Some giant sequoia trees weigh more than a dozen space shuttles

Flowering plants such as corn, rice, and wheat provide nearly all our food.

A mushroom is probably more closely related to humans than it is to any plant

Every 2 seconds humans destroy an area of tropical rain forest equal to the area of 3 football fields.
BIOLOGY AND SOCIETY:
THE BALANCING ACT OF FOREST CONSERVATION

- Coniferous forests are highly productive
  - They provide lumber for building and wood pulp for paper.

- Our demand for wood and paper is so great that clear-cut areas have become commonplace.

- The loss of coniferous forests
  - Threatens the trees and other organisms that live in forests
  - Can be minimized by conservation practices.
COLONIZING LAND

- Plants
  - Are terrestrial organisms
  - Are multicellular eukaryotes that make organic molecules by photosynthesis.

Terrestrial Adaptations of Plants

Structural Adaptations

- Living on land poses different problems from living in water
  - Plants require structural specializations
    - Roots and shoots.

![Diagram of plant structure](image.png)

Figure 16.2
• Most plants have mycorrhizae, symbiotic fungi associated with their roots.

• Leaves
  – Are the main photosynthetic organs of most plants
  – Have stomata for gas exchange
  – Contain vascular tissue for transporting vital materials.

• Other types of vascular tissue are found in the roots and shoots of plants.
Reproductive Adaptations

• Plants produce their gametes in protective structures called gametangia.

• In plants, but not algae, the zygote develops into an embryo while still contained within the female parent.
The Origin of Plants from Green Algae

- The move onto land and the spread of plants to diverse terrestrial environments were incremental.

Molecular comparisons and other evidence place a group of green algae called charophyceans closest to plants.

Figure 16.6

PLANT DIVERSITY

- The history of the plant kingdom is a story of adaptation to diverse terrestrial habitats.
Highlights of Plant Evolution

• The fossil record chronicles four major periods of plant evolution.

• The first period
  – Was the origin of plants from their aquatic ancestors, charophyceans

• The second period
  – Was the diversification of vascular plants
• The third period
  – Began with the origin of the seed
• The fourth period
  – Was the emergence of flowering plants, or angiosperms.

Bryophytes
• Mosses
  – Are the most familiar bryophytes.

• Mosses display two key terrestrial adaptations
  – A waxy cuticle that helps prevent dehydration
  – The retention of developing embryos within the mother’s gametangium.
Mosses have two distinct versions of the plant

- The gametophyte, which produces gametes
- The sporophyte, which produces spores.

The life cycle of a moss exhibits an alternation of generations.
Ferns

- Are seedless vascular plants.

During the Carboniferous period, about 290–360 million years ago, ferns formed swampy forests that covered much of what is now Eurasia and North America
- These forests formed what would become fossil fuels.

Gymnosperms

- A drier, colder climate at the end of the Carboniferous period favored the evolution of gymnosperms, the first seed plants.
Conifers

- Conifers
  - Cover much of northern Eurasia and North America
  - Are usually evergreens, which retain their leaves throughout the year.

Terrestrial Adaptations of Seed Plants

- Conifers and most other gymnosperms have three terrestrial adaptations
  - Further reduction of the gametophyte
  - The evolution of pollen
  - The advent of the seed.

- The first adaptation is a greater development of the diploid sporophyte compared to the haploid gametophyte generation.
• A pine tree of other conifer is actually a sporophyte with tiny gametophytes living in cones.

• A second adaptation of seed plants to dry land was the evolution of pollen
  • A pollen grain
    – Is actually the much-reduced male gametophyte
    – Fertilizes the female gametophyte.
The third terrestrial adaptation was the development of the seed.

A seed consists of a plant embryo packaged along with a food supply within a protective coat.

Angiosperms

- Angiosperms
  - Supply nearly all our food and much of our fiber for textiles
  - More efficient water transport and the evolution of the flower help account for the success of the angiosperms.

Flowers, Fruits, and the Angiosperm Life Cycle

- The dominant stage of the angiosperms is a sporophyte with gametophytes in its flowers.
• The life cycle of an angiosperm.
• The seed being enclosed within an ovary distinguishes angiosperms from gymnosperms.

• A fruit
  – Is a ripened ovary
  – Helps protect the seed and increase seed dispersal
  – Is a major food source for animals.

Angiosperms and Agriculture
• Angiosperms
  – Supply fiber, medications, perfumes, and decoration
• Agriculture
  – Is a unique kind of evolutionary relationship between plants and animals.
Plant Diversity as a Nonrenewable Resource

- The exploding human population is extinguishing plant species at an unprecedented rate.

- Humans depend on plants for thousands of products including food, building materials, and medicines.

Table 16.1

<table>
<thead>
<tr>
<th>Compound</th>
<th>Example of Source</th>
<th>Example of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arnica</td>
<td>Bulbous root</td>
<td>Pupil dilator in eye exams</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Nettle plant</td>
<td>Heart medication</td>
</tr>
<tr>
<td>Wartel</td>
<td>Eucalyptus tree</td>
<td>Ingredient in cough medicine</td>
</tr>
<tr>
<td>Sagebrush</td>
<td>Apache prairie</td>
<td>Pain reliever</td>
</tr>
<tr>
<td>Guava</td>
<td>Guava tree</td>
<td>Malaria prevention</td>
</tr>
<tr>
<td>Tansy</td>
<td>Pacific sage</td>
<td>Diverticulitis cancer drug</td>
</tr>
<tr>
<td>Saffron</td>
<td>Crocus flower</td>
<td>Muscle relaxant during surgery</td>
</tr>
<tr>
<td>Riviera</td>
<td>Pesci fish</td>
<td>Laxative drug</td>
</tr>
</tbody>
</table>

Table 16.1
• Preserving plant diversity is important to many ecosystems as well as humans.

Fungi

• Fungi are extremely important to ecosystems because they decompose and recycle organic materials.

• Fungi
  – Are eukaryotes, and most are multicellular
  – Are more closely related to animals than plants.
• A gallery of diverse fungi

Characteristics of Fungi
• In this section, the structure and function of fungi are described.

Fungal Nutrition
• Fungi are heterotrophs
  – They digest their food externally and acquire the nutrients by absorption.
Fungal Structure

- The bodies of most fungi are constructed of structures called hyphae.

- The hyphae
  - Form an interwoven mat called a mycelium
  - Are separated into cells by cross-walls made mainly of chitin.
Fungal Reproduction

- Fungi reproduce by releasing spores that are produced either sexually or asexually.

The Ecological Impact of Fungi

- Fungi
  - Have an enormous ecological impact.

Fungi as Decomposers

- Fungi and bacteria
  - Are the principal decomposers of ecosystems
  - Keep ecosystems stocked with nutrients necessary for plant growth.
• Molds
  – Can destroy fruit, wood, and human-made materials.

Parasitic Fungi

• Of the 100,000 known species of fungi, about 30% make their living as parasites.

• About 50 species of fungi are known to be parasitic in humans and other animals.
Commercial Uses of Fungi

- Fungi are commercially important
  - As food and in baking
  - In beer and wine production.

Some fungi produce antibiotics.

EVOLUTION CONNECTION: MUTUAL SYMBIOSIS

- Interdependence between species, or symbiosis, is an evolutionary product
  - Mutualism is symbiosis that benefits both species.
**Lichens**
- Are symbiotic associations between fungi and algae.

**SUMMARY OF KEY CONCEPTS**

- **Terrestrial Adaptations of Plants.**
  - Leaves are main photosynthetic organs.
  - Gametangia protect gametes from dehydration; female gametangia protect developing embryos.
  - Cuticle reduces water loss.
  - Stomata allow gas exchange between plant and atmosphere.
  - Lignin hardens cell walls.
  - Shoot supports plant; may perform photosynthesis.
  - Vascular tissues transport water, minerals, and sugars; provide support.
  - Roots anchor plant; mycorrhizae (root/fungus associations) help absorb water and minerals from the soil.

- **Highlights of Plant Evolution.**
  - Origin of gametangia (protect gametes and embryos).
  - Diversification of seedless vascular plants (vascular tissue conducts water and nutrients).
  - Origin of seeds (protect embryos from desiccation and other hazards).
  - Origin of flowers (bear ovules within protective chambers called ovaries).