I. Ferns & fern allies (pteridophytes)

- Vascular
- Rhizomatous / Stoloniferous
- Water needed for fertilization
- Free-sporing (lack seeds)

A. Club-mosses, Lycophytes, or lycopods

Lycopodiaceae
- Microphylls
- Dichotomous branching
- Sporangia in strobilus typical

Lycopodium
I. Ferns & fern allies (pteridophytes)

A. Club-mosses, Lycophytes, or lycopods

Lycopodiaceae
- Microphylls
- Dichotomous branching
- Sporangia in strobilus typical

B. Horsetails & Scouring-Rushes

Equisetaceae
- Minute microphylls in whorls
- Nodal, whorlar branching
- Hollow, ribbed stems
- Silicaceous stems
- Sporangia in strobilus

Huperzia

Equisetum
I. Ferns & fern allies (pteridophytes)

C. Leptosporangiate Ferns

Polypodiaceae sensu lato
- Macrophylls (typically pinnate)
- Circinate vernation
- Branching variable
- Sporangia in sorus (plural sori)
- Leptosporangia

---

D. Whisk-Ferns

Psilotaceae
- Rootless
- Microphylls or enations
- Branching dichotomous
- Sporangia in synangium (plural synangia)

---

E. Phylogeny of Vascular plants

- Xylem & Phloem
- Sporophyte dominant; branching of sporophytes
- Leaves (Microphylls)
- Roots; clustered sporangia
- Macrophylls
- Pollen; Eustele; Vascular Cambium (wood)
- Spermatophytes, seed plants
- Ferns, horsetails, & whisk-ferns
- Club-mosses, lycophytes
- Rhyniophytes †
- Spermatophytes, seed plants
- Ferns, horsetails, & whisk-ferns
- Club-mosses, lycophytes
- Rhyniophytes †
- Spermatophytes, seed plants
E. Phylogeny of Vascular plants

- Hollow internodes;
- Ribbed stem;
- Interaxillary branching with whorled phyllotaxy
- Horse-tails, scouring-rushes
- Loss of hvs; loss of roots; synangia
- Whisk-ferns
- Leptosporangiate ferns

II. Seed plants (spermatophytes)

- Eustele & vascular cambium (except in monocots)
- Macrophylls
- Branching axillary (except in cycads)
- Spores retained, gametophytes develop on parent sporophyte
- Pollen (external water not required for fertilization)
- Ovules and Seeds

II. Seed plants (spermatophytes)

A. Gymnosperms

- Ovules exposed at pollination, seeds naked
II. Seed plants (spermatophytes)

A. Gymnosperms

1. Cycads
   - Mostly unbranched, evergreen trees or shrubs with terminal rosette of pinnate lvs.
   - Circinate vernation
   - Cataphylls
   - Branching, when present, dichotomous or adventitious
   - Dioecious
   - Male sporangia in strobilus

II. Seed plants (spermatophytes)

A. Gymnosperms

2. Ginkgos
   - Ginkgoaceae (Ginkgo)
   - Branched, deciduous trees w/ fan-shaped lvs on short shoots
   - Leaf venation dichotomous
   - Dioecious
   - Male sporangia in pendulous strobilus
   - Ovules on forked, pendulous peduncle
II. Seed plants (spermatophytes)
A. Gymnosperms
   3. Conifers
   • Trees or shrubs with needle-like or scale-like lvs
   • Mostly evergreen
   • Resin canals
   • Dioecious or monoecious
   • Male sporangia in strobilus
   • Ovules on branched strobilus called a “cone”

II. Seed plants (spermatophytes)
A. Gymnosperms
   3. Conifers
   Male strobili
   Female cone

II. Seed plants (spermatophytes)
A. Gymnosperms
   3. Conifers
   Male strobili
   Female cone

II. Seed plants (spermatophytes)
A. Gymnosperms
   3. Conifers
   Male strobili
   Female cone
II. Seed plants (spermatophytes)

A. Gymnosperms
3. Conifers

- Taxaceae (yew family)
  - Lvs needle-like
  - Small cone with 1-fertile scale w/ 1 seed
  - Fleshy aril from funiculus

- Taxus

II. Seed plants (spermatophytes)

B. Angiosperms or flowering plants

- Ovules concealed by carpels comprising pistil(s) at pollination
  - seeds in fruits
- "Flowers"
- Plants variable in habit