

Principles of Plant Evolution

- Higher land plants evolved from algae about 400,000,000 years ago
- Plants evolved physiological adaptations that allowed them to survive in the soil-plant-air continuum
- Some evolutionary adaptations were structural, some were chemical, and most affected reproduction
- Ontogeny recapitulates phylogeny in plants as well as animals

Figure 29.0 Ferns



Figure 29.2 Charophyceans: *Chara* (top), *Coleochaete orbicularis* (bottom)

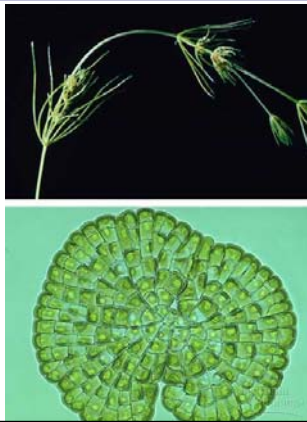


Figure 26.2 Clock analogy for some key events in evolutionary history

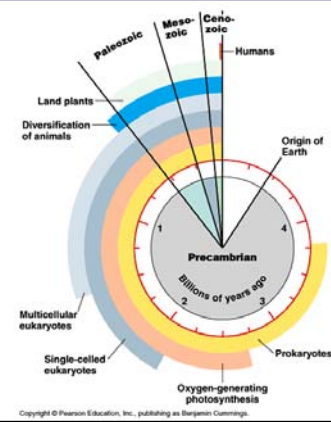


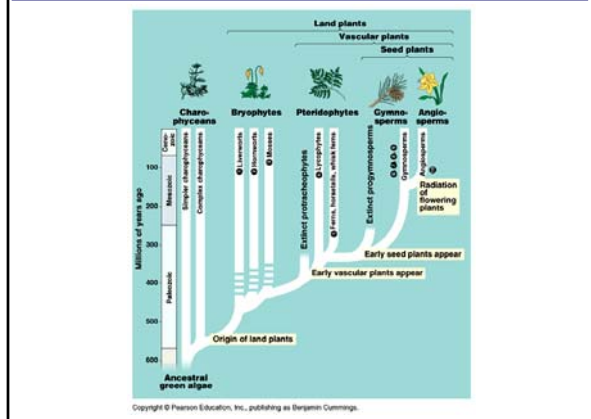
Figure 29.2x *Chara*



Three big waves of evolutionary plant adaptation

- Waxy cuticle and stomata for water conservation and gas exchange
- Vasculature - xylem and phloem - for water and photosynthate transport
- Seeds as a means of reproduction

Figure 29.1 Some highlights of plant evolution



Three big categories of plant adaptations

- Structural
- Chemical
- Reproductive

Important structural adaptations

- Subterranean organs - roots
- Aerial organs – stems, leaves, cones, flowers
- Vasculature and a siphonous body plan
- A cuticle and stomata

Figure 35.2 Morphology of a flowering plant: an overview

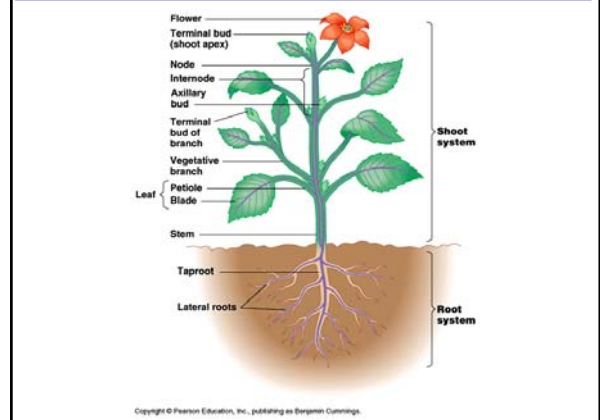


Figure 30.12 Xylem cells in angiosperms

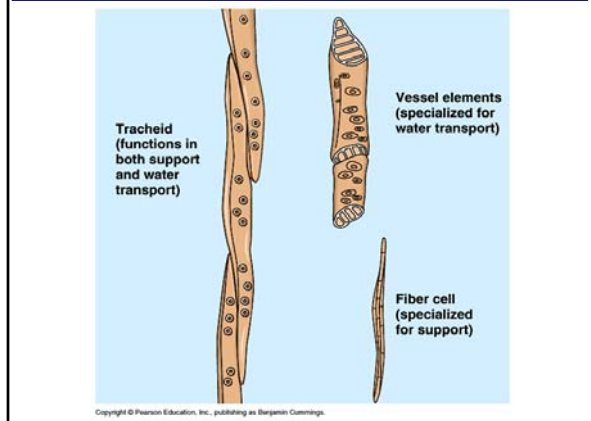


Figure 29.11 The stem of *Polypodium*, a fern (a pteridophyte)



Figure 29.11 Xylem and phloem in the stem of *Polypodium*, a fern (a pteridophyte)

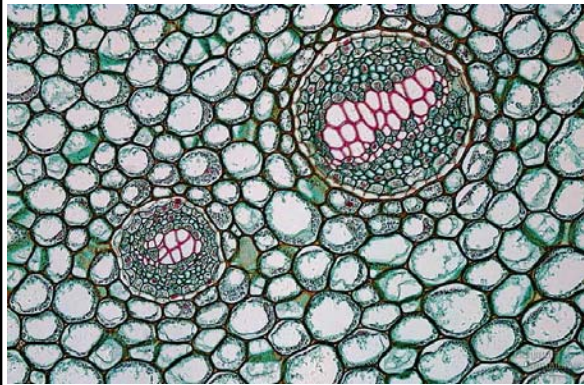


Figure 29.10 Cuticle of a stem from *Psilotum* (a pteridophyte)

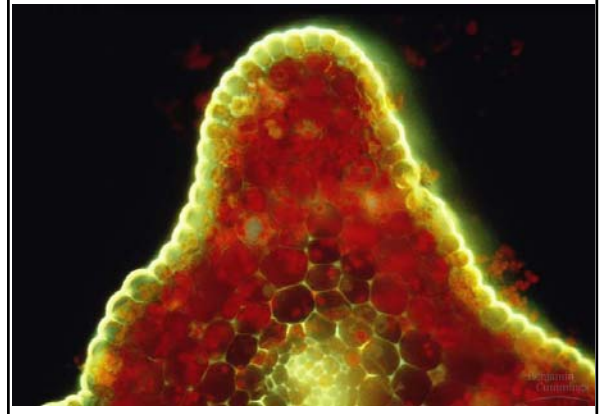
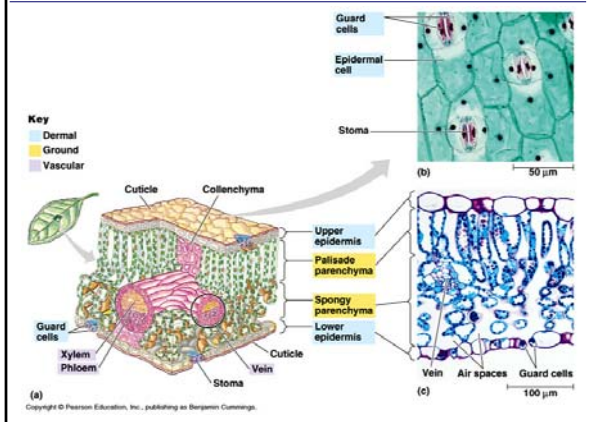


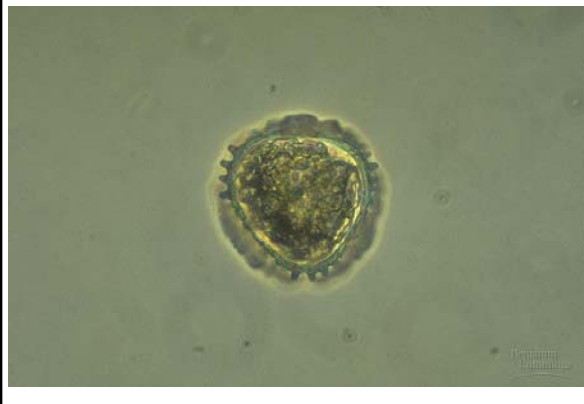
Figure 35.19 Leaf anatomy



Examples of important “secondary plant products” that are chemical adaptations to living on land

- “Waxes” of the cuticle
- Herbivory deterrents – e.g., ouabain
- Lignin of woody plants
- Sporopollenin

Figure 29.7 A fern spore



Plant reproductive adaptations

- Reproductive structures: spores, gametangia, embryos
- Alternation of generations
- Heterosporosity
- Pollen
- Cones and seeds of gymnosperms
- Flowers and seeds of angiosperms

Figure 29.9 Gametangia: Archegonium of *Marchantia* (left), Anteridium of a hornwort (right)

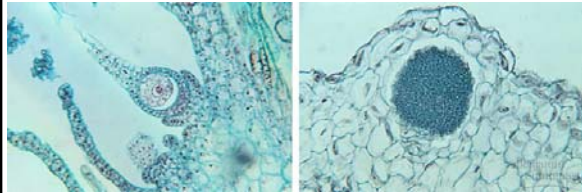
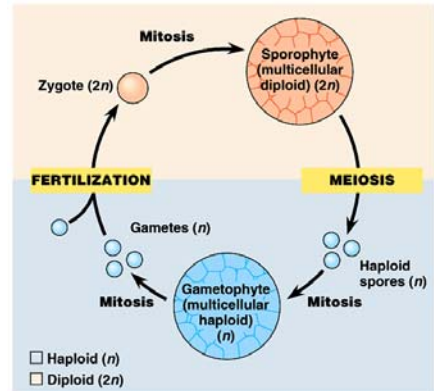


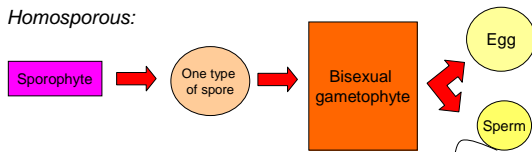
Figure 29.6 Alternation of generations: a generalized scheme



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Homospory vs. Heterospory

Homosporous:



Heterosporous:

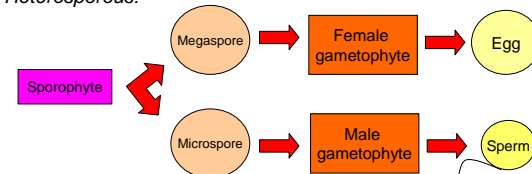
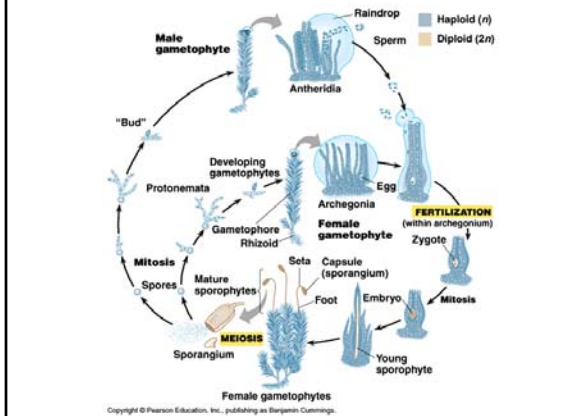


Figure 29.15 Bryophytes



Figure 29.16 The life cycle of *Polytrichum*, a moss (Layer 3)



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Figure 29.24a Fern sporophyll, a leaf specialized for spore production



Figure 29.24b Fern sporophyll, a leaf specialized for spore production



Figure 29.24c Fern sporophyll, a leaf specialized for spore production

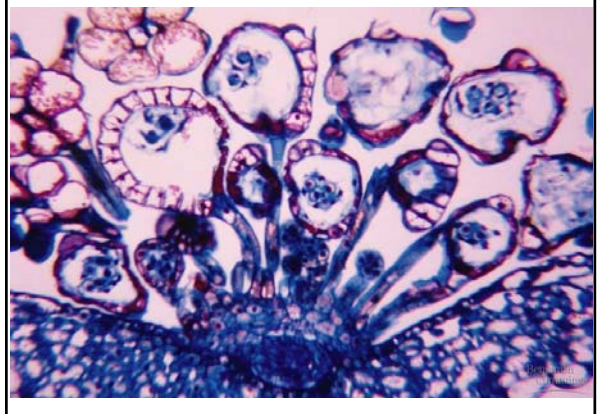


Figure 29.23 The life cycle of a fern

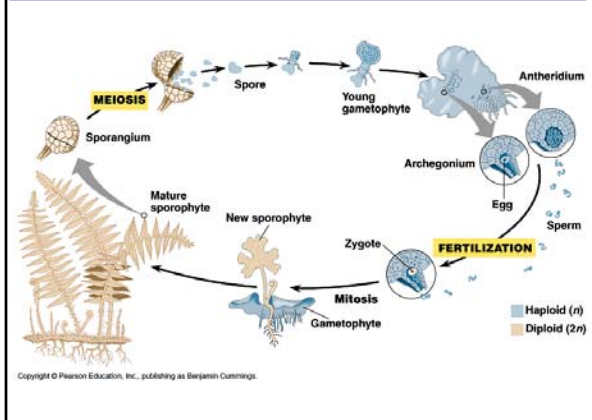


Figure 30.0 Seed fossil



Figure 29.4 Embryos of land plants: *Marchantia* (left), Shepherd's purse (right)



Figure 30.2 From ovule to seed

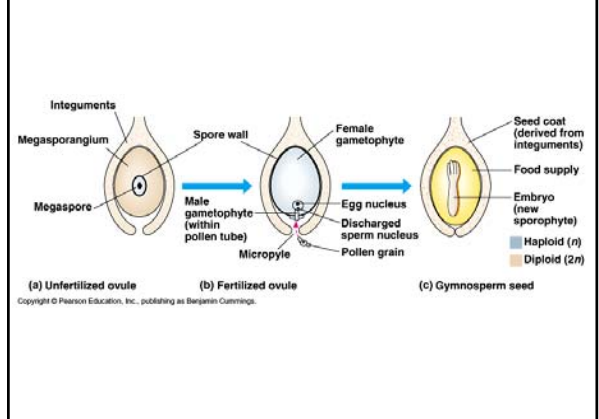


Figure 30.10 A closer look at pine cones (*Pinus* sp.)



Figure 30.9 The life cycle of a pine (Layer 3)

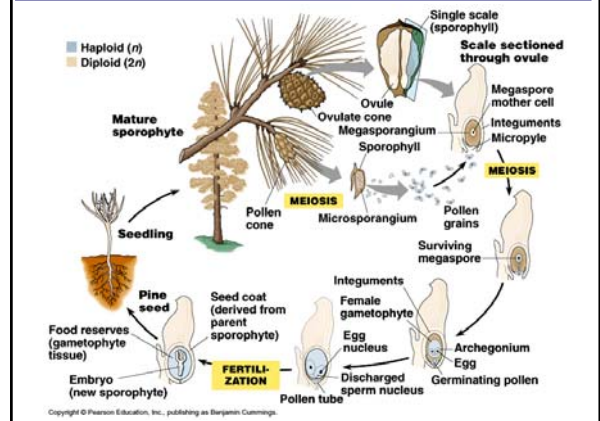


Figure 30.10x1 Pine Sporangium with spores

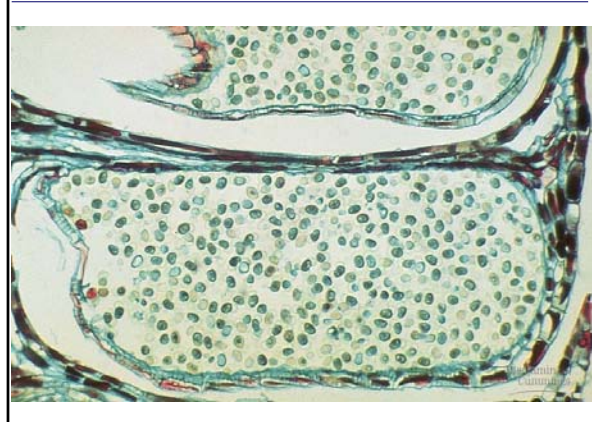


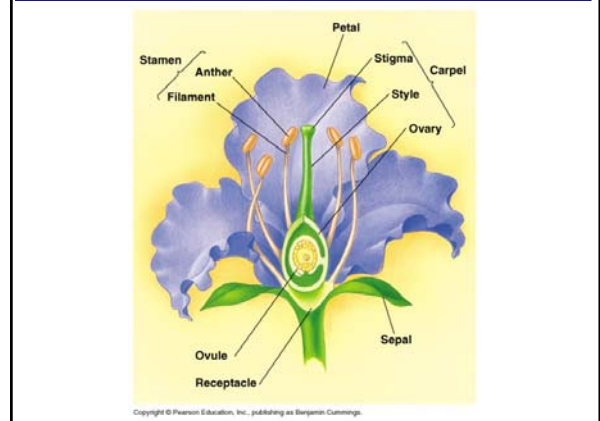
Figure 30.10x2 Pine pollen



Figure 30.10x3 Pine embryo



Figure 30.13a The structure of a flower



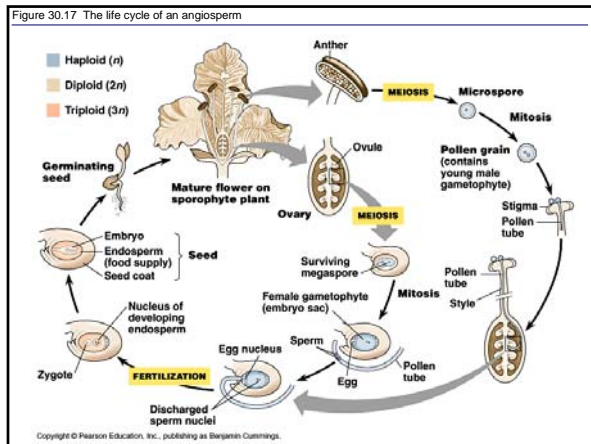


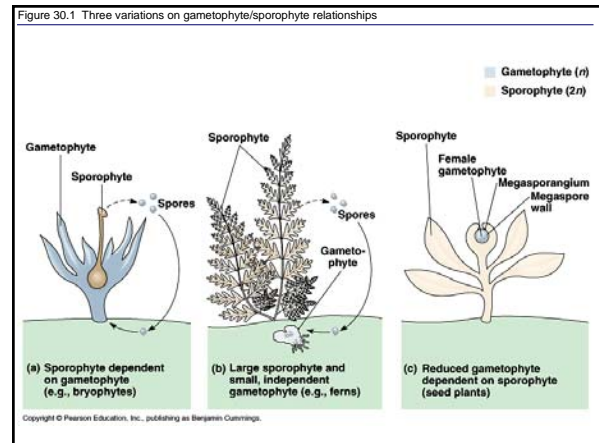
Table 29.1 Ten Phyla of Extant Plants

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	Common Name	Approximate Number of Extant Species	
Bryophytes			
1	Phylum Hepatophyta	Liverworts	6,500
2	Phylum Anthoceroophyta	Hornworts	100
3	Phylum Bryophyta	Mosses	12,000
Vascular Plants			
<i>Scadica Vascular Plants (Pteridophytes)</i>			
4	Phylum Lycophyta	Lycophytes	1,000
5	Phylum Pterophyta	Ferns, horsetails, and whisk ferns	12,000
Seed Plants			
<i>Gymnosperms</i>			
6	Phylum Ginkgoophyta	Ginkgo	1
7	Phylum Cycadophyta	Cycads	100
8	Phylum Gnetophyta	Gnetae	70
9	Phylum Coniferophyta	Conifers	550
<i>Angiosperms</i>			
10	Phylum Anthophyta	Flowering plants	250,000

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Four most important plant reproductive adaptations

- Reduction of the gametophyte so that it is contained within the sporophyte
- Seeds as a resistant means of dispersing embryos
- Pollen for dispersing gametes
- Flowers of angiosperms



Why plants are important

- Plants are our agricultural source of food, fiber, medications, perfumes, decoration
- Plants provide food and shelter for animals
- Plants transform the atmosphere and thereby affect climate
- Some flowering plants have co-evolved with their pollinators so that each requires the other to survive

Plant biodiversity is being threatened as 50,000,000 acres of rainforest are being cleared each year.

<http://en.wikipedia.org/wiki/Deforestation>

Figure 29.13 A hypothetical mechanism for the origin of alternation of generations in the ancestor of plants

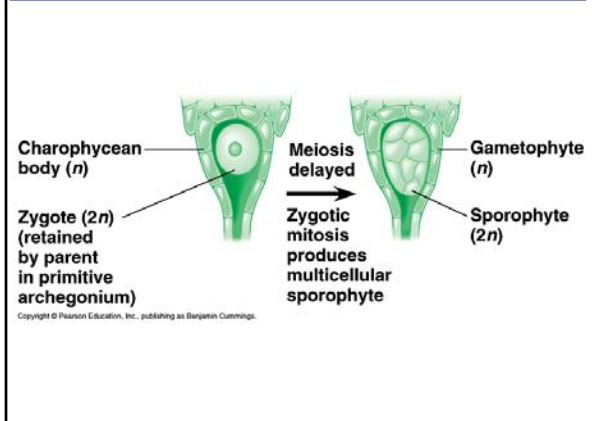


Figure 25.5 Diversity of life and periods of mass extinction

