Plants: An Introduction

The Plant Kingdom can be viewed as having the true terrestrial plants and those that are “almost” true terrestrial plants.

Outline

- Key concepts
- Important roles of Plants
  - provide food, air (oxygen), clothing, etc.
- Classification
  - Bryophytes, Seedless Vascular Plants,
  - Gymnosperms, and Angiosperms
- Evolutions
- Conclusions

Key Concepts:

- The plant kingdom consists of multicelled photoautotrophs
- Nearly all plants live on land
- Plants have structural adaptations that allow them to photosynthesize, absorb water and ions, and conserve water
- Land plants are reproductively adapted to withstand dry periods
Key Concepts:

- Early divergences gave rise to the bryophytes, then the seedless vascular plants, and then the seed-bearing vascular plants
- Gymnosperms are the seed-bearing vascular plants and the angiosperms are also vascular plants that bear flowers and seeds
- Angiosperms include two main classes
  - Eudicots (Dicots) and Monocots

The Plant Kingdom

Evolution of land plants: What general types of adaptations are needed to allow plants to successfully invade terrestrial environments?

Adaptations required to move from aquatic to terrestrial environments:

a. Roots/root-like structures

b. Vascular transport of water, minerals, and nutrients.

c. Structural support
d. Regulation of water loss/gain, and gas exchange

e. Reproduction
   1. flagellated or non-flagellated gametes.
   2. Fertilization water free.

f. Origin of the plant kingdom
   Charophyceans (Green algae)

**Genetic Evidence**
- Comparisons of both nuclear and chloroplast genes
  - Point to charophyceans as the closest living relatives of land plants
Fossilized spores and tissues
- Have been extracted from 475-million-year-old rocks

Classification & Evolution
Over 290,000 species
1. Bryophytes: Non-vascular Plants
2. Seedless Vascular Plants
3. Gymnosperms: Seed-bearing Plants
4. Angiosperms: The Flowering Seed-Bearing Plants

A Classification of Plants

<table>
<thead>
<tr>
<th>Table 29.1 Ten Phyta of Extant Plants</th>
<th>Common Name</th>
<th>Approximate Number of Extant Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryophyta</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Marchantiales</td>
<td>Liverworts</td>
<td>6,598</td>
</tr>
<tr>
<td>2. Marchantiales</td>
<td>Liverworts</td>
<td>818</td>
</tr>
<tr>
<td>3. Marchantiales</td>
<td>Mosses</td>
<td>12,000</td>
</tr>
<tr>
<td>Seed Plants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Equisetophyta</td>
<td>Lycophyta</td>
<td>3,000</td>
</tr>
<tr>
<td>2. Equisetophyta</td>
<td>Ferns, horsetails, and whiskers</td>
<td>12,000</td>
</tr>
<tr>
<td>Gymnosperms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pteridosperms</td>
<td>Gymnosperms</td>
<td>1</td>
</tr>
<tr>
<td>2. Pteridosperms</td>
<td>Cylais</td>
<td>800</td>
</tr>
<tr>
<td>3. Pteridosperms</td>
<td>Conifers</td>
<td>700</td>
</tr>
<tr>
<td>4. Pteridosperms</td>
<td>Conifers</td>
<td>500</td>
</tr>
<tr>
<td>Angiosperms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Pteridosperms</td>
<td>Angiosperms</td>
<td>295,000</td>
</tr>
</tbody>
</table>
Representatives
Bryophytes: mosses, liverworts and hornworts

Non-vascular plants
a. Have embryo
b. Reproductive structures that protect embryo: Gametangia = Antheridia & Archegonia
c. Rhizoids absorb water and nutrients; anchor
d. Gametophyte generation dominant
e. Must have water for fertilization

f. Cuticles
g. Stomata
h. Sporopollenin in spore walls
The life cycle of a moss

Alternation of generations

Marchantia one of the liverworts

male gametophyte  female gametophyte

Mosses
- Nonvascular
- Moist habitats mostly
- Small
  - < 20 cm tall
- Simplest plants

Moss-covered rocks
Seedless Vascular Plants

1. Arose from bryophyte-like ancestors
2. Cooksonia - dichotomous branching
3. Homosporous vs. Heterosporous
   - bisexual gametophyte
   - archegonium antheridium
   - megaspore microspore
4. Body support (lignin)
5. Vessels for conduction (Xylem and Phloem)

Lycophytes, Whisk Ferns, Horsetails, Ferns

- Has vascular tissues
- Habitat
  - Moist places
  - Sperm needs water to reach egg
  - Sporophyte becoming dominant

The life cycle of a fern
Ferns

Seed Plants
1. Sporophyte now dominant
2. Reproductive adaptations
   a. Pollen (water no longer needed for fertilization)
   b. Seeds (protection and nutrition for embryo)
[Gymnosperms] Non-flowering seed plants
   Conifers, Cycads, Ginkgos, Gnetophytes
   a. “naked” seeds
   b. evergreen leaves; evergreen and needle-like

Three variations on alternation of generations in plants

(a) Sporeophyte dependent on gametophyte (e.g., bryophytes)
(b) Large sporeophyte and small, independent gametophyte (e.g., ferns)
(c) Reduced gametophyte dependent on sporeophyte (seed plants)
Gymnosperm Diversity

Gymnosperm Diversity

Bristlecone pine

http://www.rmtrr.org/oldlist.htm

A cycad's seed-bearing cone

Gymnosperm Diversity

Ginkgo

Ginkgo seeds

Ginkgo leaf and fossil

Gymnosperm Diversity

Welwitschia mirabilis—Gnetophyte

It grows in hot deserts of Africa with a deep taproot. It has one or two strap-shaped leaves that split lengthwise repeatedly as the plant ages.
Angiosperms: Flowering plants

I. Major adaptations
   a. Flowers
   b. Fruit
   c. Broad leaves

II. Types of flowering plants:
   a. Monocots
   b. Eudicots (Dicots)

Angiosperms: flowering seed plants

- The dominant plant form on earth (>250,000 species)
- Flowers to increase insect pollination
- Fruit to protect the seed and developing embryo until favorable germination conditions occur
- Broad leaves to increase photosynthesis during the growing season are shed during periods of cold and drought
The life cycle of an angiosperm

Eudicots and Monocots

- Almost 180,000 Eudicots
  - Cabbage and Daisies
  - Flowering shrubs and trees
  - Cacti
- About 80,000 Monocots
  - Orchids, palms, grasses, crop plants, rice
**Evolution of Plants**

Key Terms

- Stomata
- Cuticle
- Lignin
- Sporopollenin
- Gametangia
- Gametophyte
- Sporophyte
- Vascular tissue
- Gymnosperm
- Angiosperm
- Antheridium
- Archegonium
- Sporangium
- Mosses
- Liverworts
- Hornworts
- Horsetails
- Ferns
- Megasporangia
- Microsporangia
- Seed
- Conifer
- Fruit
- Pollen grains
- Cotyledons
- Flowering plants
In Conclusion

- Plants probably arose from green algae
- Trends in evolution can be identified by comparing structural adaptations to dry conditions, shifts to diploid dominance
- Bryophytes are nonvascular plants and require free water for fertilization
- Vascular plants are adapted to life on land

- Gymnosperms are vascular plants that produce pollen grains and seeds
- Evolution of pollen grains freed these plants from dependence on water for fertilization
- Angiosperms produce flowers and coevolved with pollinators