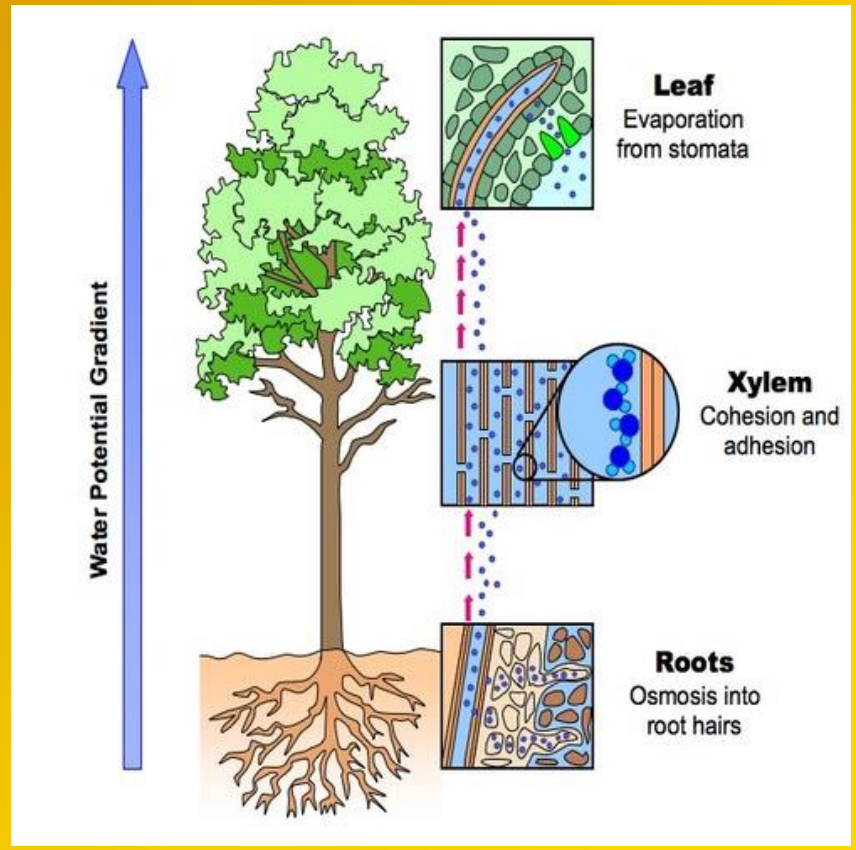
Root Pressure

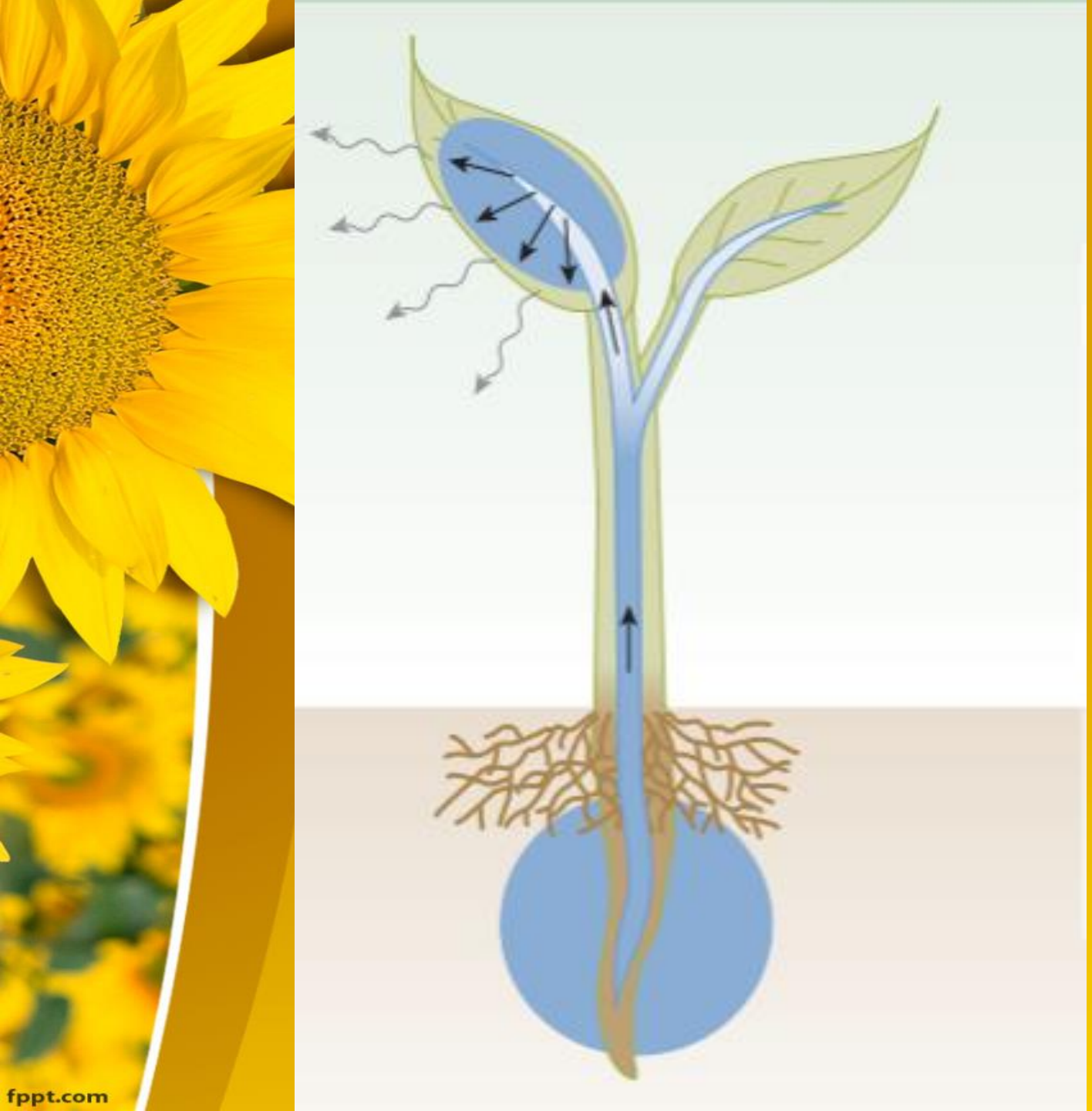
- the mechanism by which positive pressure in the roots moves water upward in a plant



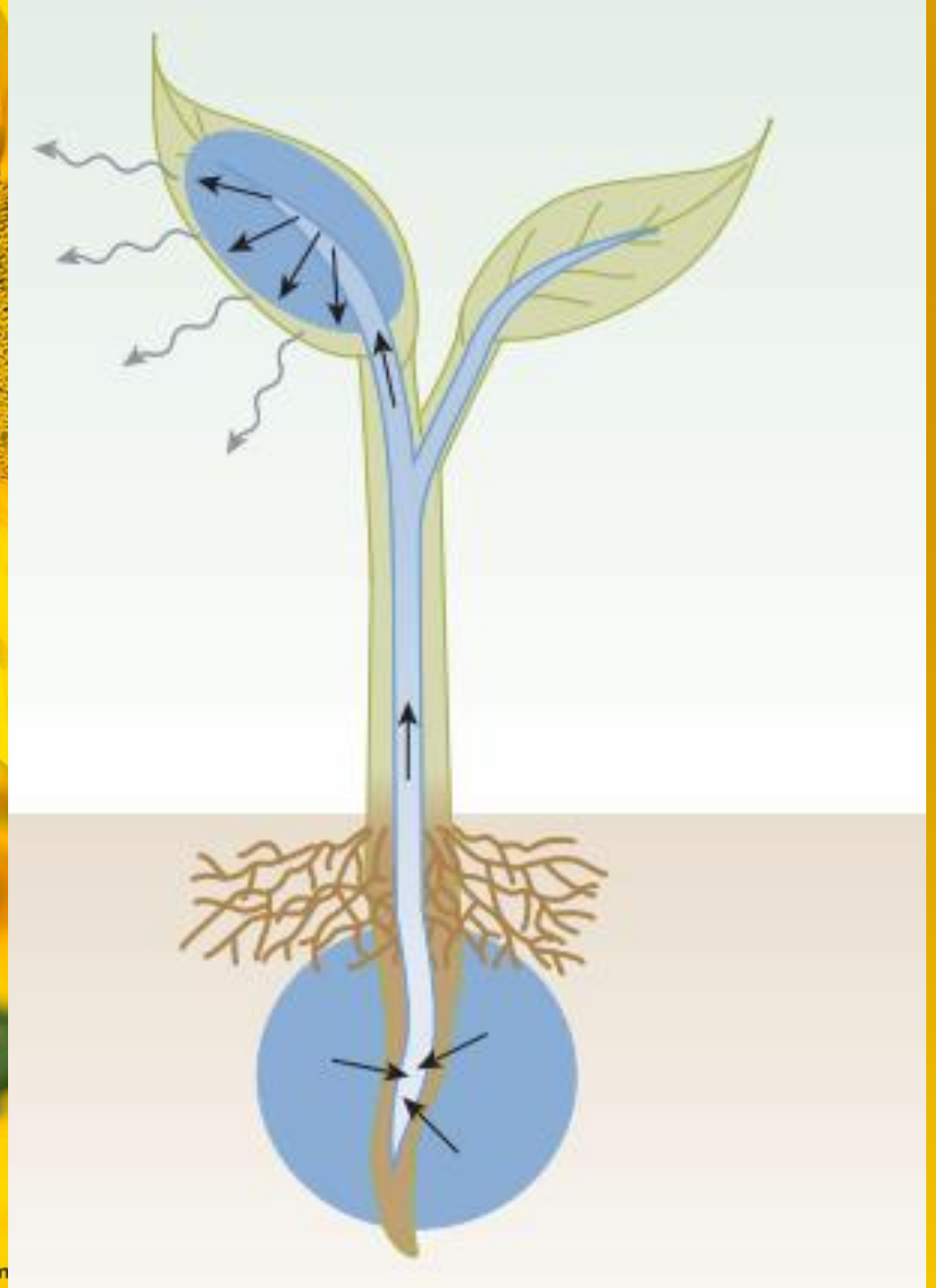
cohesion-tension model

- a model of water transport that explains how water is moved from the roots to the leaves of a plant
- Caused by
  - Transpiration
  - Cohesion
  - Adhesion





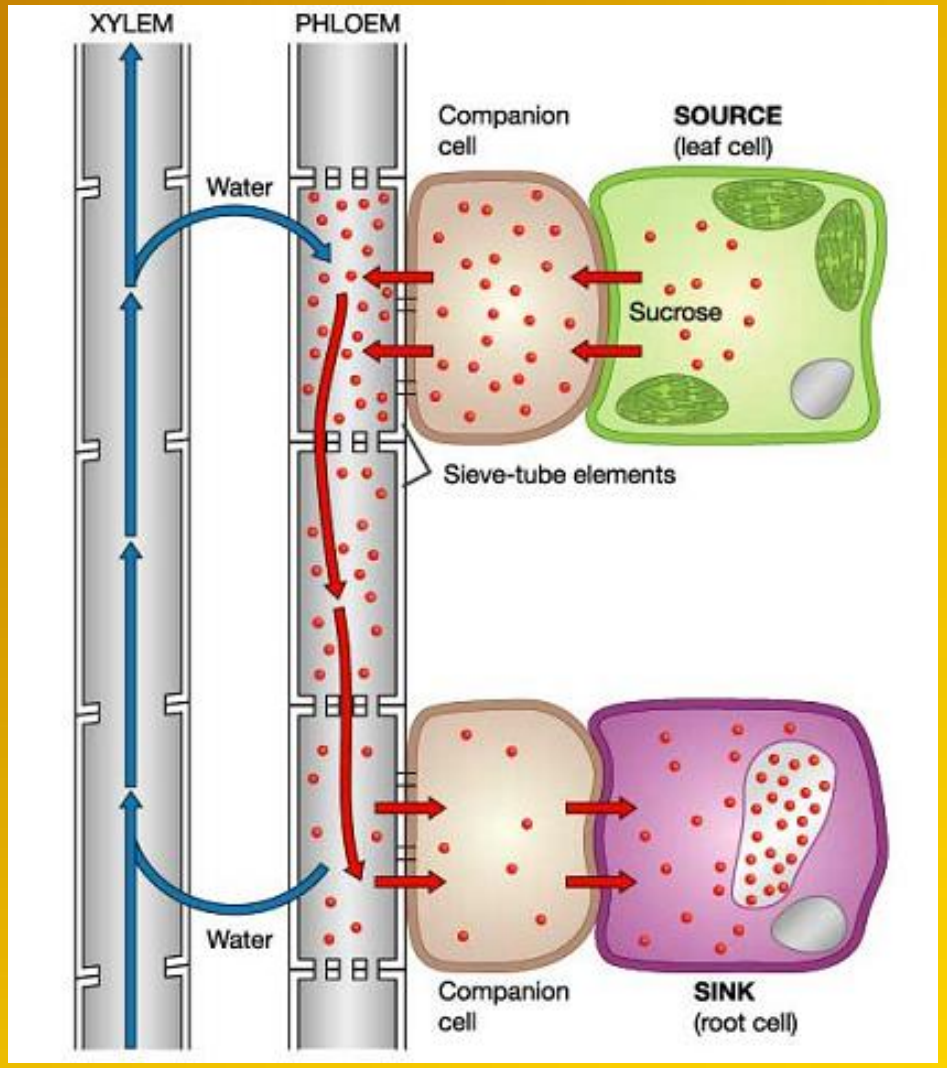
- 1. water evaporates from leaf cell causing pressure to drop
- 2. water moves form the xylem to veins by osmosis
- 3. pressure in the xylem tissue lowers causing water to flow from the stem to the leaf
- 4. this causes water to flow from the root xylem to the stem.



- 5. transpiration continues from the leaves and pressure continues to drop
- 6. water is sucked into the xylem because of the low pressure
- 7. the water in the xylem sticks together because of cohesion
- 8. adhesion causes water to stick to the walls of the xylem cells

translocation

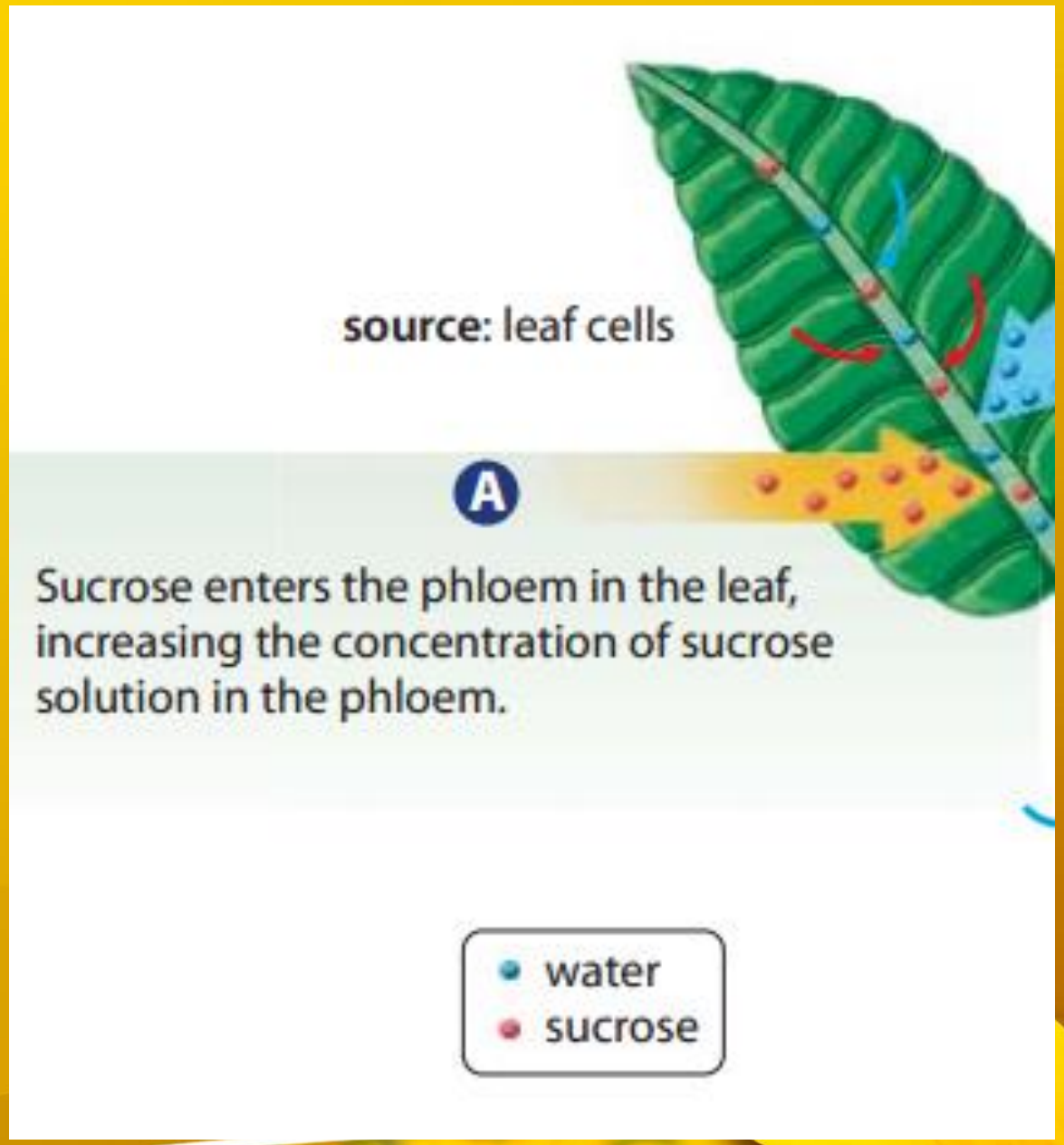
- the transport of sucrose and other organic molecules through the phloem of a plant

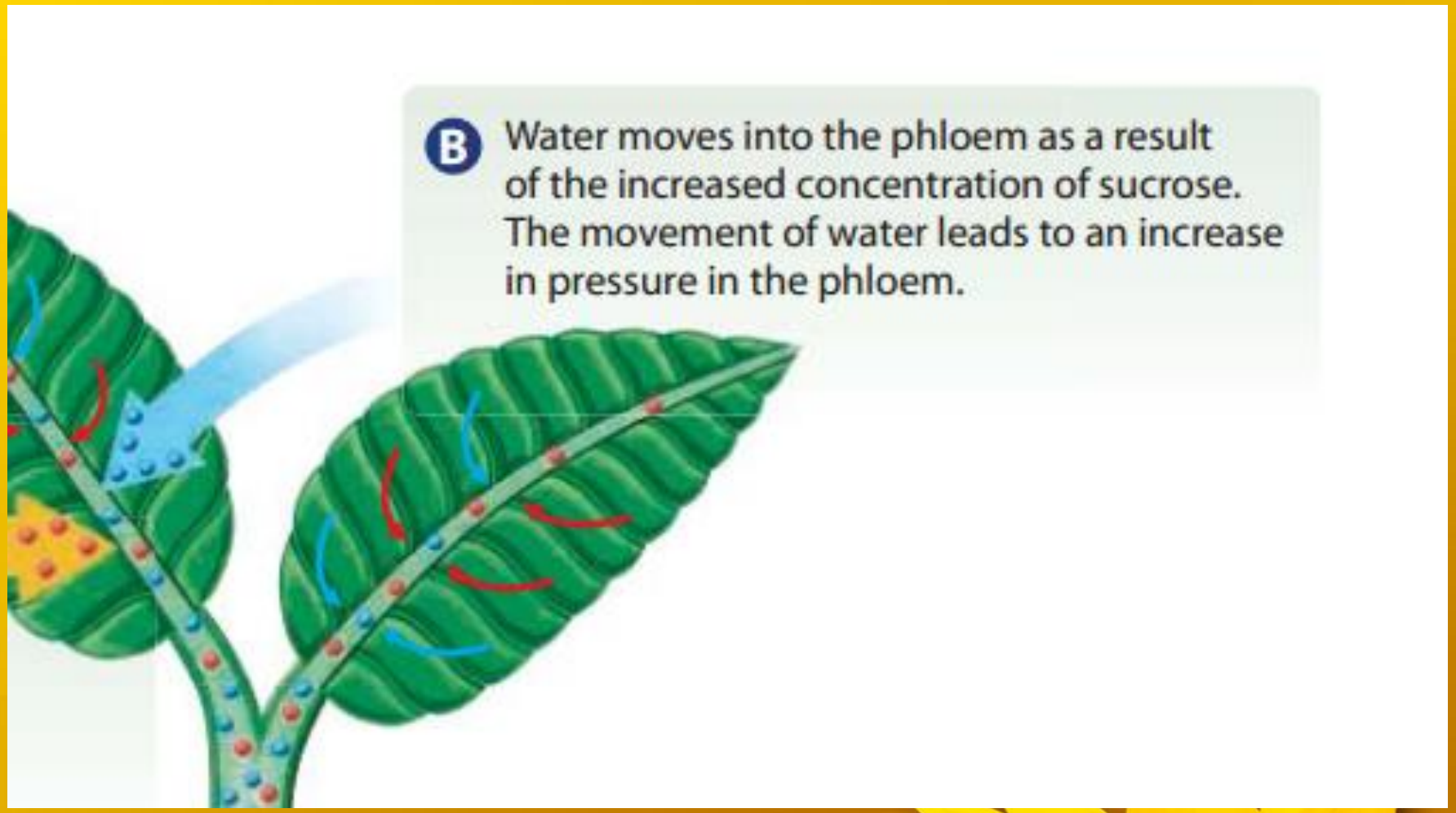


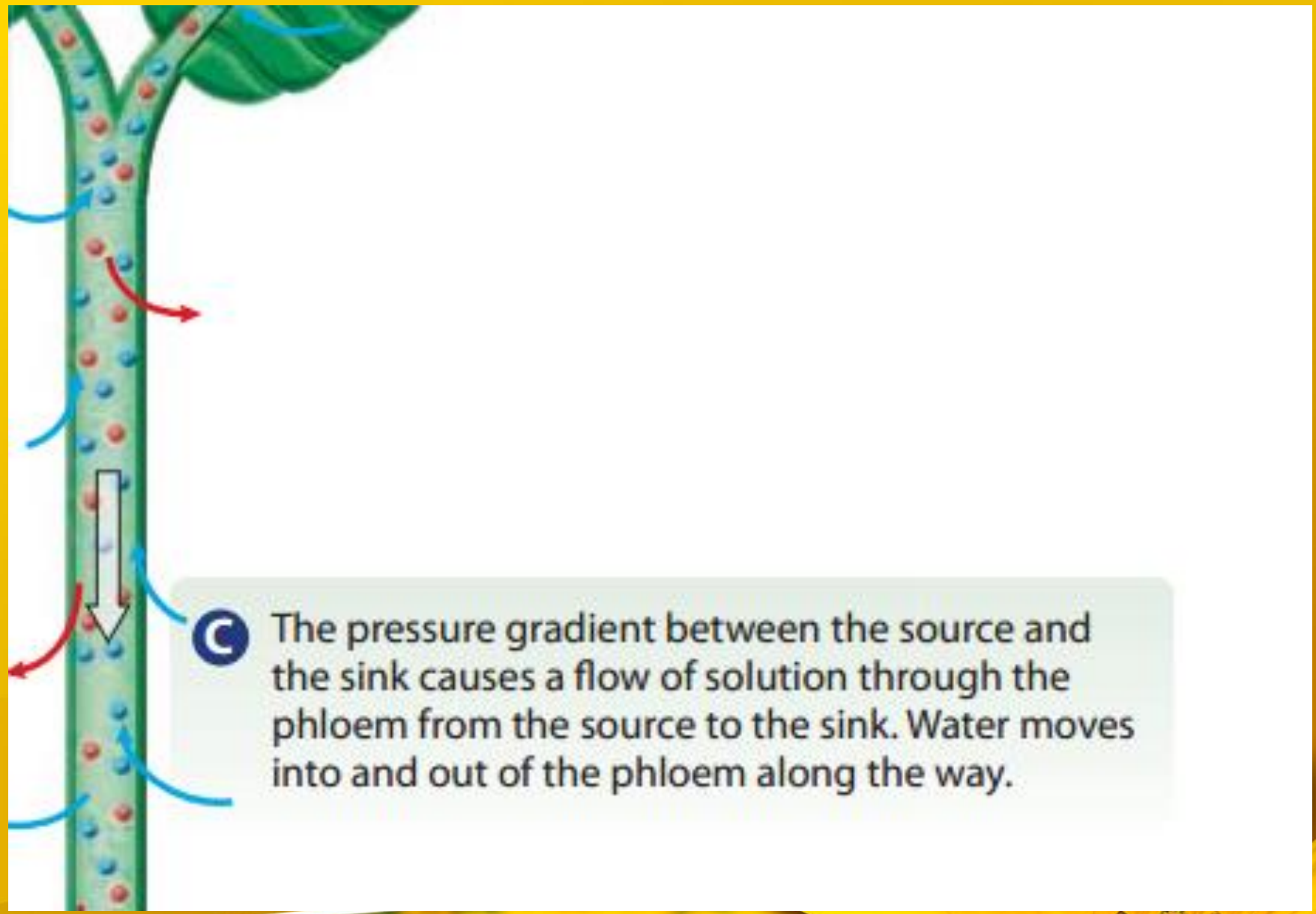
The Pressure-Flow Model

- a model that explains how organic molecules move from source to sink through phloem in a flowering plant

- 4 Step Hypothesis


source: leaf cells
A
Sucrose enters the phloem in the leaf, increasing the concentration of sucrose solution in the phloem.
water
sucrose


B Water moves into the phloem as a result of the increased concentration of sucrose. The movement of water leads to an increase in pressure in the phloem.



C The pressure gradient between the source and the sink causes a flow of solution through the phloem from the source to the sink. Water moves into and out of the phloem along the way.

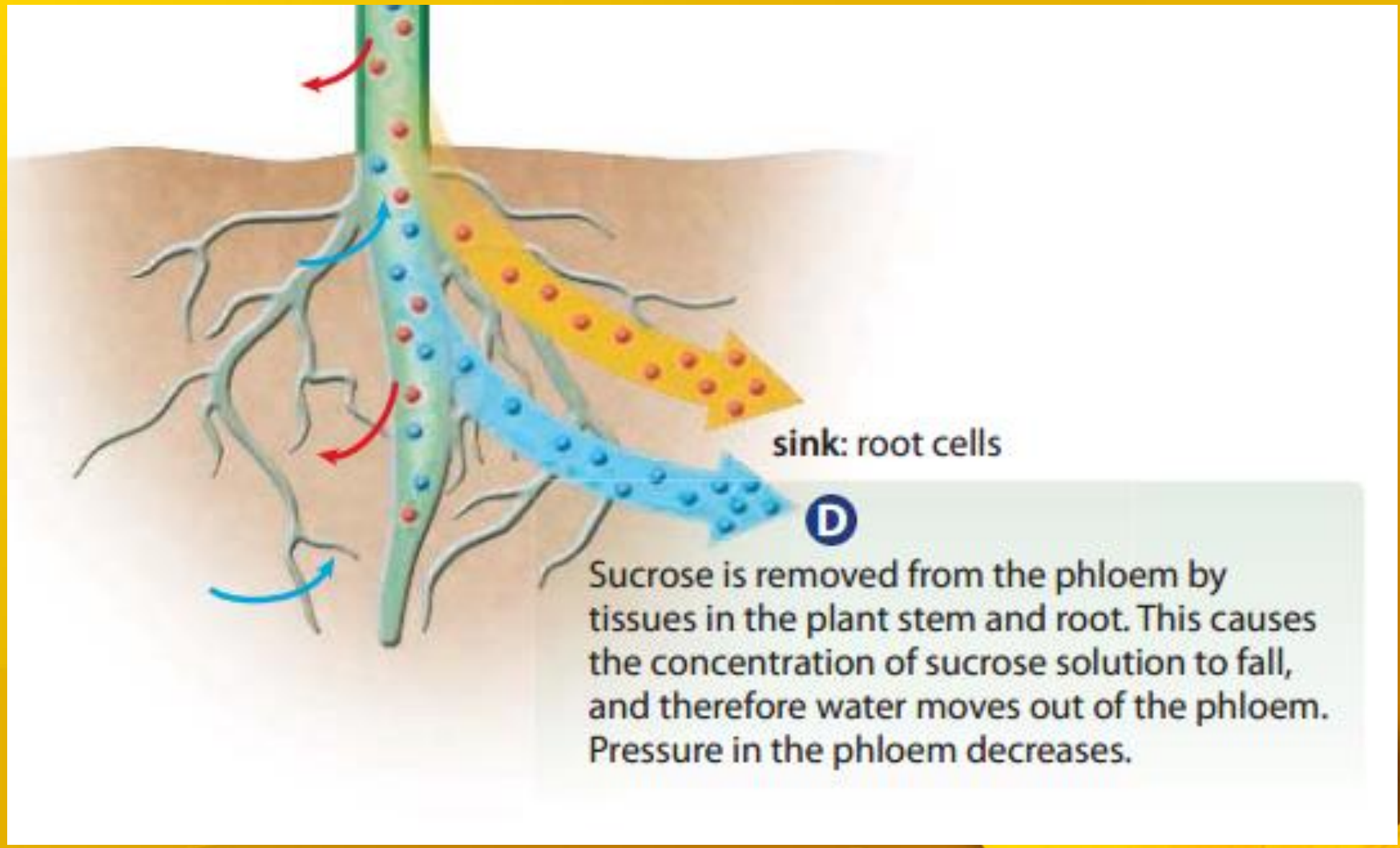
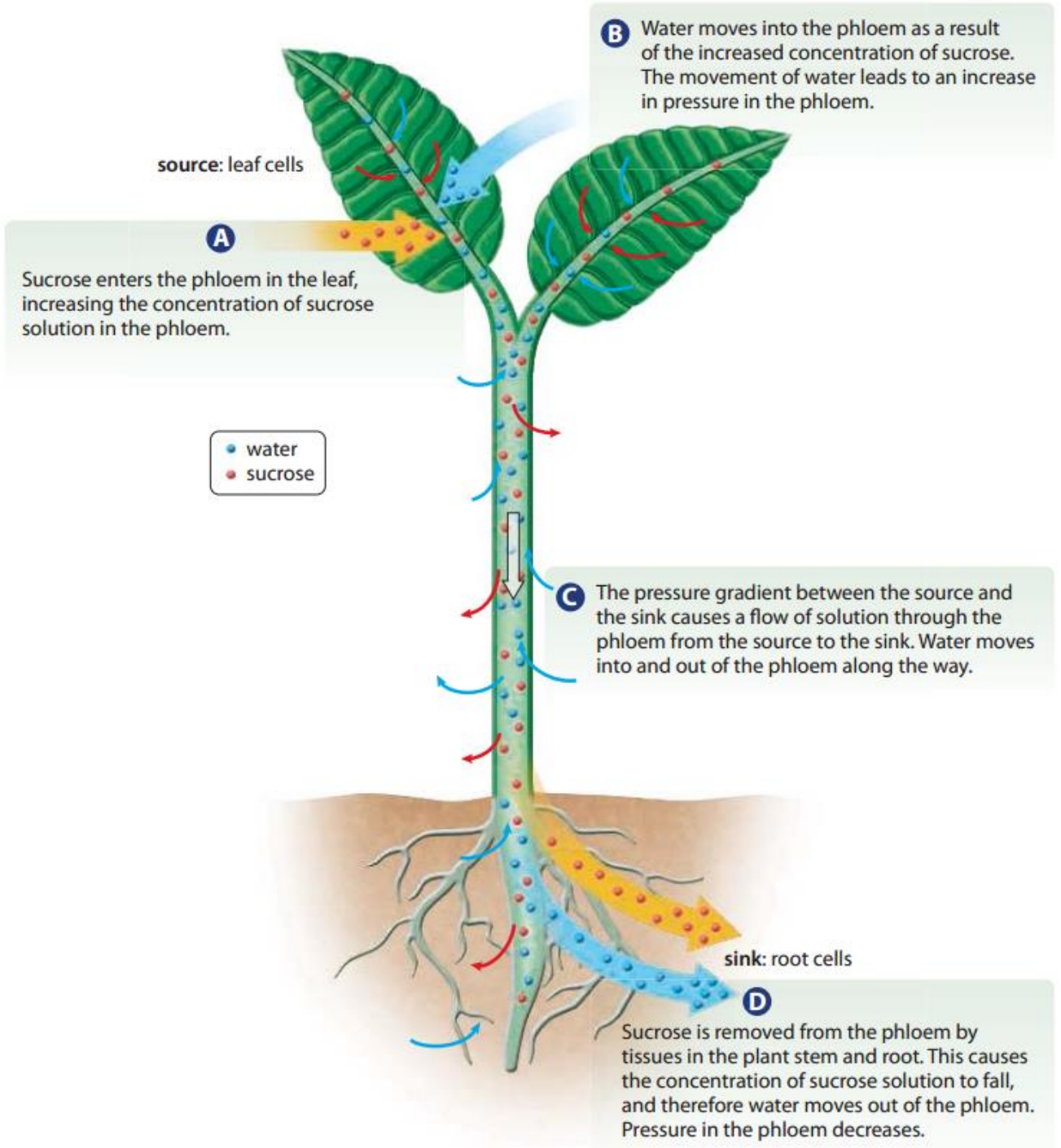

sink: root cells
D
Sucrose is removed from the phloem by tissues in the plant stem and root. This causes the concentration of sucrose solution to fall, and therefore water moves out of the phloem. Pressure in the phloem decreases.

Figure 11.17 A common source of pressure is photosynthetic tissue in a leaf. Glucose produced by photosynthesis is converted to sucrose and then enters the phloem by active transport. Fluid pressure increases and pushes the solute-rich solution toward a sink where cells are growing, carrying out processes that require energy, or storing food.



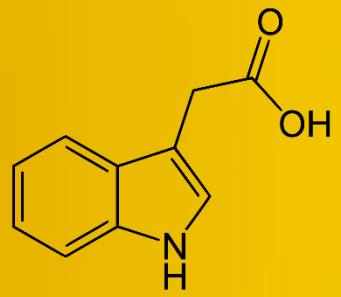
Connections Plant Anatomy Worksheet

Factors That Affect Plant Growth

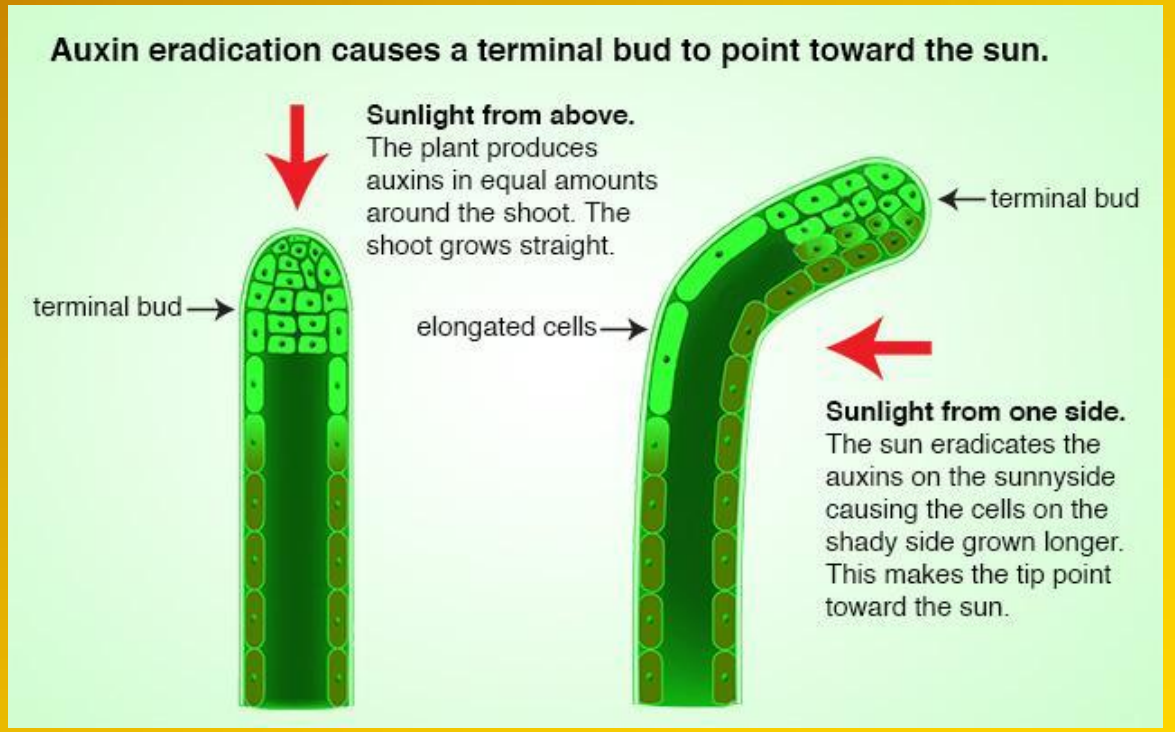
- Some hormones stimulate growth activity in the plant, while others inhibit growth activity. Because they regulate growth, plant hormones are often called plant growth regulators.
- hormone a chemical compound produced in one part of the plant that controls growth activity in another part of that plant

- The five main plant hormones are auxins, cytokinins, gibberellins, ethylene, and abscisic acid.

Stimulatory

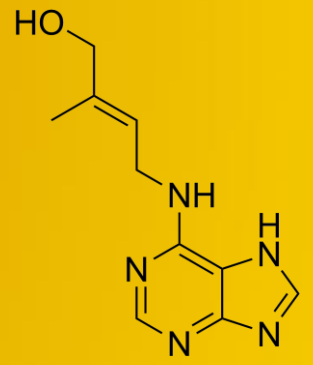


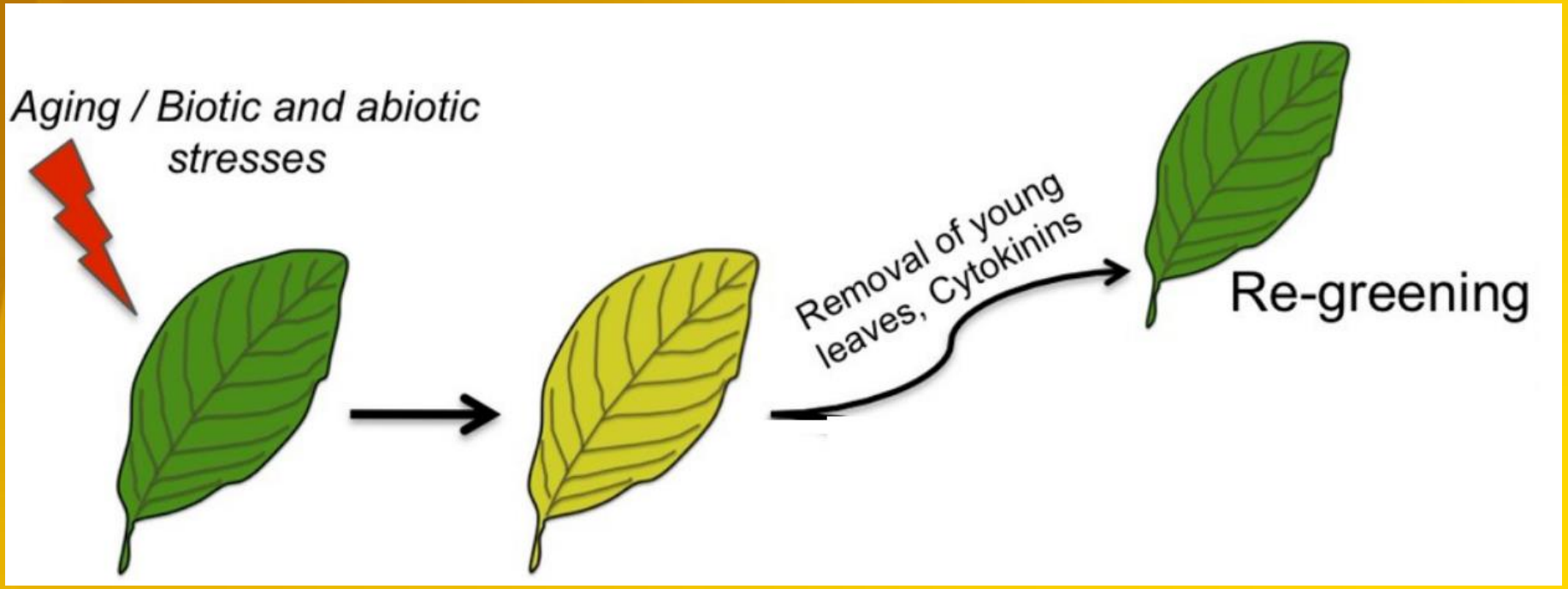
- Auxins – Stimulate cell division and elongation in stems and roots. Also regulates cell expansion in response to light and gravity.



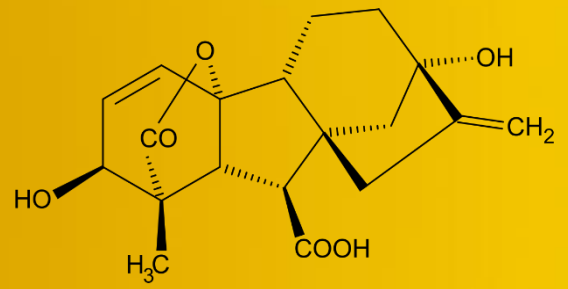
Stimulatory

- Cytokinins – Stimulate cell division and prevent aging in leaves

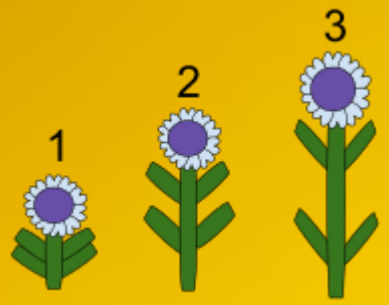




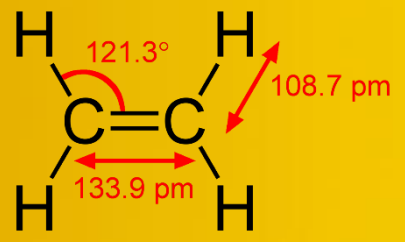
Stimulatory



- Gibberellins – Stimulate cell elongation and seed germination
- They promote the growth of taller, stronger plants and plants that flower early. They are used in commercial crops all over the world to increase fruit size and to increase cluster size in grapes.

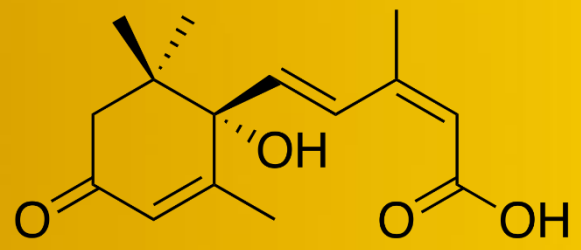


Inhibitory

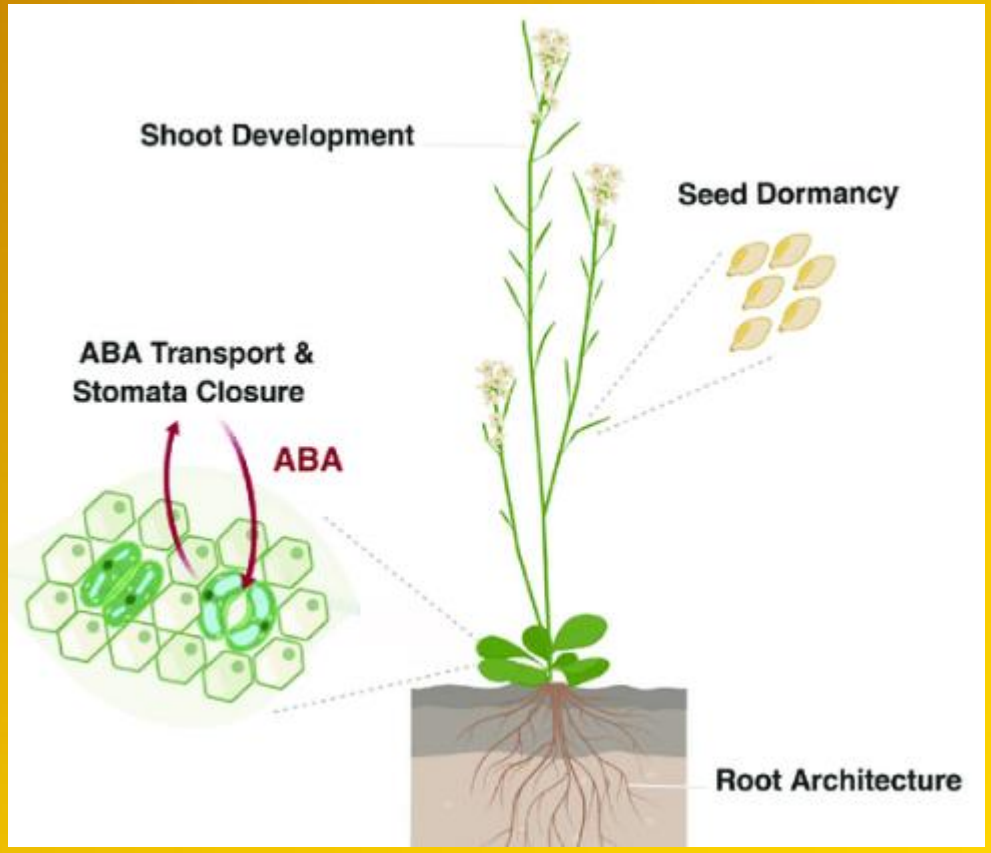


- Ethylene - Involved in flower and seed production, and the ripening of fruits. It stimulates a variety of enzymes which convert starch and acids of the unripe fruit to sugars, and softens the fruit by breaking down pectin's in the cell walls.
- It has a **positive feedback** effect: the first fruit that begins to ripen emits ethylene triggering the surrounding fruit to ripen. Over-ripening can occur, thus one "bad apple" can really "spoil the whole bunch".

Inhibitory



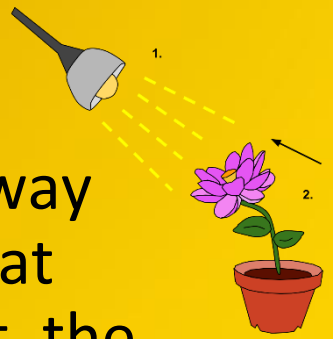
- Abscisic acid - induces and maintains seed dormancy and inhibits shoot growth. Also closes stomata



Tropic Responses

- tropism a plant's growth response to external stimulation coming from one direction in the environment

- phototropism a plant's growth response to light caused by an unequal distribution of auxin.
- There is less auxin on the side of the plant toward the light source than there is on the side away from the light source.
- Because auxin can cause cell elongation, the cells on the side away from the light elongate, making that side of the stem longer. As a result, the stem curves in the direction of the light.



- Gravitropism is a growth response to gravity.

Roots generally show a positive gravitropism. The downward growth of roots into soil helps to anchor the plant and brings roots in contact with water and minerals. However, a stem exhibits a negative gravitropism when it grows upward, pushing against gravity.

This growth positions leaves for maximum exposure to light.

- Thigmotropism is a growth response to mechanical stimuli, such as contact with an object, another organism, or even wind. Thigmotropism is evident in vines that twist around a nearby structure, such as a fence or tree.

Plant Lab