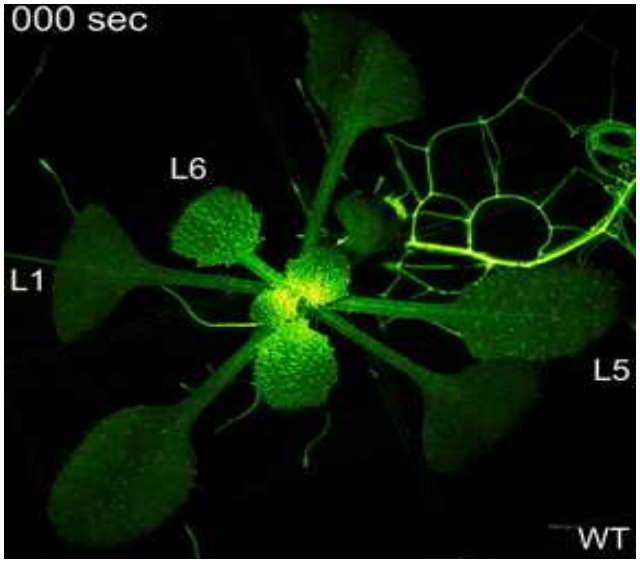
Plant anatomy: Halloween Edition

- Phenotypic plasticity
- Modified leaves, stems, roots can do lots of stuff
- Roots and shoots
  - Tissue systems: dermal, vascular, ground
- Meristems generate new cells for primary and secondary growth
  - vascular cambium and cork cambium



Overview: Plastic Plants?

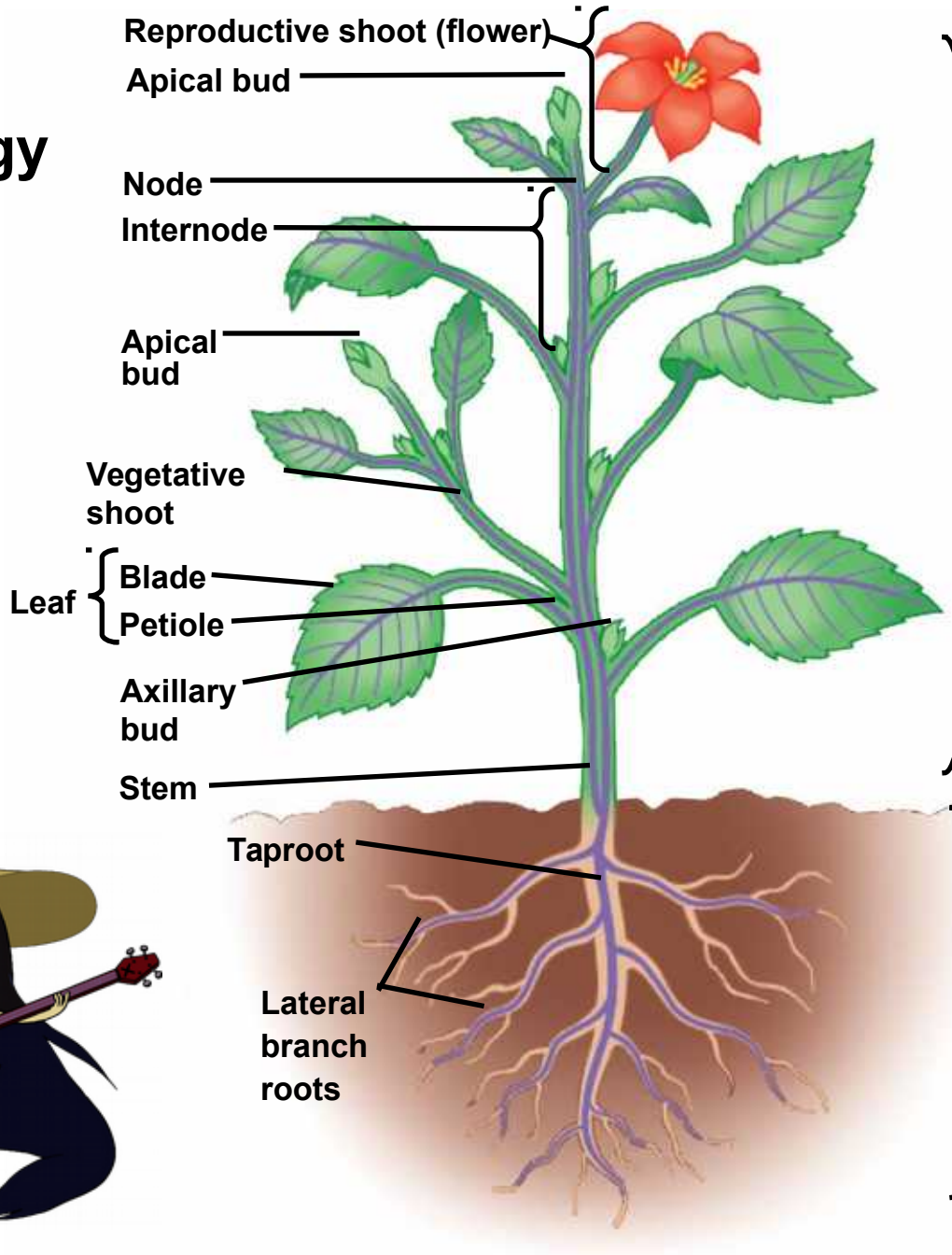
- The fanwort plant exhibits ***developmental plasticity***, the *ability to alter itself in response to its environment*.
- Developmental plasticity is more marked in plants than in animals.

The fanwort has two types of leaves -- developmental plasticity

Concept 35.1: The plant body has a hierarchy of organs, tissues, and cells

- Like multicellular animals, plants have **organs** composed of different **tissues**, which in turn are composed of **cells**.
- *Three basic organs evolved: roots, stems, and leaves*.
- They are organized into a **root system** and a **shoot system:**
- Roots rely on sugar produced by photosynthesis in the ***shoot system***.
- Shoots rely on water and minerals absorbed by the ***root system***.

Flowering Plant Morphology



The Three Basic Plant Organs: Roots, Stems, and Leaves

- ***Roots*** are multicellular organs with important functions:
  - *Anchoring* the plant
  - *Absorbing* minerals and water
  - *Storing* organic nutrients

Root Hairs of a radish seedling

Many plants have modified roots

Prop roots

Storage roots

"Strangling" aerial roots

Pneumatophores

Buttress roots

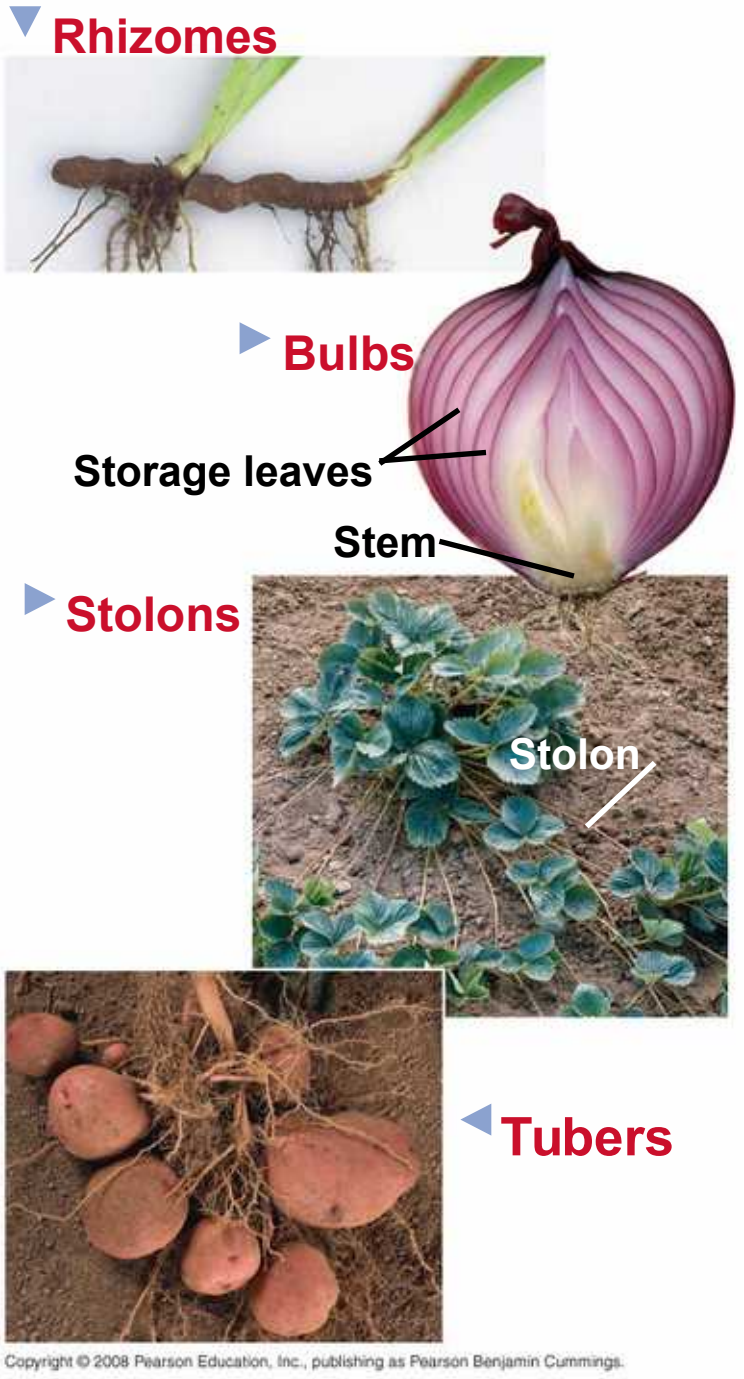
Stems = organs consisting of nodes & internodes

Nodes, the points at which leaves are attached.

Internodes, the stem segments between nodes.

- An **axillary bud** is a structure that has the potential to form a lateral shoot, or branch.
- **Apical bud**, or terminal bud, is located near the shoot tip and causes elongation of a young shoot.
- **Apical dominance** helps to maintain dormancy in most non-apical buds.

Many Plants have Modified Stems



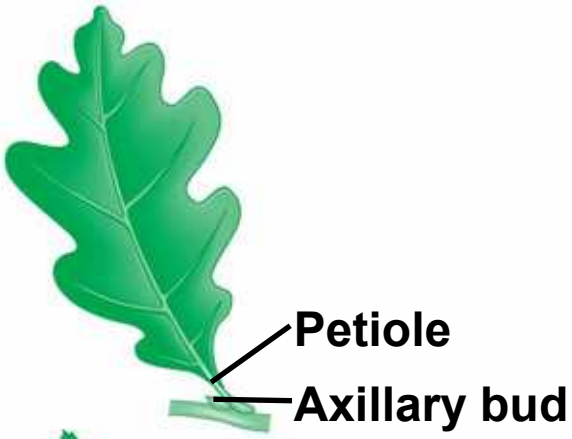
Leaves = the main photosynthetic organs

Leaves generally consist of a flattened **blade** and a stalk called the **petiole**, which joins the leaf to a node of the stem.

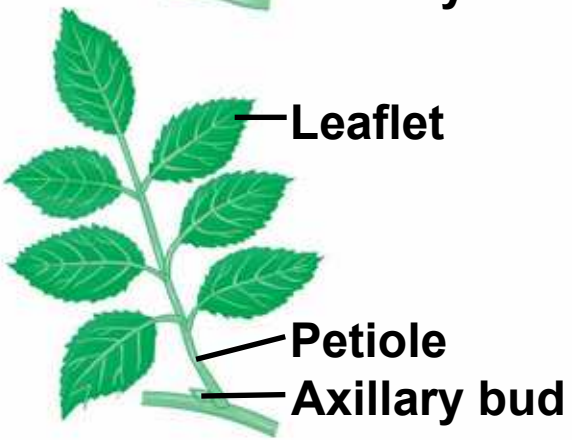
- Monocots and eudicots differ in the arrangement of **veins**, the vascular tissue of leaves:
  - Most monocots have parallel veins.
  - Most eudicots have branching veins.

Simple vs. Compound Leaves

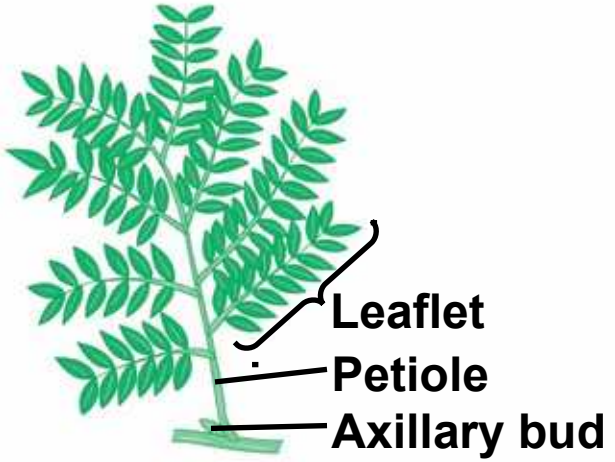
(a) Simple leaf



(b) Compound leaf



(c) Doubly compound leaf



Some plant species have evolved* modified leaves *that serve various functions

Tendrils
cling

Spines *"prickly" Photosynthesis is carried out mainly by the fleshy stems*

Storage Leaves *succulent plant leaves store water*

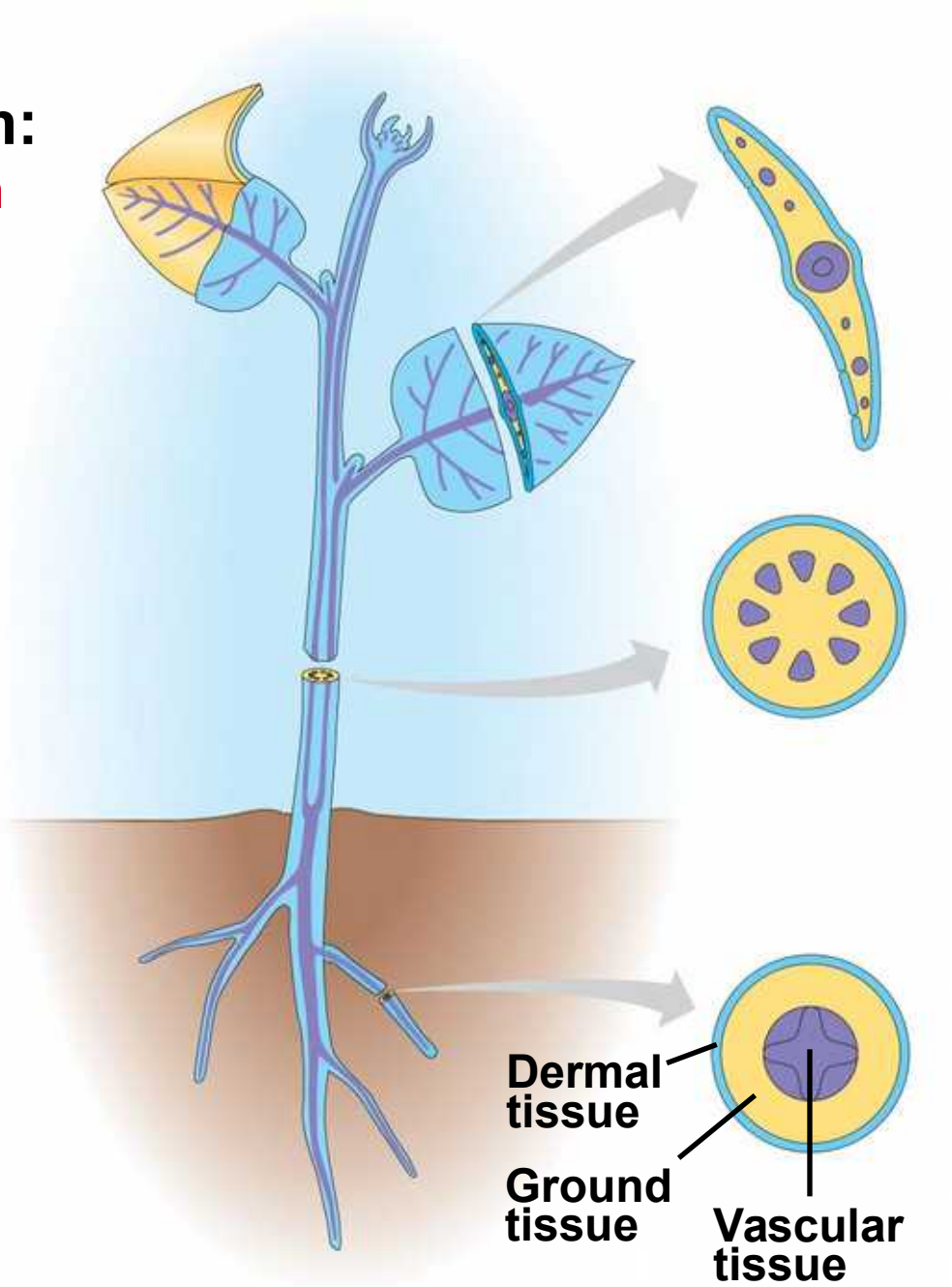
Reproductive leaves
Little plantlets fall off and take root in the soil

Bracts
Look like petals
Attract pollinators

Tissue System:

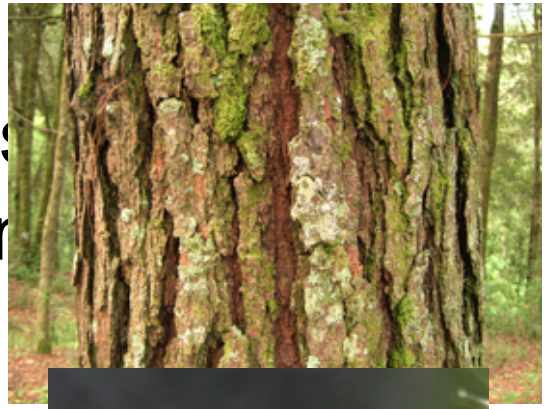
Each plant organ has:

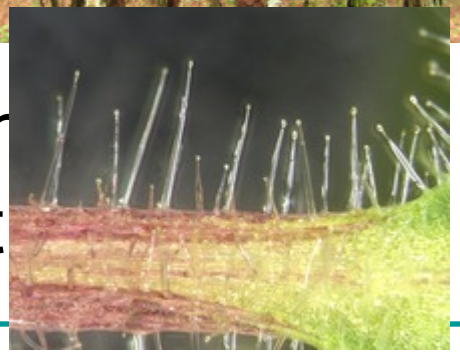
* dermal
* vascular
* ground tissues



- In nonwoody plants, the **dermal tissue system** consists of the **epidermis.**
- A waxy coating called the **cuticle** helps prevent water loss from the epidermis.
- In woody plants, protective tissues called **periderm** replace the epidermis in older regions of stems and roots.
- *Trichomes* are outgrowths of the shoot epidermis and can help with insect defense.

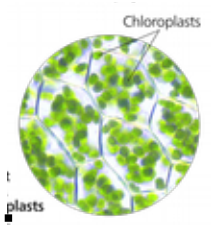
- In nonwoody plants, the **dermal tissue system** consists of the **epidermis.**
- A waxy coating called the **cuticle** helps prevent water loss from the epidermis.
- In woody plants, protective tissues called **periderm** replace the epidermis in older regions of stems and roots.
- *Trichomes* are outgrowths of the shoot epidermis and can help with insects



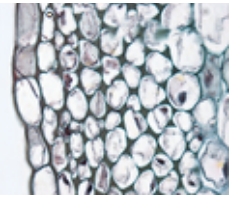


- Tissues that are neither dermal nor vascular are the **ground tissue system.**
- Ground tissue internal to the vascular tissue is **pith**; ground tissue external to the vascular tissue is **cortex.** Both have plastids for **storage.**
- *Ground tissue includes cells specialized for storage, photosynthesis, and support.*

Common Types of Plant Cells - are specialized of cells in structure and function.



- Some major types of plant cells:
  - Parenchyma - ground: thin flexible cell walls: photosynthesis, storage.
  - Collenchyma - ground: thicker cell walls for flexible support.



  - Sclerenchyma - ground: thick secondary cell walls reinforced with lignin for rigid, sturdy support.

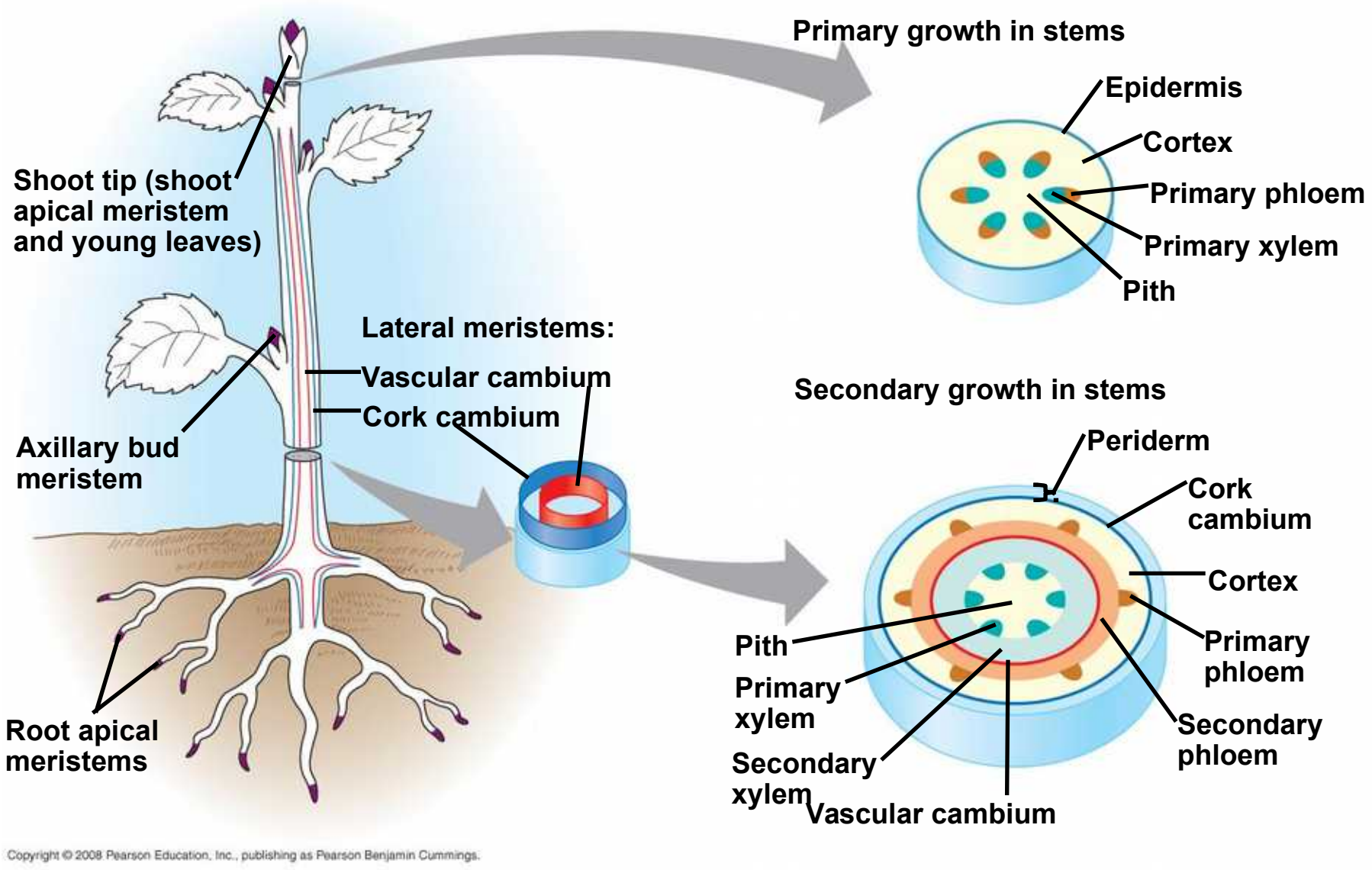
  - Xylem - vascular: water-conducting cells.
  - Phloem - vascular: sugar-conducting cells.

Concept 35.2: Meristems generate cells for new organs

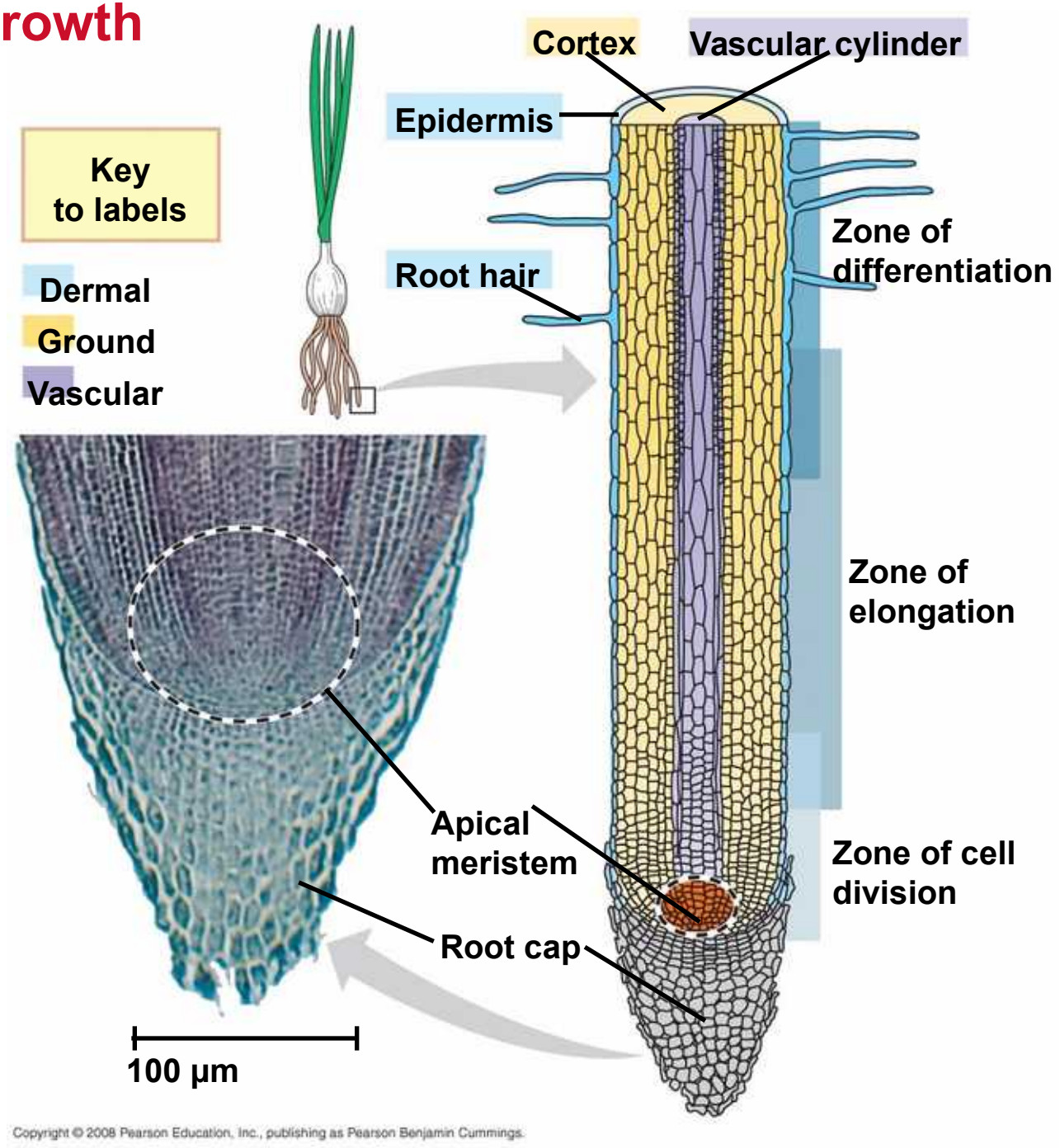
- A plant can grow throughout its life; this is called **indeterminate growth.**
- Some plant organs cease to grow at a certain size; this is called **determinate growth.**
- **Annuals** complete their life cycle in a year or less.
- **Biennials** require two growing seasons.
- **Perennials** live for many years.

- **Meristems** are growth regions - have perpetual embryonic tissue that allows for indeterminate growth.
- ***Apical meristems*** are located at the *tips* of roots and shoots and at the axillary buds of shoots.
- Apical meristems *elongate* shoots and roots, a process called ***primary growth***.

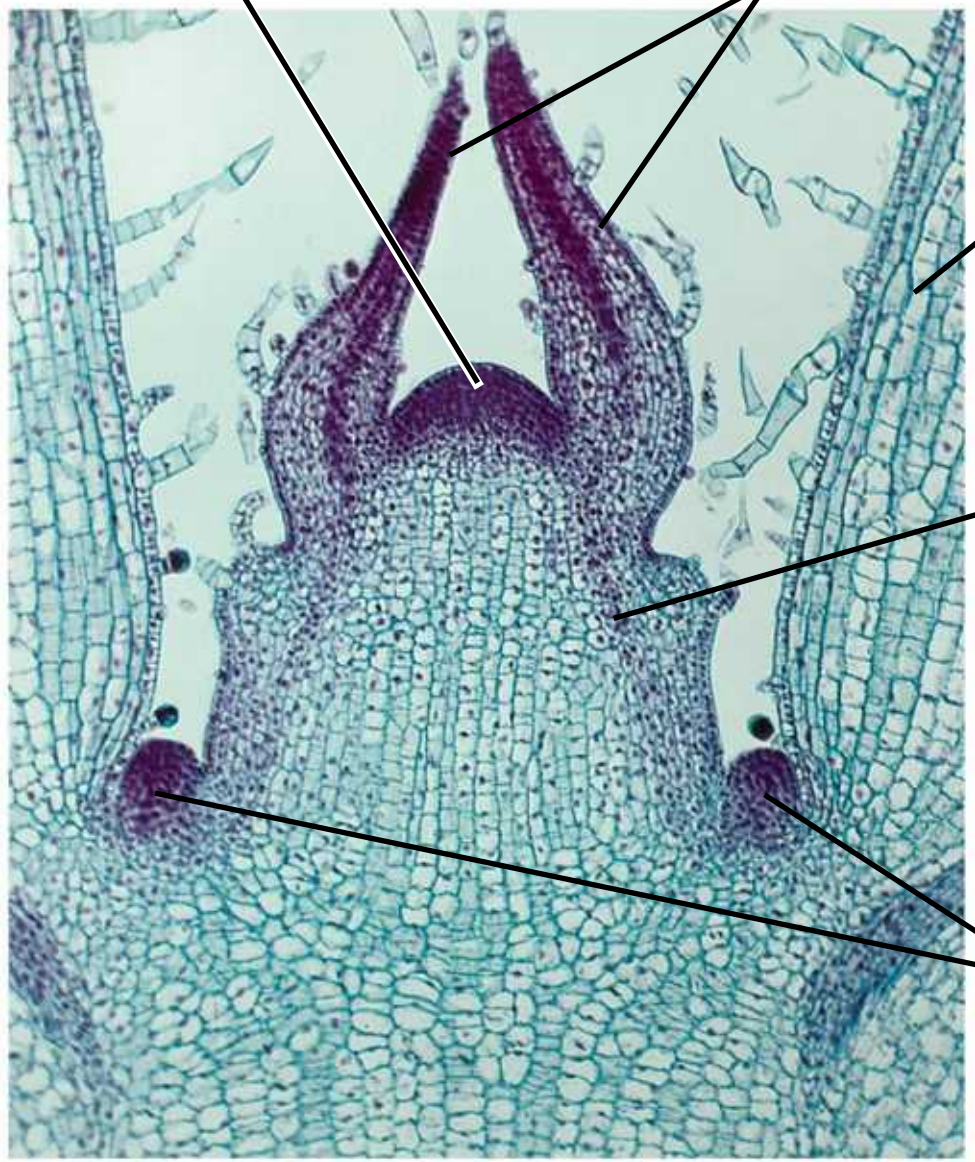
An overview of primary and secondary growth



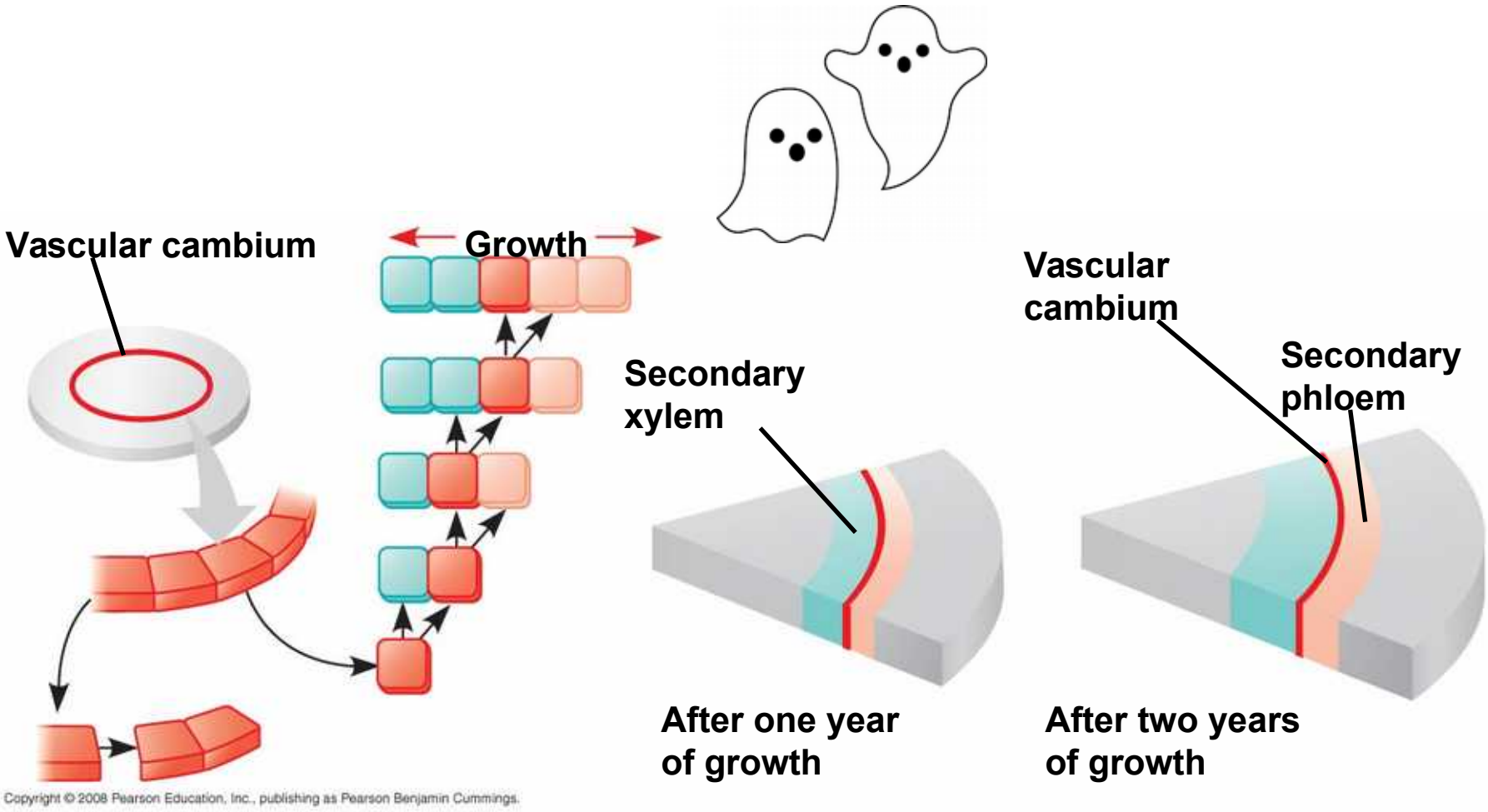
Primary growth of a root



Shoot tip



Secondary growth produced by the vascular cambium



Location and a Cell's Developmental Fate

- Positional information underlies all the processes of development: growth, morphogenesis, and differentiation.
- Cells are not dedicated early to forming specific tissues and organs.
- The cell's final position determines what kind of cell it will become.

Genetic Control of Flowering

- Flower formation involves a phase change from vegetative growth to reproductive growth.
- It is triggered by a combination of environmental cues and internal signals.
- Transition from vegetative growth to flowering is associated with the switching on of floral **meristem identity genes.**

- Plant biologists have identified several **organ identity genes** = plant homeotic genes. These genes regulate the development of floral pattern.
- A mutation in a plant organ identity gene can cause abnormal floral development.

(a) Normal *Arabidopsis* flower

(b) Abnormal *Arabidopsis* flower

Organ identity genes and pattern formation in flower development