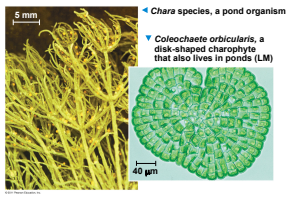
Chapters 29 & 30: Plant Diversity

AP Biology 2013

1

Colonization of the Land

- Since colonizing land, plants have diversified into about 290,000 species
- Evolved from green algae
  - Charophyceans are closest relatives of land plants and share these characteristics:
    - Rose-shaped complexes for cellulose synthesis
    - Peroxisome enzyme
    - Structure of flagellated sperm
    - Formation of phragmoplast (aids in cell plate formation)
- Plants have been on land for at least 475 million years



Chara species, a pond organism

Coleochaete orbicularis, a disk-shaped charophyte that also lives in ponds (LM)

Fig. 29.3

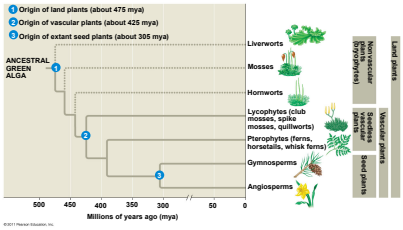


Fig. 29.7

2

Derived Adaptations

- So closely related to green algae that some think they should be included as plants
- Plants differ from charophyceans in five key ways:
  - Apical meristems
  - Alteration of generations
  - Walled spores produced in sporangia
  - Multicellular gametangia
  - Multicellular dependent embryos

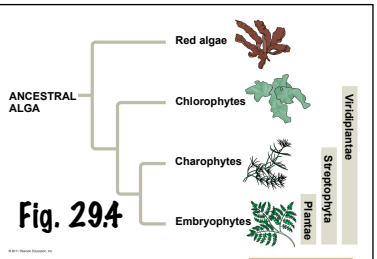


Fig. 29.4

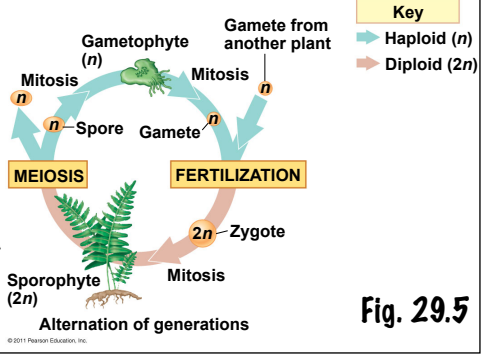


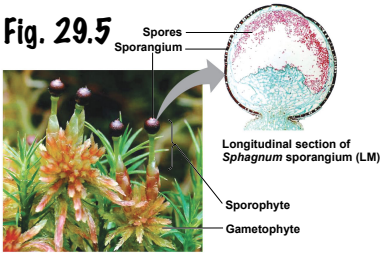
Fig. 29.5

3

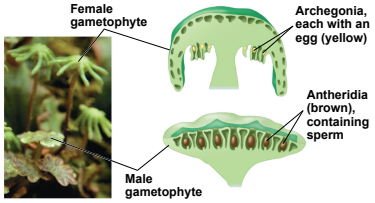
Important Plant Terminology

- Sporophyte produces spores in organs called sporangia
  - Diploid cells called sporocytes undergo meiosis to generate haploid spores
- Gametes are produced within organs called gametangia
  - Female gametangia are called archegonia (produce eggs and are site of fertilization)
  - Male gametangia are called antheridia (produce and release sprem)

Fig. 29.5



Sporophytes and sporangia of *Sphagnum* (a moss)



Archegonia and antheridia of *Marchantia* (a liverwort)

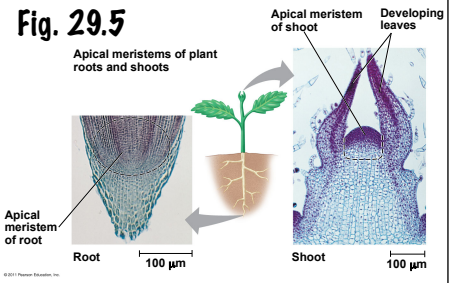
Fig. 29.5

4

Important Plant Terminology

- Apical Meristems - where plants exhibit continual growth
  - Cells here can differentiate into various tissues
- Cuticle - waxy coating of the epidermis
- Mycorrhizae - symbiotic association between plants and fungi that helps plants obtain nutrients
- Plants are grouped based on presence of vascular tissue

Fig. 29.5

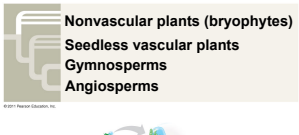


- Seed - an embryo surrounded by a protective coat
  - Seed plants form a clade that can be divided into the clades gymnosperm and angiosperm

5

Bryophytes

- Nonvascular plants
- Represented by three phyla of small herbaceous (nonwoody) plants
  - Liverworts - phylum Hepatophyta
  - Hornworts - phylum Anthocerophyta
  - Mosses - phylum Bryophyta
- Sequence of bryophyte evolution is not clear, but mosses are most closely related to vascular plants
- In all three phyla, gametophytes are larger and longer-living than sporophytes



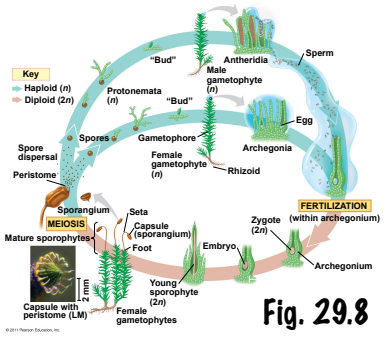


Fig. 29.8

Fig. 29.9

6

Importance of Mosses

- Capable of inhabiting diverse and extreme environments (although most common in moist forests and wetlands)
- Help retain nitrogen in soil
- Sphagnum (peat moss) forms deposits of partially decayed organic material called peat which can be used for fuel
  - Reservoir for organic carbon
  - Overharvesting or water level drop could cause stored CO_2 to be released into the atmosphere

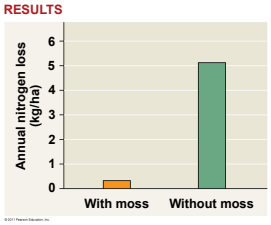


Fig. 29.10

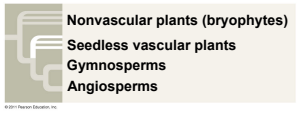
Fig. 29.11

(a) Peat being harvested from a peatland

(b) "Tollund Man," a bog mummy dating from 405–100 B.C.E.

7

Seedless Vascular Plants



- Date back to 420 million years ago
- Vascular tissue allowed the plants to grow tall
- Have flagellated sperm (require moist environments)
- Early tiny plants had independent, branching sporophytes but lacked the other derived traits of vascular plants
- Sporophytes are the larger generation; gametophytes are tiny plants that grown on or below the soil surface

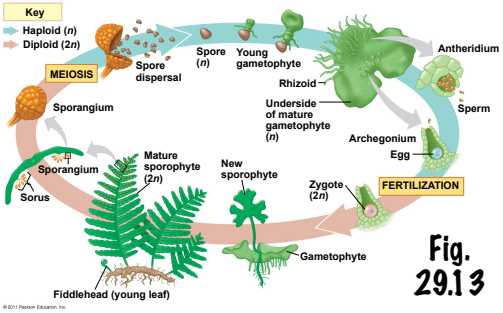


Fig. 29.13

8

Evolution of Leaves

- Leaves - organs that increase surface area of vascular plants (capture more solar energy)
- Two types:
  - Microphylls - with a single vein (perhaps evolved from outgrowths of stems)
  - Megaphylls - highly branched vascular system (perhaps evolved from webbing of flattened branches)
- Sporophylls - modified leaves with sporangia
  - Most seedless vascular plants are homosporous. Seed plants and some seedless vascular plants are heterosporous

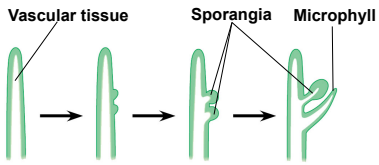
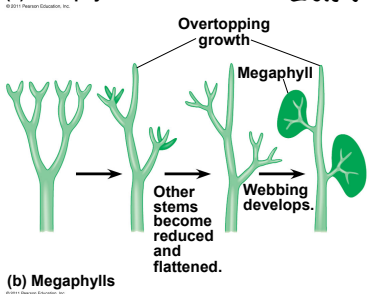


Fig. 29.14

(a) Microphylls



(b) Megaphylls

9

Seedless Vascular Plant Phyla

- Lycophyta - club mosses, spike mosses, and quillworts
  - Small herbaceous plants
- Pterophyta - ferns, horsetails, and whisk ferns
  - Ferns - most diverse group
- These phyla formed the first forests during the Carboniferous period
  - Caused major global cooling
  - Eventually became coal

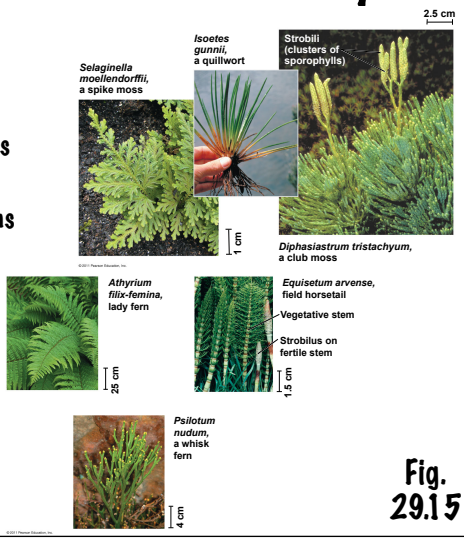


Fig. 29.15

10

Seeds Bearing Plants

- Changed the course of plant evolution
- Plants could become dormant
- Reduced gametophytes are protected in ovules and pollen grains
  - Develop within the walls of spores and retained within the tissue of the parent sporophyte
- Heterospory
- Ovules and Pollen

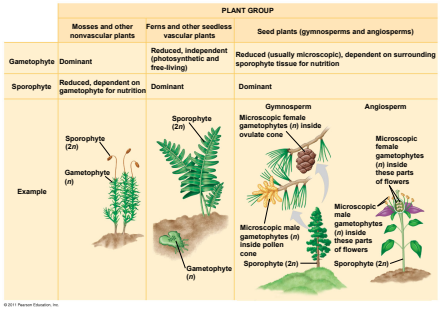


Fig. 30.2

11

Heterospory

- Seed plants evolved from plants that had megasporangia (produce megaspores that give rise to female gametophytes)
  - Ovule consists of a megasporangium, megaspore, and protective integuments
- Seed plants evolved from plants that had microsporangia (produce microspores that give rise to male gametophytes - contained in pollen)
  - Pollen grain germination involves pollen tube that discharges two sperm into the female gametophyte within the ovule
- Pollination - transfer of pollen to the part of the seed plant that contains the ovules

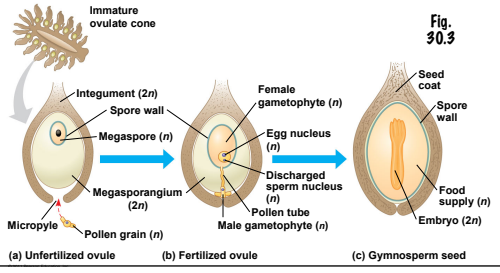


Fig. 30.3

Seed develops from the whole ovule

Sporophyte embryo along with its food supply packaged in a protective coat

12

Gymnosperms

- Conifers
- Include four plant phyla: Cycadophyta, Gingkophyta, Gnetophya, Coniferophyta
- Appear early in the fossil record


Cycas revoluta

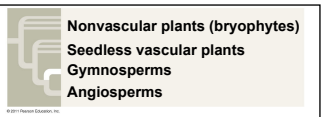


Fig. 30.5


Ginkgo biloba leaves and fleshy seeds

Ginkgo biloba pollen-producing


Gnetum


Ovulate cones

Welwitschia


Ephedra


Douglas fir

Sequoia

Common juniper

European larch

Weeping pine

Bristlecone pine

13

Gymnosperm Life Cycle

- Key features:
  - Dominance of sporophyte generation
  - Development of seeds from fertilized ovules
  - Role of pollen in transferring sperm to ovules

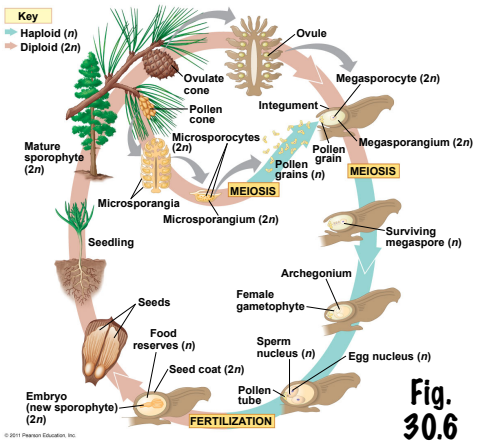
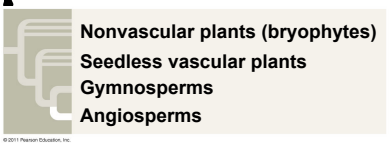


Fig. 30.6

14

Angiosperms

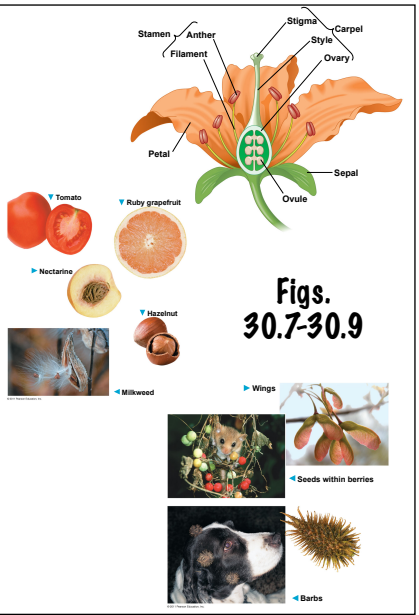
- Flowering plants
- Seed plants that produce reproductive structures called flowers and fruits
  - Key adaptation of angiosperms
  - Flower is a specialized structure for sexual reproduction
- Most widespread and diverse of all plants



15

Flower and Fruits

- Specialized shoot with modified leaves
  - Sepals enclose the flower
  - Petals brightly colored to attract pollinators
  - Stamens which produce pollen
  - Carpels which produce ovules
- Fruits consist of a mature ovary and can be dispersed by wind, water, or animals



Figs. 30.7-30.9

16

Angiosperm Life Cycle

- Double fertilization occurs when a pollen tube discharges two sperm into the female gametophyte within an ovule
- One sperm fertilizes the egg; the other combines with two nuclei in the center cell of the female gametophyte and initiates development of a food-storing endosperm
- Endosperm nourishes the developing embryo

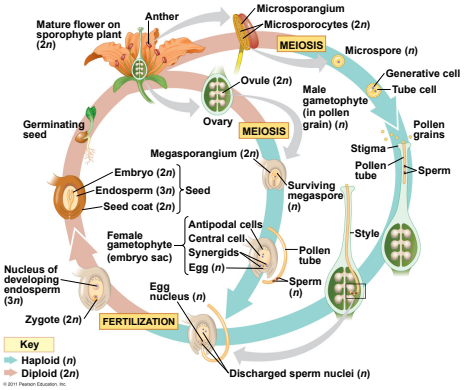


Fig. 30.10

17

Angiosperm Evolution

- Originated at least 140 million years ago
- Primitive fossils of 125 million-year-old angiosperms display both derived and primitive characteristics
- Thought that ancestors had separate pollen producing and ovule producing structures before they were combined into a single flower

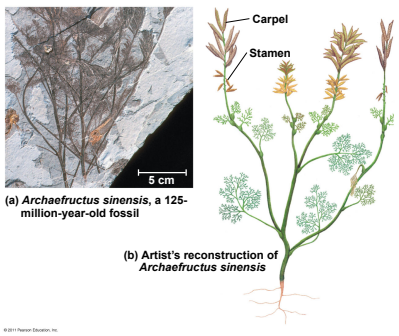


Fig. 30.11

18

Angiosperm Diversity

- Two groups:
  - Monocots - one cotyledon
  - Eudicots - two cotyledons
- Basal angiosperms - less derived
- Magnoliids - share some traits with basal angiosperms but are more closely related to monocots and eudicots

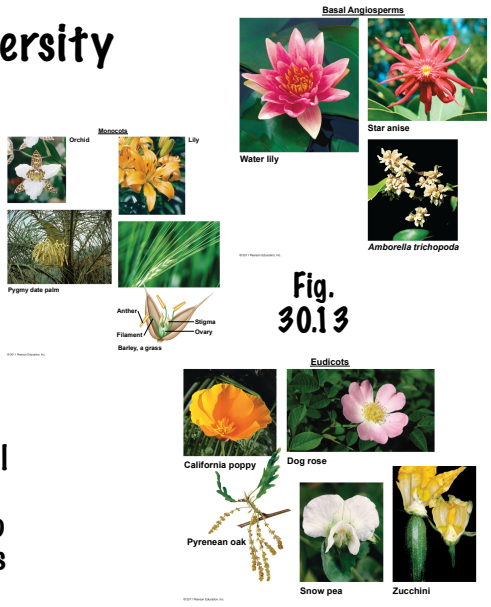


Fig. 30.13

19

Angiosperm Diversity

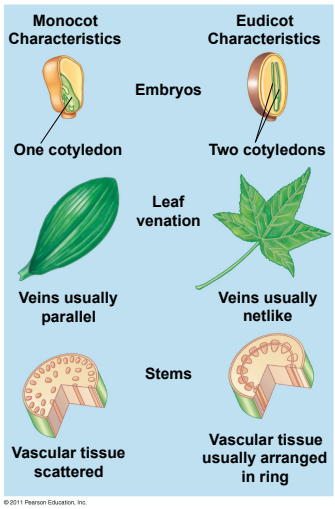
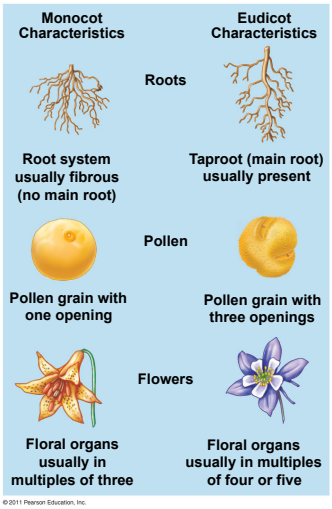


Fig. 30.13



20

Links Between Angiosperms and Animals

- Pollination of flowers by animals and transport of seeds by animals
- Crucial for survival of humans
  - Food, wood, and medicines
  - Humans are destroying habitats and causing extinction

Table 30.1 Examples of Plant-Derived Medicines

Compound	Source	Use
Atropine	Belladonna plant	Eye pupil dilator
Digitalin	Foxglove	Heart medication
Menthol	Eucalyptus tree	Throat soother
Quinine	Cinchona tree	Malaria preventive
Taxol	Pacific yew	Ovarian cancer drug
Tubocurarine	Curare tree	Muscle relaxant
Vinblastine	Periwinkle	Leukemia drug

21