LECTURE PRESENTATIONS
For CAMPBELL BIOLOGY, NINTH EDITION
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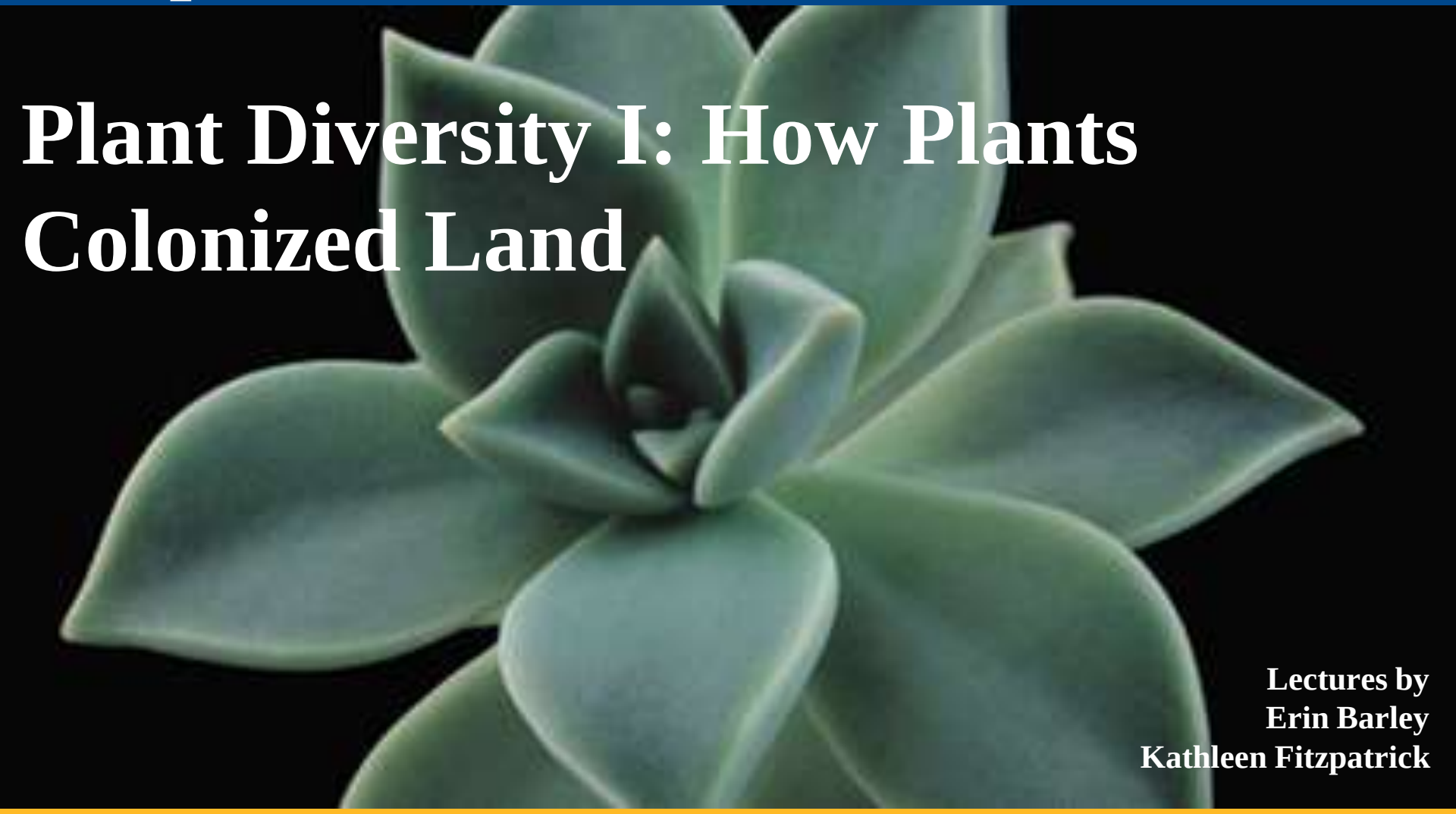
Chapter 29

Plant Diversity I: How Plants Colonized Land



Lectures by
Erin Barley
Kathleen Fitzpatrick

Figure 29.1

Concept 29.1: Land plants evolved from green algae

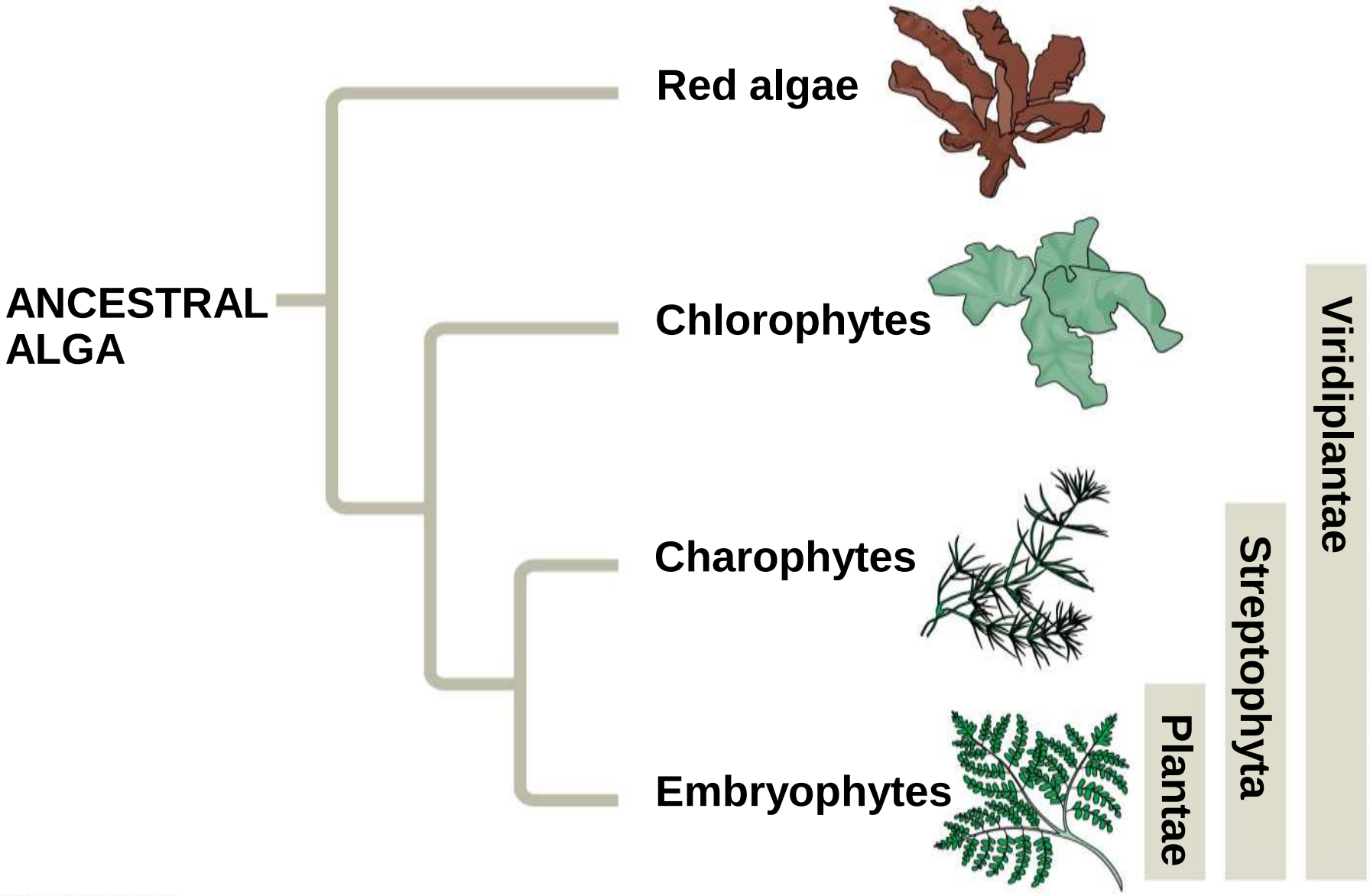
- Green algae called **charophytes** are the closest relatives of land plants

Adaptations Enabling the Move to Land

- In charophytes a layer of a durable polymer called **sporopollenin** prevents exposed zygotes from drying out
- Sporopollenin is **also found in plant spore walls**
- The movement onto land by charophyte ancestors provided
  - unfiltered sun
  - more plentiful CO_2,
  - nutrient-rich soil,
  - few herbivores or pathogens
- Land presented challenges: a **scarcity(نقص)** of water and lack of structural support

- The accumulation(تراكم) of traits that facilitated survival on land may have opened the way to its colonization by plants
- Systematists are currently debating the **boundaries** of the plant kingdom
- Some biologists think the **plant kingdom should be expanded to include some or all green algae**
- Until this debate is resolved, we define plants as **embryophytes**, plants with embryos

Figure 29.4



Derived Traits of Plants

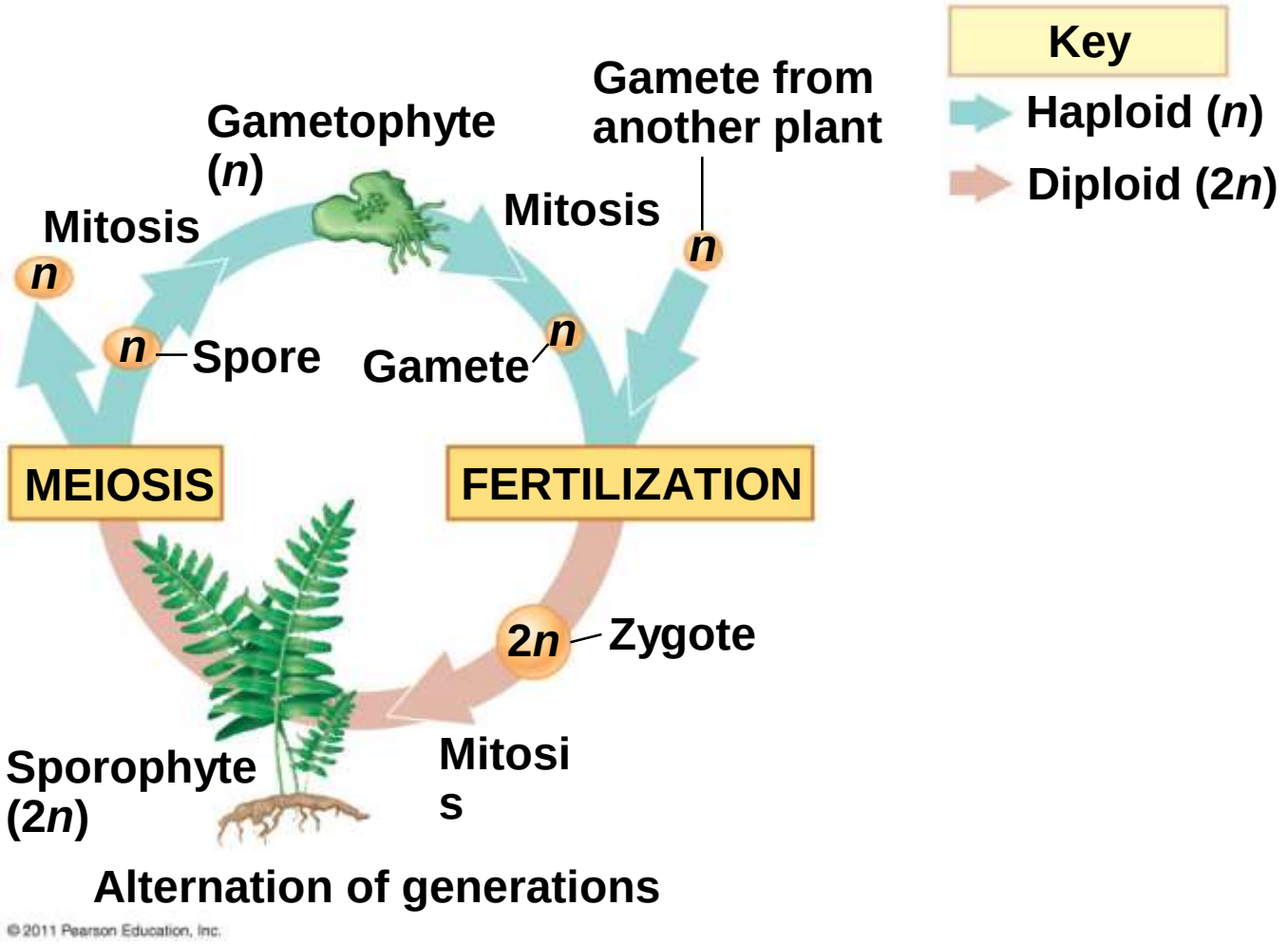
- Four key traits appear in nearly all land plants but are **absent** in the charophytes
  - **Alternation** of generations and multicellular, dependent embryos
  - **Walled spores produced** in sporangia
  - Multicellular **gametangia**
  - Apical **meristems**

Alternation of Generations and Multicellular, Dependent Embryos

- Plants alternate between two multicellular stages, a reproductive cycle called **alternation of generations**
- The **gametophyte** is haploid and produces haploid gametes by mitosis
- Fusion of the gametes gives rise to the diploid **sporophyte**, which produces haploid **spores** by meiosis

- The diploid embryo is **retained(المحتجزة)** within the tissue of the female gametophyte
- Nutrients are transferred from parent to embryo through **placental transfer cells**
- Land plants are called **embryophytes** because of the dependency of the embryo on the parent

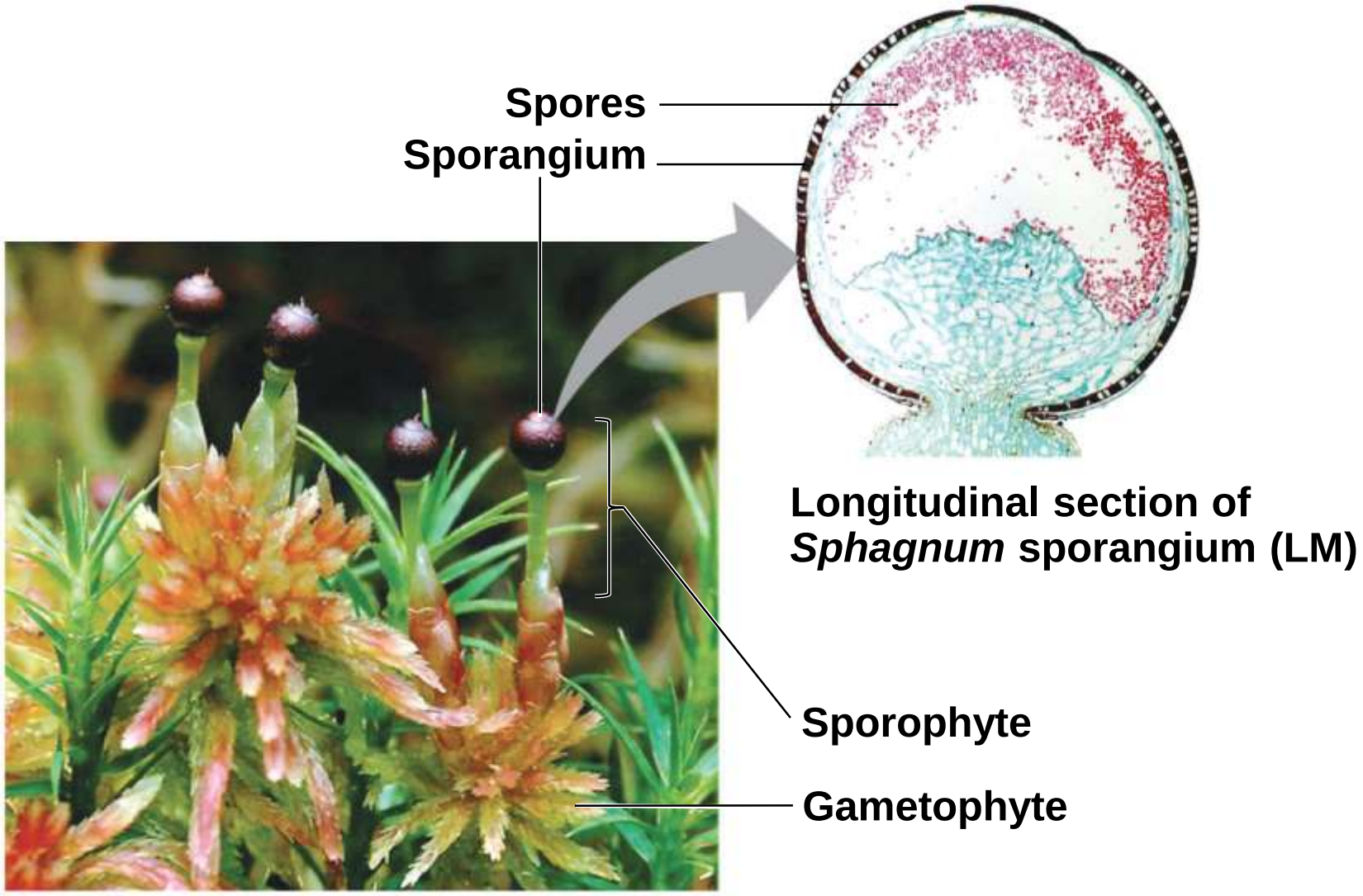
Figure 29.5a



Walled Spores Produced in Sporangia

- The sporophyte produces spores in organs called **sporangia**
- Diploid cells called **sporocytes** undergo meiosis to generate haploid spores
- Spore walls contain **sporopollenin**, which makes them resistant(مقاومة) to harsh environments(البيئات القاسية)

Figure 29.5c

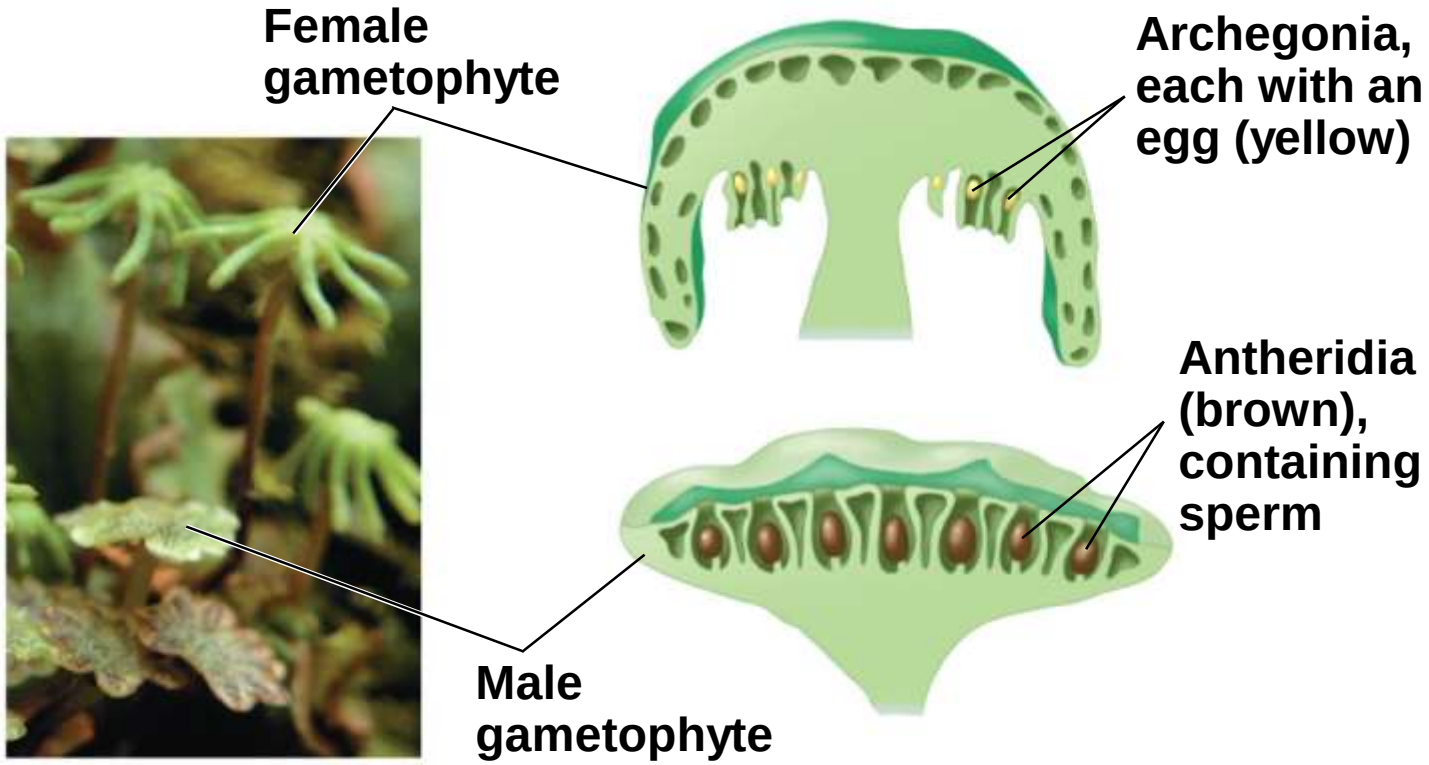


Sporophytes and sporangia of *Sphagnum* (a moss)

Multicellular Gametangia

- Gametes are produced within organs called **gametangia**
- Female gametangia, called **archegonia**, produce eggs and are the site of fertilization
- Male gametangia, called **antheridia**, produce and release sperm

Figure 29.5d

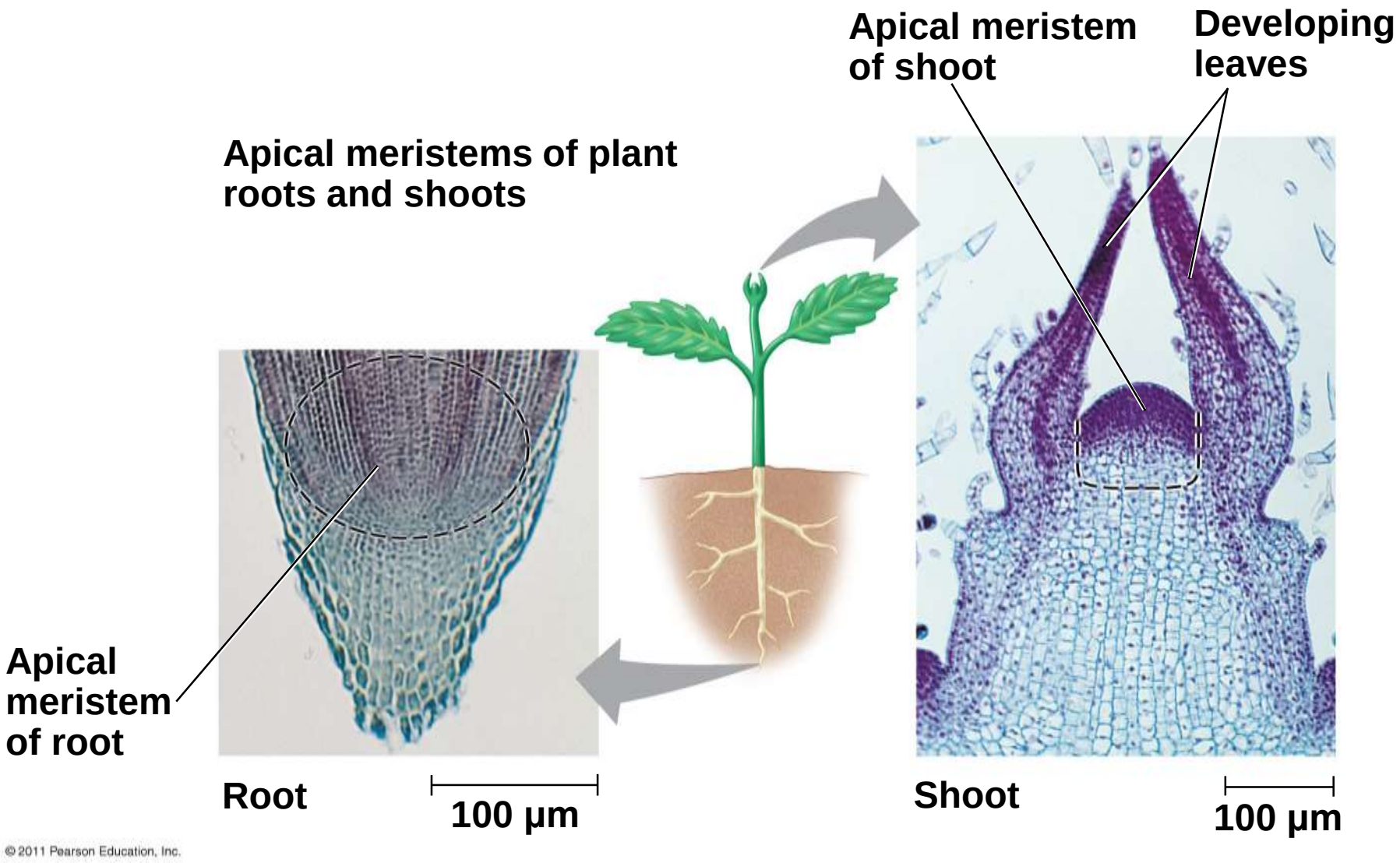


Archegonia and antheridia of *Marchantia* (a liverwort)

Apical Meristems

- Plants sustain continual growth in their **apical meristems**
- Cells from the apical meristems **differentiate** into various tissues

Figure 29.5e

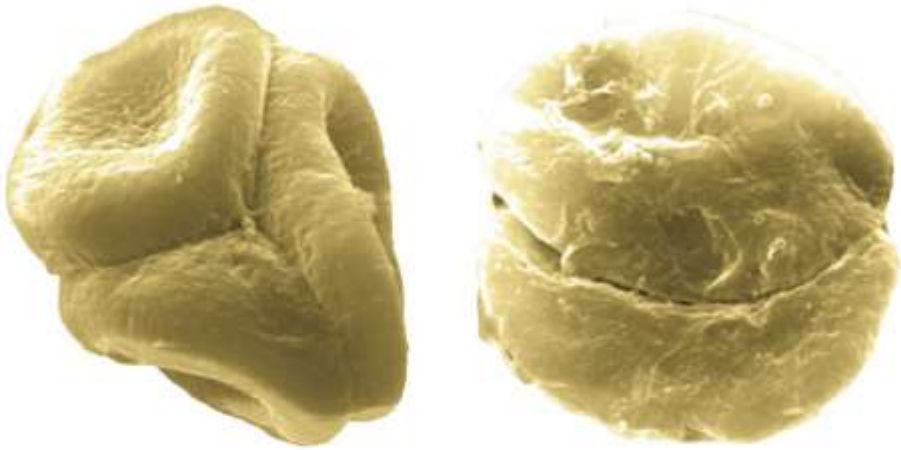


- Additional derived traits include
  - **Cuticle**, a waxy covering of the epidermis
  - **Mycorrhizae**, symbiotic(تكافلية) associations between fungi and land plants that may have helped plants without true roots to obtain nutrients

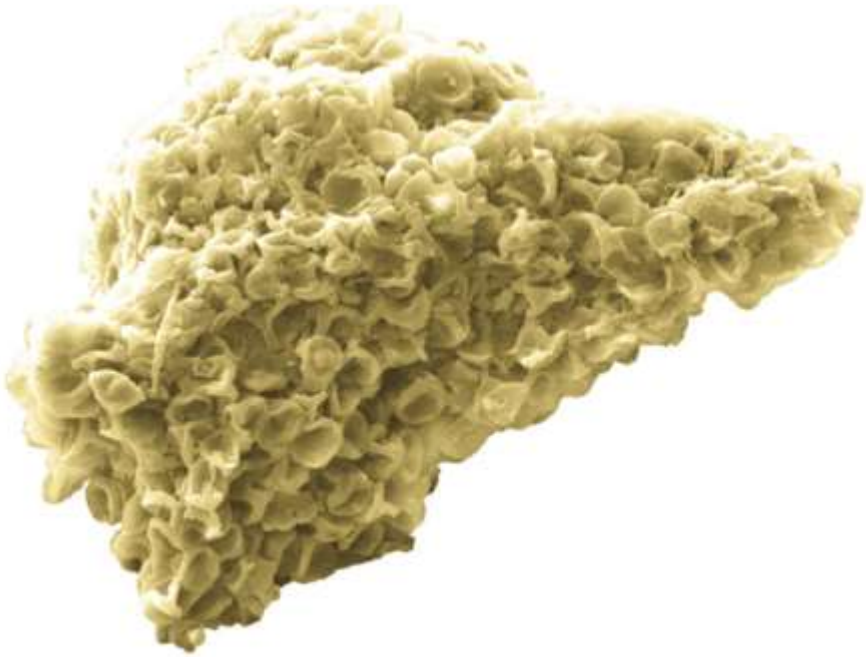
The Origin and Diversification of Plants

- Fossil evidence indicates that plants were on land at least 475 million years ago
- Fossilized spores and tissues have been extracted from 475-million-year-old rocks

Figure 29.6



(a) Fossilized spores



(b) Fossilized sporophyte tissue

- Those ancestral species gave rise to a vast diversity(تنوع شاسع) of modern plants

Figure 29.7a

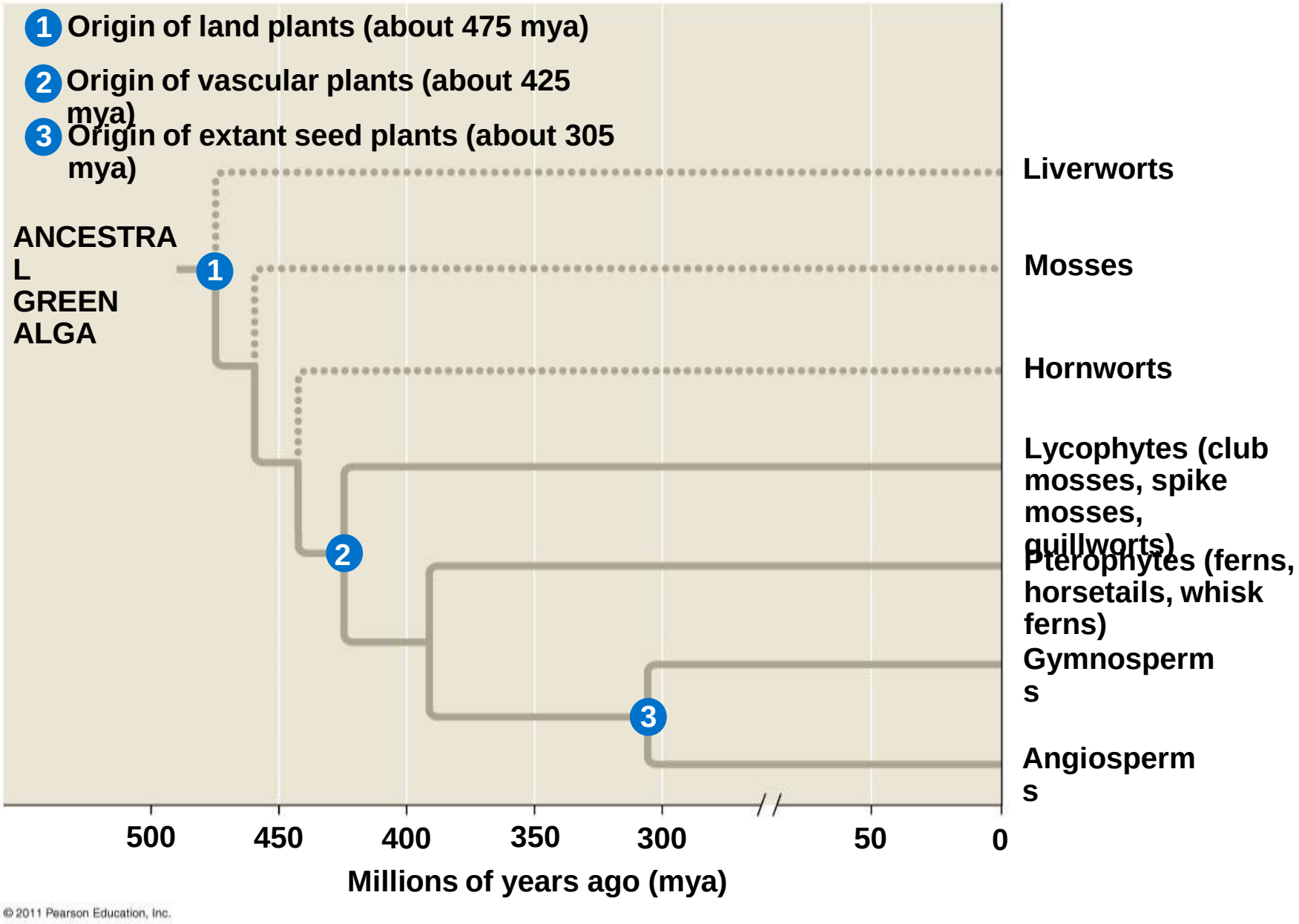
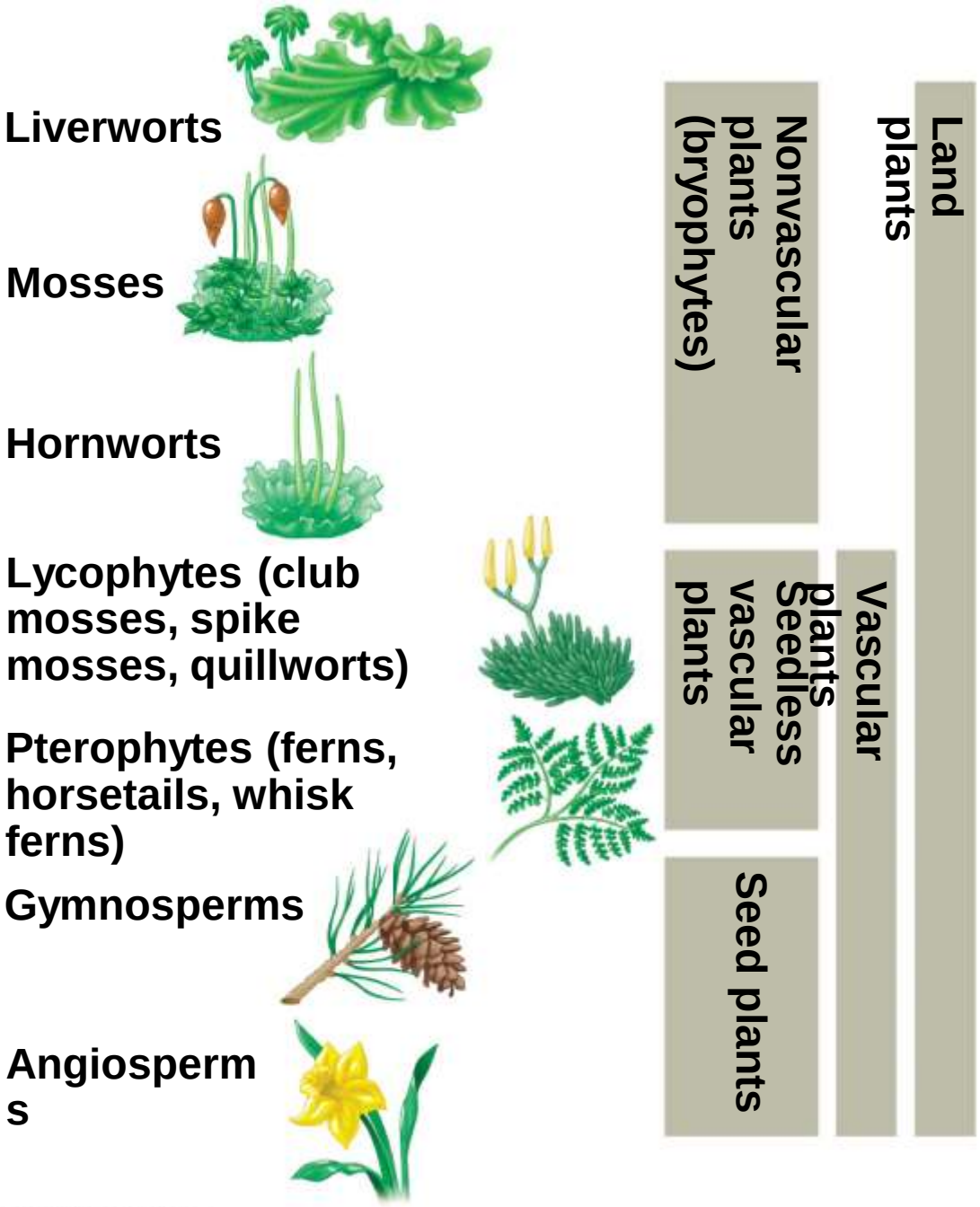


Figure 29.7b



- Land plants can be informally grouped based on the presence or absence of **vascular tissue**

- Most plants have vascular tissue; these constitute (تشكل) the **vascular plants**

- **Nonvascular plants** are commonly called **bryophytes**

- A **seed** is an embryo and nutrients surrounded by a protective coat
- Seed plants form a clade and can be divided into further clades
  - **Gymnosperms**, the "**naked seed**" plants, including the conifers(الصنوبريات)
  - **Angiosperms**, the flowering plants

Table 29. 1

Table 29.1 Ten Phyla of Extant Plants

	Common Name	Number of Known Species
Nonvascular Plants (Bryophytes)		
Phylum Hepatophyta	Liverworts	9,000
Phylum Bryophyta	Mosses	15,000
Phylum Anthocerophyta	Hornworts	100
Vascular Plants		
Seedless Vascular Plants		
Phylum Lycophyta	Lycophytes	1,200
Phylum Pterophyta	Pterophytes	12,000
Seed Plants		
Gymnosperms		
Phylum Ginkgophyta	Ginkgo	1
Phylum Cycadophyta	Cycads	130
Phylum Gnetophyta	Gnetophytes	75
Phylum Coniferophyta	Conifers	600
Angiosperms		
Phylum Anthophyta	Flowering plants	250,000

Concept 29.2: Mosses and other nonvascular plants have life cycles dominated by gametophytes

- Bryophytes are represented today by three phyla of small herbaceous (nonwoody) plants
  - **Liverworts**, phylum Hepatophyta
  - **Hornworts**, phylum Anthocerophyta
  - **Mosses**, phylum Bryophyta
- Bryophyte refers to all nonvascular plants

Bryophyte Gametophytes

- In all three bryophyte phyla, gametophytes are **larger and longer-living than sporophytes**

- Sporophytes are typically present only part of the time

Figure 29.8-1

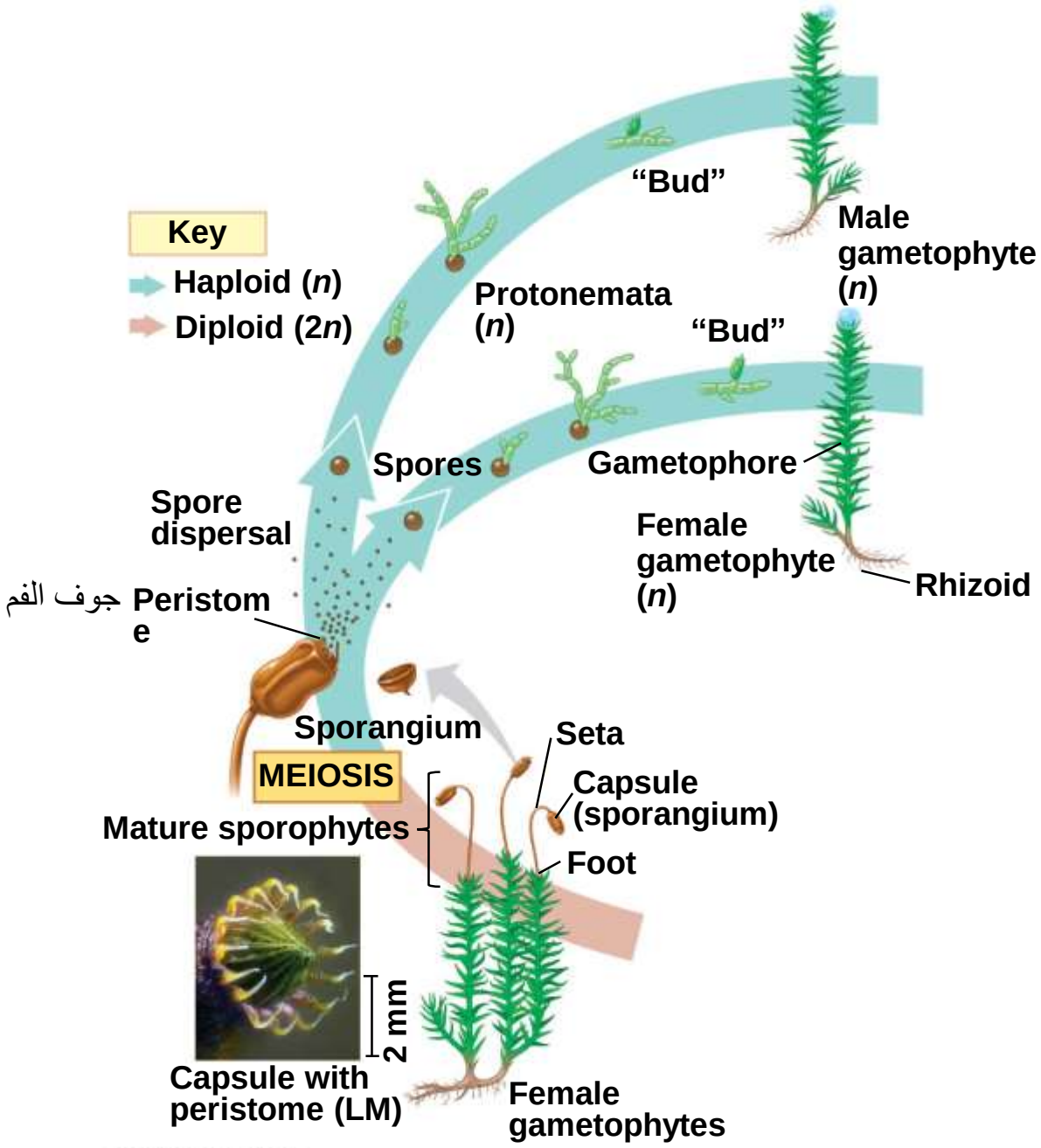


Figure 29.8-2

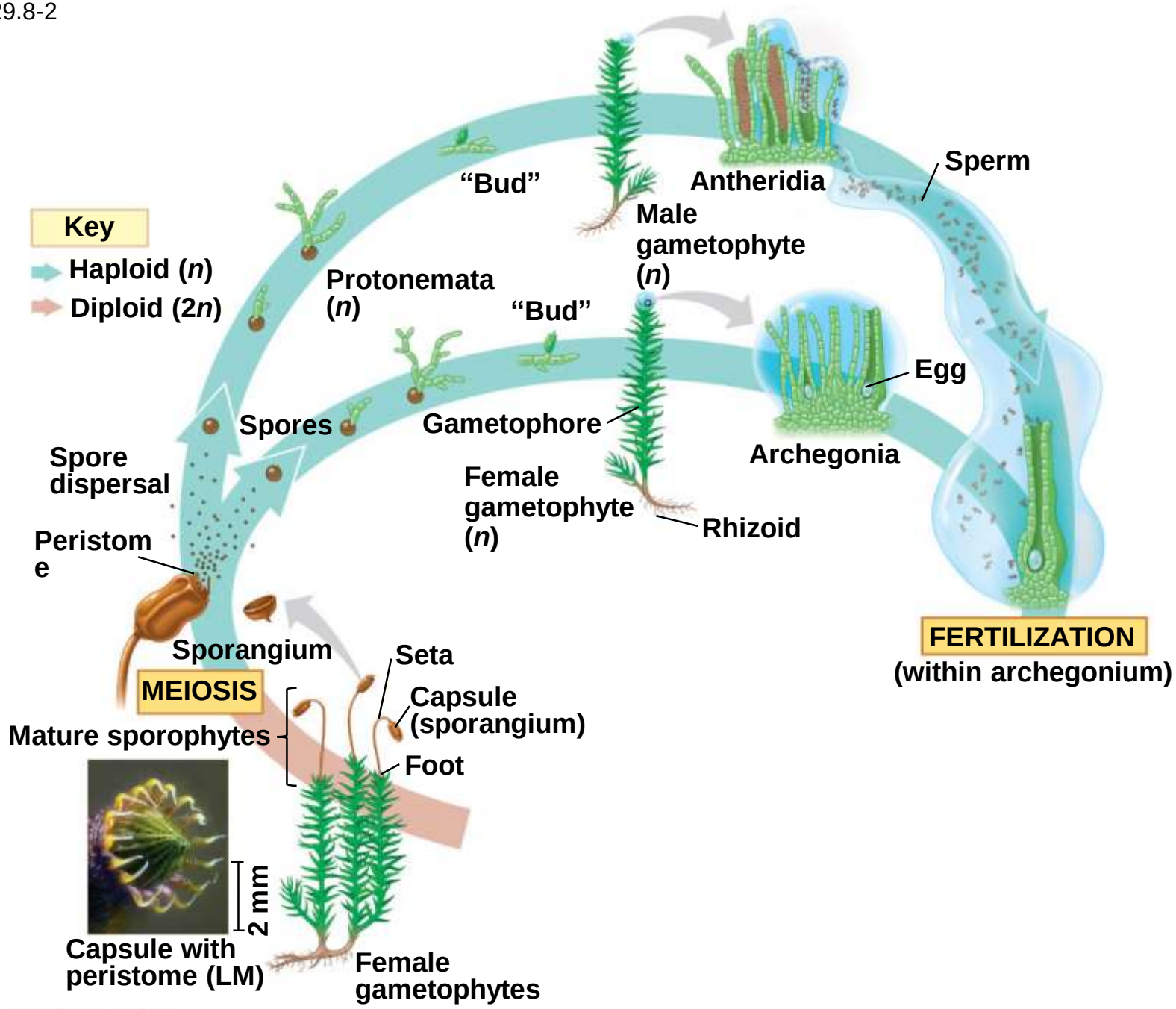


Figure 29.8-3

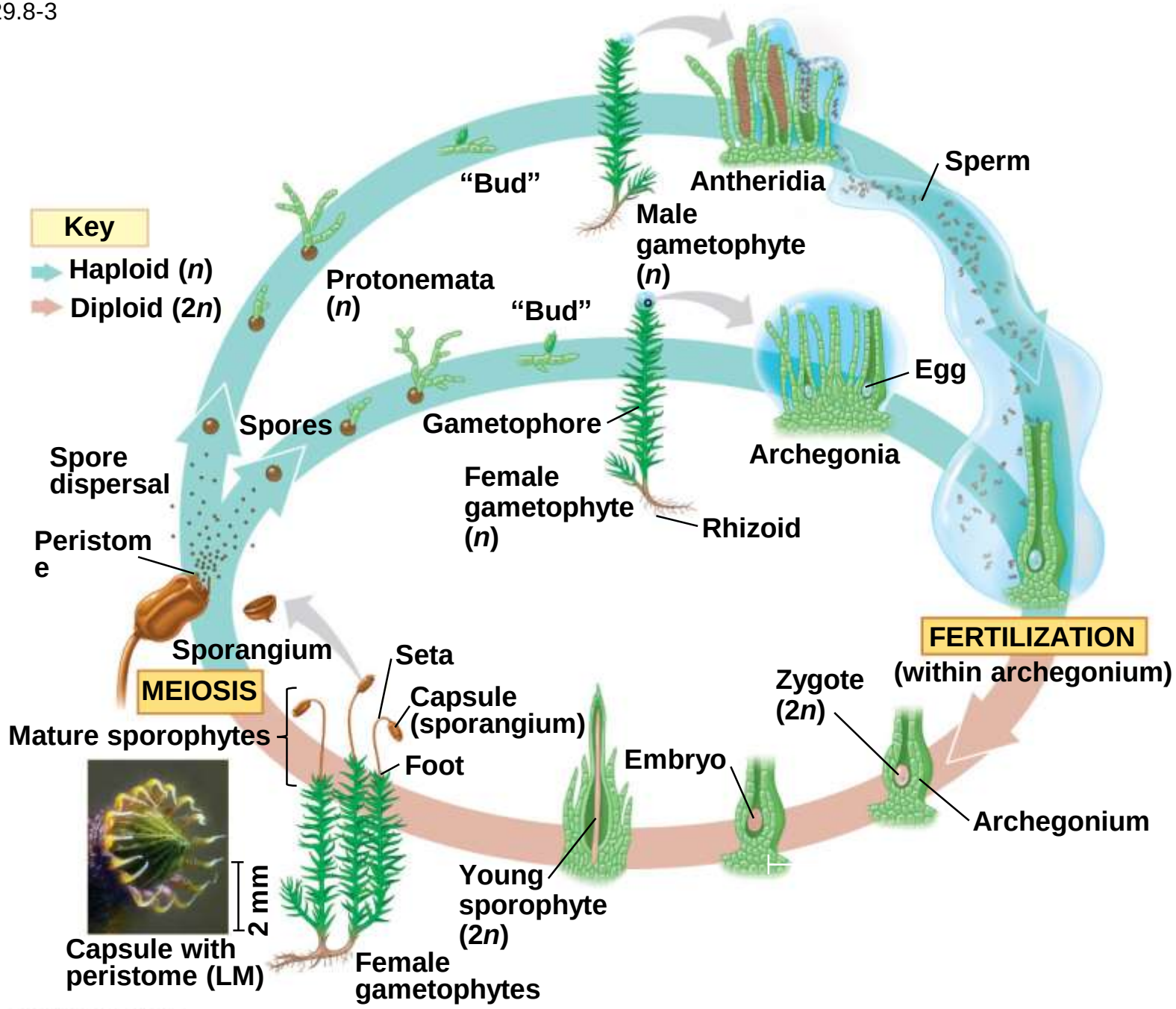


Figure 29.9b

An *Anthoceros* hornwort(نباتات زهقرنية) species

Figure 29.9c

***Polytrichum commune*, hairy-cap moss**

Capsule

Set a

Sporophyte (a sturdy(قوي) plant that takes months to grow)

Gametophyte

Concept 29.3: Ferns and other seedless vascular plants were the first plants to grow tall

- Bryophytes and bryophyte-like plants were the prevalent vegetation(الغطاء النباتي السائد) during the first 100 million years of plant evolution
- Vascular tissue allowed these plants to grow tall
- Seedless vascular plants have flagellated sperm and are **usually restricted to moist environments (بيئات رطبة)**

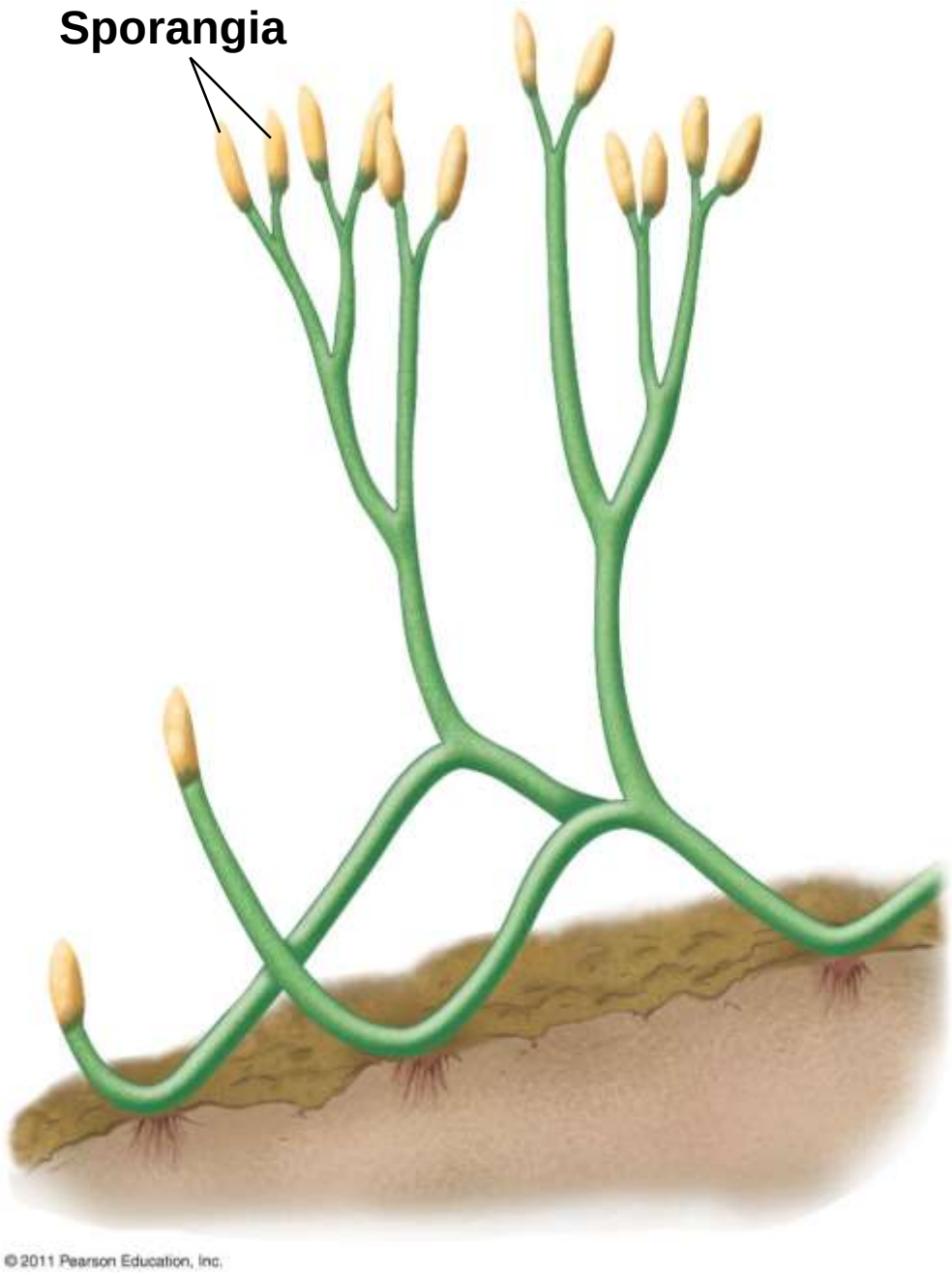
Origins and Traits of Vascular Plants

- Fossils of the forerunners of vascular plants date back about **425 million years**

- These early tiny plants had independent, branching sporophytes

- Living vascular plants are characterized by
  - Life cycles with dominant sporophytes
  - Vascular tissues called xylem and phloem
  - Well-developed roots and leaves

Figure 29.12



Life Cycles with Dominant Sporophytes

- In contrast with bryophytes, sporophytes of seedless vascular plants are the larger generation, as in familiar ferns

- The gametophytes are tiny plants that **grow on or below the soil surface**

Animation: Fern Life Cycle

Figure 29.13-1

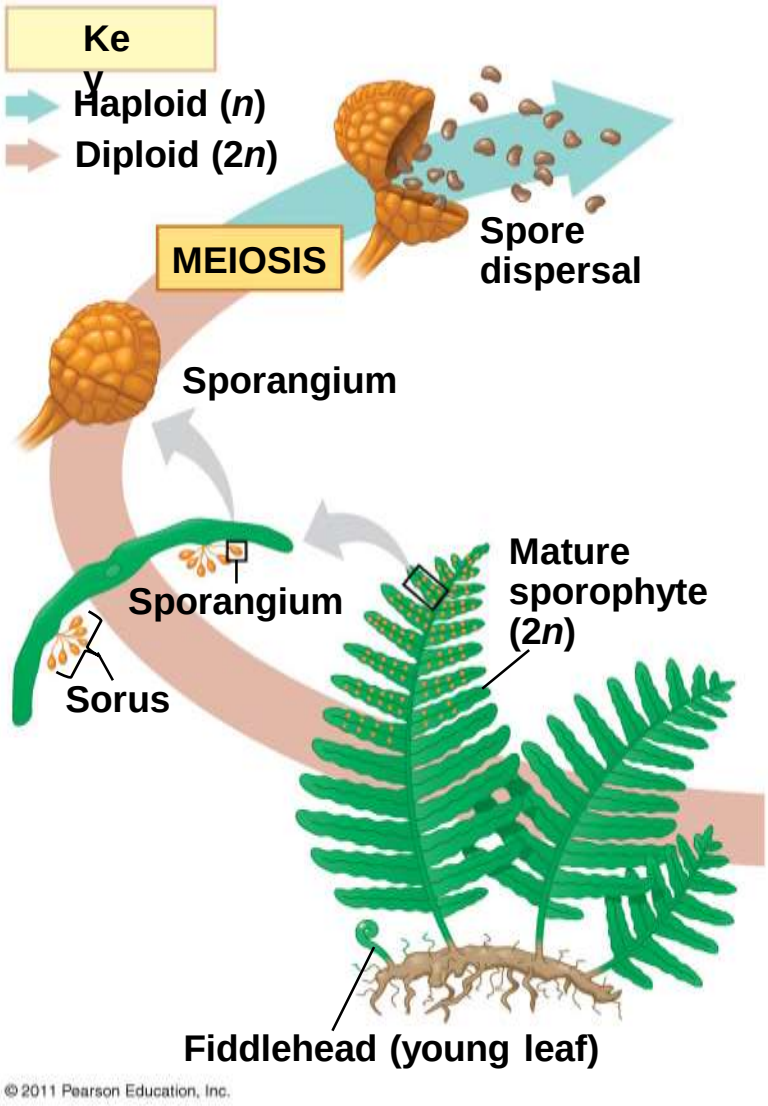


Figure 29.13-2

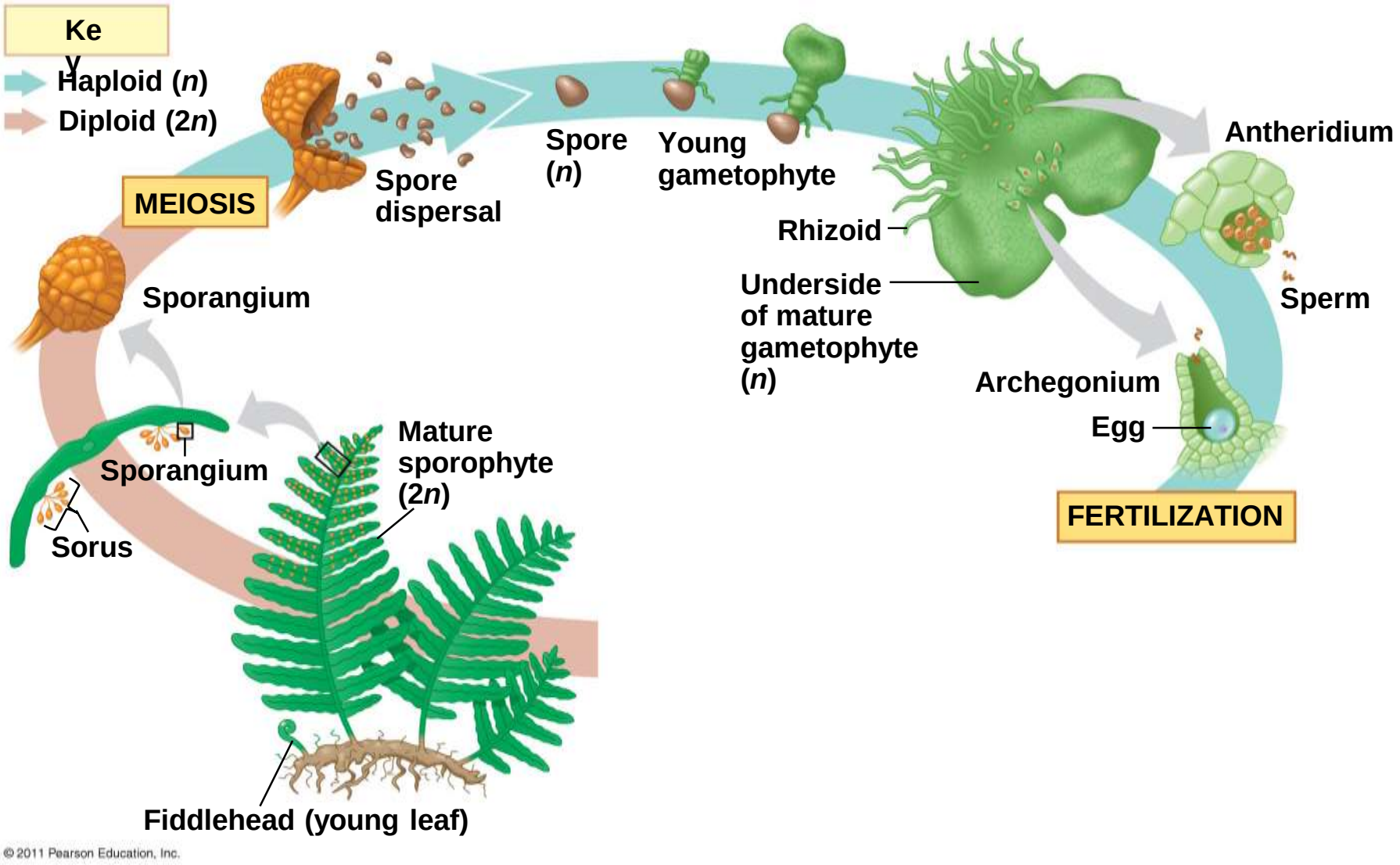
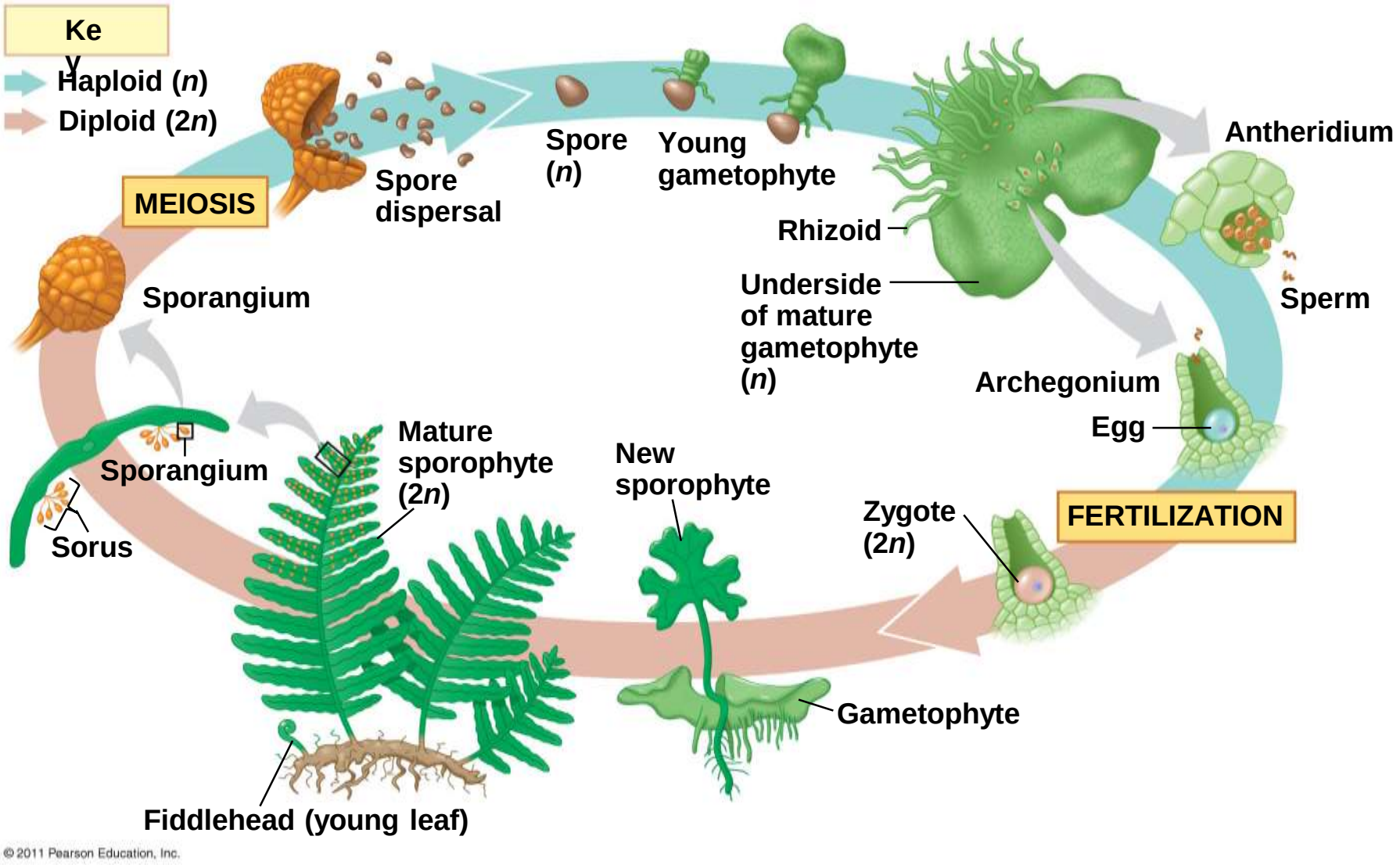


Figure 29.13-3



Transport in Xylem and Phloem

- Vascular plants have two types of vascular tissue: xylem and phloem
- **Xylem** conducts most of the water and minerals and includes dead cells called **tracheids**
- Water-conducting cells are strengthened by **lignin** and provide structural support
- **Phloem** consists of living cells and distributes sugars, amino acids, and other organic products
- **Vascular tissue allowed for increased height, which provided an evolutionary advantage**

Evolution of Roots

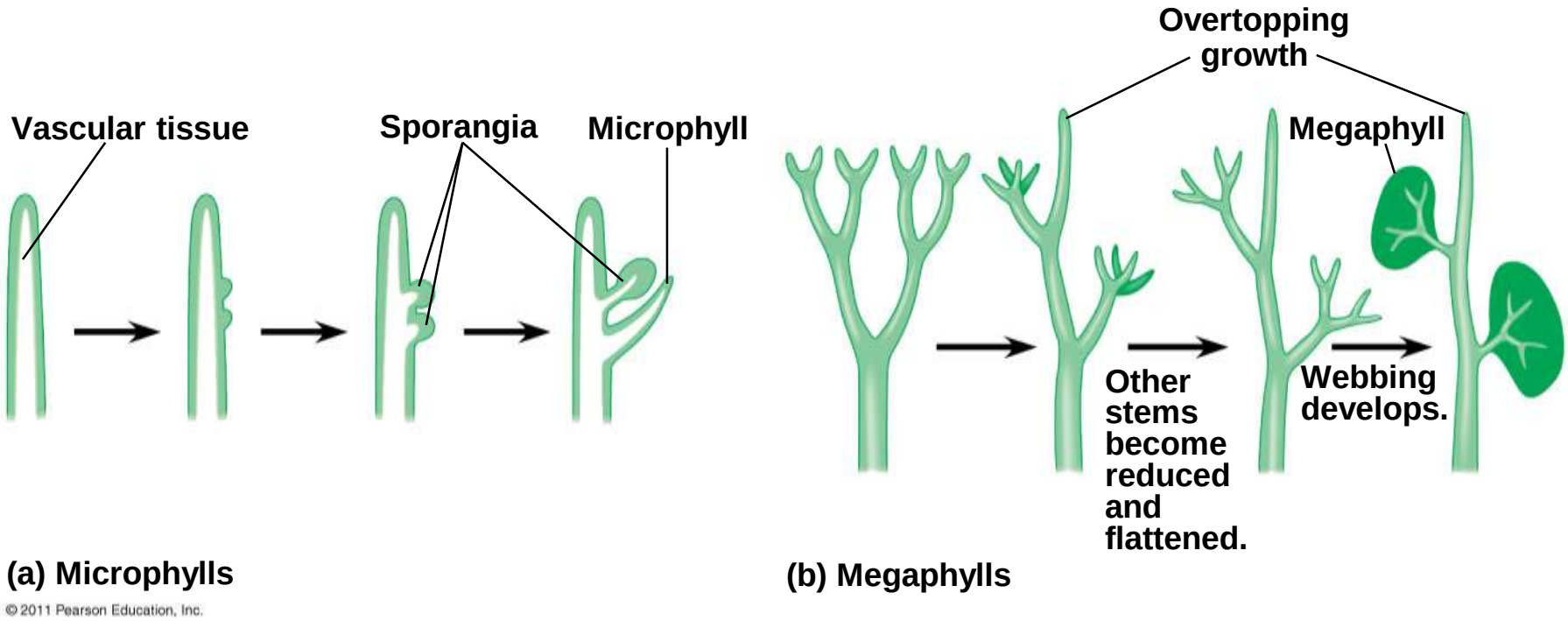
- **Roots** are organs that **anchor** vascular plants
- They enable vascular plants to absorb water and nutrients from the soil

Evolution of Leaves

- **Leaves** are organs that **increase the surface area** of vascular plants, thereby capturing more solar energy that is used for photosynthesis

- Leaves are categorized by two types
  - **Microphylls**, leaves with a single vein
  - **Megaphylls**, leaves with a highly branched vascular system

Figure 29.14



- protection from predators(الحيوانات المفترسة)

secondary compounds

- protection from desiccation(الجفاف-التجفيف)

cuticle

- Transport of water, minerals, and nutrients

Tracheids and phloem

- Plant spores are produced directly by

Sporophytes.

- Bryophytes

Multicellularity.

Specialized cells and tissues.

Walled spores in sporangia.

A reduced, dependent sporophyte

- General characteristic of bryophytes

A cellulose cell wall.

Chlorophylls a and b.

Being photosynthetic autotrophs.

Being eukaryotic

- The life cycle of mosses

External water is required for fertilization.

Flagellated sperm are produced.

Antheridia and archegonia are produced by gametophytes.

The gametophyte generation is domina