

# Plant Kingdom

## Characteristics

- Eukaryotic
- Photosynthetic
- Multicellular
- Sexually reproducing
- Life History involves an alternation of a haploid phase (**Gametophyte**) with a diploid phase (**Sporophyte**)

## Classification

Artificially grouped into Nonvascular or Vascular Plants

### Non Vascular Plants – "Bryophytes"

- Disperse by spores
- Require H<sub>2</sub>O for sexual fertilization
- Small
- No vascular tissue
- Grow in clumps or masses
- Many capable of prolonged dehydration
- Most lack cuticle (protective surface layer)
- Three Divisions of Bryophytes

### Three Phyla

**Bryophyta** – Mosses

**Hepatophyta** – Liverworts

**Anthocerophyta** – Hornworts

### Vascular Plants

- Vascular tissue
- Cutin or suberin on aerial parts
- Body an axis (stem)
- Large surface/volume ratio common
- Much survival value for terrestrial habitat with water deficit – increase in size by conducting tissue – especially **xylem**
- Many subdivision and classes
- Each textbook varies, but – patterns are visible as increase in complexity of body structure
- Vascularization (Microphylls vs megaphylls in leaves)
- Dispersal {spore (Single cell) vs seed}
- Sperm transport H<sub>2</sub>Ovs pollen grain)

## Lower (spore-dispersing) Vascular Plants

Mostly predominant in fossil eras

Important in coal-formation

### Fossil Phyla

Rhyniophyta

Zosterophyllophyta

Trimerophytrophyta

### Extant Phyla

**Lycophyta** (Lycopodiophyta) – Ground Pines, Club Mosses and Quillwort

Three Extant Classes (Orders) (Families)

**Lycopodiae** (Lycopodiaes) (Lycopodiaceae)

**Selaginellae** (Selaginellales) (Selaginellaceae)

**Isoetae** (Isoetales) (Isoetaceae)

### Monilophyta or Pteridophyta

**Ferns** (Pterophyta)

Five Orders

**Ophioglossales** – Eusporangiate

**Marattiales** – Eusporangiate

**Filicales** – Homosporous and Leptosporangiate

**Salviniales** – Heterosporous and Leptosporangiate

**Marsileales** – Heterosporous and Leptosporangiate

**Horsetails or *Equisetum*** – One Order

**Equisetales** (Sphenophyta)

**Whisk Ferns** – One Order

**Psilotales** (Psilotophyta)

## Higher (seed-dispersing) Vascular Plants

- Disperse by multicellular seeds
  - Embryo head-start in seed package
- Transport sperm in pollen grain
  - Freedom from H<sub>2</sub>O for fertilization

Two Broad Groups plus the Fossils

### Fossil Phyla

#### Progymnospermophyta

**Pteridospermales** – Fossil Seed Ferns

**Cordaitales** – Primitive Conifer-like

**Bennettitales** – Fossil Cycadeoides

### Extant Phyla

**Gymnosperms** – Seed not protected by a fruit

#### Four Phyla

**Cycadophyta:** Cycads

**Coniferophyta:** Conifers (e.g., Pine, Spruce, Fir, Hemlock, Yew)

**Ginkgophyta:** *Ginkgo*

**Gnetophyta:** *Gnetum*, *Ephedra*, *Welwitschia*

**Angiosperms** (Flowering plants) – Seed protected by a fruit (the ovary)

#### One Phylum Anthophyta – Flowering Plants

Two Classes comprise 97% of Angiosperms

**Eudicotyledones** (Dicots)

**Monocotyledones** (Monocots)

Additional Groups comprise 3 % of the more primitive Angiosperms

**Magnoliidae**, including several orders

**Nymphaeales** – Water Lilies

**Illiciales** – Star Anise

**Amborellales**

**Archaeofractales** – Earliest Anthophyte Fossil

# Characteristics of the Plant Groups

## Non-Vascular Plants

### The Bryophytes (Mosses, Hornworts and Liverworts)

- Multicellular
- Non-vascular
- Haploid generation dominant, assimilative phase
- Mostly terrestrial, of moist habitats
- Water necessary for sexual reproduction
- Flagellated sperm cells
- **Archegonium** - female sex organ
- **Antheridium** - male sex organ
- All small!

### Phylum – Hepatophyta (Liverworts)

- Two groups
  - Thallose
    - Leafy (resemble mosses, but lack a midrib on the "leaves", and have dorsal-ventral symmetry)
- Dorsal-ventral symmetry
- Vegetative reproduction by
  - Fragmentation
  - Gemmae
- Sporangium simple

### Phylum – Bryophyta (Mosses)

- Radially symmetrical
- Gametophyte phyllodes ("leaves") have a midrib (costa)
- Sporangium a capsule elevated by a stalk or seta above the gametophyte

### Phylum – Anthoceroophyta (Hornworts)

- Rounded thallose-like gametophyte
- Vegetative reproduction by
  - Fragmentation
- Sporophyte "horn-shaped" growing from a basal sheath beneath the surface of the gametophyte thallus. The sporophyte continues to grow from a basal meristem, producing spores clustered around a central stalk. The sporophyte tip splits releasing spores
- Less common than liverworts or mosses

## Vascular Plants

### Phylum – Lycophyta (Lycopodiophyta) (Club mosses)

- True roots, stems and leaves (Microphylls)
- Sporangia borne in a strobilus
- May be Homosporous (One type of sporangium) or Heterosporous (Produce megasporangia and microsporangia)
- Strobili may be axillary or terminal
- **Examples**
  - Lycopodium*
  - Selaginella*
  - Isoetes*

### Phylum - Monilophyta or Pterophyta (Ferns, Whisk Ferns and Horsetails)

#### Ferns

- Sporophyte generation dominant
- Both gametophyte and sporophyte independent
- Underground rhizome typical (Stem)
- Fertile and sterile fronds (Leaves {Megaphylls})
- Spores produced in sporangia located in a **sorus** which usually has a protective indusium
  - Sori located on underside of fertile fronds
- **Several Orders**
  - Ophioglossales** – Eusporangiate
  - Marattiales** – Eusporangiate
  - Filicales** – Homosporous and Leptosporangiate
  - Salviniales** – Heterosporous and Leptosporangiate
  - Marsileales** – Heterosporous and Leptosporangiate

#### Order – Equisetales (Sphenophyta) (Horsetails and Scouring rushes)

- Stems silica impregnated
- Branches whorled
- Stems jointed
- Leaves microphylls and often non-photosynthetic
- Homosporous (Archegonia and Antheridia on same plant)
- Spores have **elaters** for dispersal
- One Genus
  - Equisetum*

#### Order – Psilotales (Psilotophyta)

- No true roots or leaves
- Phyllodes present
- Sporangia borne in axils, in clusters
- Determined to be a degenerate group related to ferns
- **Examples**
  - Psilotum*
  - Tmesipteris*

## Phylum - Progymnospermophyta

### Order - Pteridospermales (Pteridospermophyta) (Seed Ferns)

- All fossils
- Important as the probable progenitors of today's seed plants

## Phylum - Cycadophyta (Cycads)

- 9 genera, 100 species
- Tropic and subtropical
- Vegetative characteristics:
- Stem unbranched, short or columnar
- Terminal crown of long, leathery, compound leaves (Palm-like)
- Less than 6 feet tall (mostly)
- **Reproduction**
  - All Dioecious (Male and Female Strobili on separate plants)
  - Pollen sacs on scalelike microsporophylls in compact cones (Microsporangia)
  - Megasporophylls also in cones (some up to 3 ft in length)
  - Pollination by wind, but male gamete motile
  - Largest motile gametes with up to 20,000 flagella
- **Examples**
  - Cycas revoluta* (Sago palm)
  - Zamia*

## Phylum - Ginkgophyta (Ginkgo or Maidenhair tree)

- One living species *Ginkgo biloba*
- Deciduous tree with fan-shaped leaves
- **Reproduction**
  - Sexual cycle like cycads
  - Male strobilus in short pendant paired microsporophylls
  - Female Ovules develop into yellowish, cherry-like seeds
  - Seed coat decomposes at maturity for dispersal

## Phylum - Gnetophyta

- Do not produce flowers
- Seeds not protected by a fruit (ovary)
- Xylem contains vessels
- Oldest fossils just 50 million years BP
- **Three representatives** (All distinctive)
  - Gnetum*
  - Ephedra*
  - Welwitschia*

## Phylum - Coniferophyta (Conifers)

- Dominant vegetation of the Taiga regions
- Major source of paper and lumber
- Strobili modified into **cones**
- Cone scales are modified sporophylls
- Xylem contains tracheids but no vessels
- **Reproduction**
  - Male and female gametophytes produced in separate cones
  - Female cones contain Megasporangia
    - Each megasporangium produces an ovule with an integument
    - Meiosis produces a megaspore, retained within the cone that develops into the female gametophyte with archegonium containing an egg
  - Male cones (Microsporangia in strobilus) contain Microspores that develop into the pollen grains (male gametophytes)
  - Wind pollination – Water unnecessary for fertilization
  - Seeds unprotected by sterile tissue
- **Examples**

<i>Pinus</i>	<i>Pseudotsuga</i>	<i>Metasequoia</i>
<i>Abies</i>	<i>Tsuga</i>	<i>Taxus</i>
<i>Picea</i>	<i>Thuja</i>	<i>Juniperus</i>

## Phylum - Anthophyta (Flowering Plants)

- **Reproduction**
  - Reproductive organs within a **flower** rather than a cone
  - Ovule embedded in sporophyte tissue (ovary)
  - Gametophytes greatly reduced
  - Fertilization "double"
    - One sperm with the egg:
    - One sperm with polar nuclei to form a nutritive **endosperm**
  - Seeds enclosed in a **fruit** (ovary)

### Two Major Classes (Distinguished Anatomically)

Monocotyledones (Monocots)	Eudicotyledones (Dicots)
Flower parts in 3's	Flower parts in 5's (4's)
Leaves with parallel veins	Leaf venation palmate or pinnate
No true cambium	Cambium usually present
One cotyledon	Two cotyledons
Scattered vascular bundles	Vascular bundles in a ring (cylinder)
Noncolpate pollen	Tricolpate Pollen
Sheathing leaf bases	Leaves usually have a petiole

### Additional Groups of more primitive Angiosperms

- Magnoliidae, including several orders
- Nymphaeales – Water Lilies
- Illiciales – Star Anise
- Amborellales
- Archaeofractales – Earliest Anthophyte Fossil