

Introduction to Botany. Lecture 31

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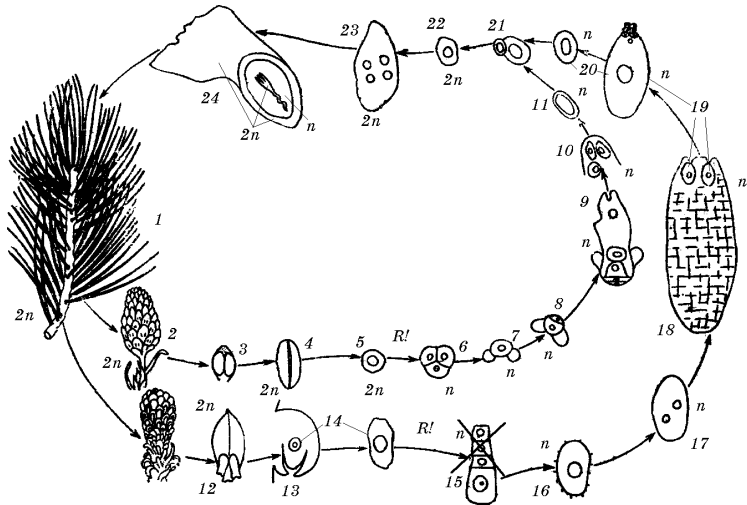
Outline

- 1 Spermatophyta: seed plants
 - Conifers
 - Gnetophytes

Pinopsida

- Three orders, several families and ≈ 600 species
- Mostly temperate evergreen trees, but some are deciduous (like *Larix*, *Pseudolarix*, and all family Taxodiaceae)
- Stem with large amount of xylem, relatively small cork and minute pith
- Ovules are always attached to specialized leaves (seed scales) and together with bract scales they are compacted in cones; microsporangia are attached to microsporophylls and also occur in cones of simpler structure
- Male gametes without flagella (spermata), consequently, pollen grains grow into **pollen tubes**
- Female gametophyte is more reduced than in cycads and *Ginkgo*
- Seeds are wind- and animal-distributed, life cycle shorter but still up to two years

Life cycle of *Pinus*



Pinopsida orders and families

- Pinales
 - **Pinaceae.**
- Araucariales—grow mostly in tropics or in South Hemisphere.
 - Araucariaceae
 - Podocarpaceae
- Cupressales
 - Sciadopityaceae
 - **Cupressaceae** (incl. Taxodiaceae)
 - Cephalotaxaceae
 - **Taxaceae**

Pinaceae

- Have resin and needle-like leaves, often in shortened shoots, **brachyblasts**. Large cones with paired (seed and bract) scales.
- Biggest conifer family, include large genus *Pinus* (pine) and other genera like *Larix* (larch), *Cedrus* (cedar), *Picea* (spruce), *Abies* (fir) etc.

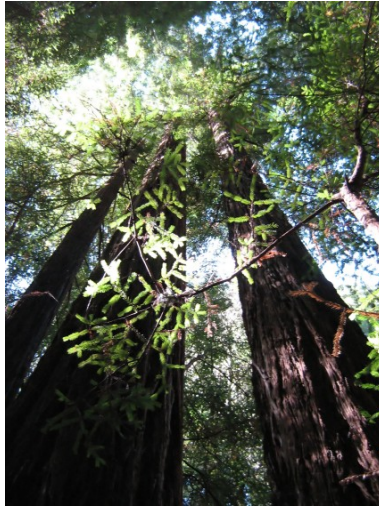
Cupressaceae and Taxaceae

- **Cupressaceae**—cypress family. No resin. Cones are small, with fused bract and seed scales. Leaves are dimorphic, needle-like and scale-like. Part of genera (formerly belong to Taxaceae family) are deciduous but with branches instead of leaves. Genera: *Cupressus* (cypress), *Juniperus* (juniper), *Taxodium* (bald cypress), *Sequoia* (coastal red cedar), *Sequoiadendron* (mountain red cedar), *Metasequoia* etc.
- **Taxaceae**—yew family. Female cones are modified in berry-like structures with one enlarged red scale. Leaves are needle-like. No resin. *Taxus* (yew) provides famous reddish-brown, springy wood.

Pseudolarix amabilis (Pinaceae), spring



Sequoia sempervirens (Cupressaceae)



Taxus baccata, Taxaceae



Gnetopsida

- Small class of only three genera (*Ephedra*, *Welwitschia*, *Gnetum*), which are so different that botanists place them in different orders (and sometimes even subclasses).
- Tropical trees (*Gnetum*) or desert shrubs (*Ephedra*) or nobody-knows-what (*Welwitschia*)
- Stem structure is similar to conifers but *Gnetum* and *Welwitschia* have vessels (like angiosperms)
- Ovules are solitary, **covered with additional outer integument** (however, **this is not a pistil** because micropyle come out of this cover)
- Male gametes are spermatia, have pollen tube and **no archegonia** in *Gnetum* and *Welwitschia* (like in angiosperms). Multiple fertilization and polyembryony is widespread, *Ephedra* even has a double fertilization (like angiosperms). Only one embryo survives, other are eaten (endosperm₂). Also have endosperm₁ (female gametophyte).
- *Welwitschia* is insect-pollinated, other are wind-pollinated like most non-angiosperms.
- Seeds are animal-dispersed (except *Welwitschia*).
- Amazingly, molecular data show relations with conifers, not with angiosperms!

Gnetum

- Tropical shrubs, vines or small trees (30–35 species) with opposite leaves with pterodromous venation (like angiosperms again!). However, investigation of leaf development showed that initially leaf had dichotomous venation (like *Ginkgo* and some conifers).
- Dioecious plants, male and female structures (fructifications) are catkin-like
- Seeds big, colored

Gnetum seeds



Gnetum female fructifications



Gnetum male fructifications



Welwitschia

- One species occurring in Namibian desert (South Africa)
- Life form is completely unusual, the best description is “overgrown seedling”: small trunk with only two (constantly growing on the basement and degrading on top) wide leaves with parallelodromous venation. Secondary thickening anomalous (like in cycads). Wood with vessels.
- Insect-pollinated (!) dioecious plants
- Fructifications are cone-like; male one is similar to flower and contain sterile ovule (!)
- Seeds are wind-dispersed

Welwitschia



Welwitschia



Welwitschia female cones



Welwitschia male cones



Welwitschia pollinators: *Odontopus sexpunctulatus* bug



Ephedra

- ≈ 35 species growing in dry places across all North Hemisphere and also in South America
- Shrubs or small trees, leaves are usually reduced to scales, stems are articulate (like horsetails). Wood is similar to conifers.
- Plants are monoecious or dioecious, male and female (bisexual also occur) fructifications are short, covered with thick scales
- Wind-pollinated, animal dispersed
- *Ephedra sinensis* is a source of pharmaceutically important **ephedrine**
- In all, *Ephedra* is more primitive than two other genera of Gnetopsida: wood does not contain vessels, ovule has large archegonia

Ephedra



Ephedra female fructification



Ephedra male fructification



Ephedra seeds



Spermatophyta classes (and genera)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Ginkgoopsida	0	0	1	0	0	0	1	1	0	1	0	0	0
Cycadopsida	1	0	0	0	1	0	1	1	0	1	0	1	0
Pinopsida	0	1	1	0	1	0	0	1	0	1	0	0	1
<i>Gnetum</i>	1	0	1	1	0	0	0	0	0	1	1	0	0
<i>Welwitschia</i>	1	0	0	1	1	1	0	0	0	1	1	1	1
<i>Ephedra</i>	0	1	1	0	0	1	0	1	1	1	1	0	0
Angiospermae	1	0	0	1	0	1	0	0	1	0	1	1	1

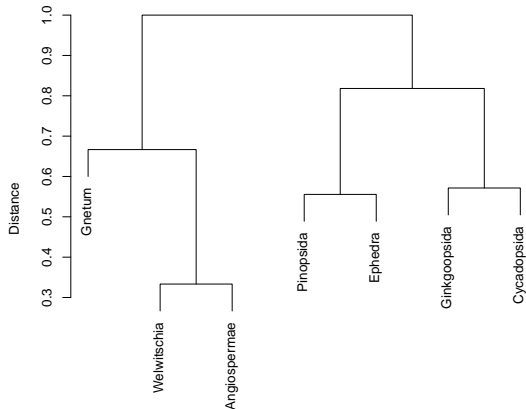
1 Tropical; 2 Leaves needle- or scale-like; 3 Coniferous wood; 4 Vessels; 5 Cones; 6 Bisexual fructifications; 7 Flagellate sperm (and micropylar chamber, and no pollen tube); 8 Archegonia; 9 Double fertilization; 10 Endosperm₁; 11 Endosperm₂; 12 Insect pollination; 13 Wind seed dispersion.

Characters are not necessary relevant to all members of class. Angiosperms characters taken from most primitive members (Magnoliidae subclass).

Make the dendrogram 1: table of dissimilarity

	Ginkgoopsida	Cycadopsida	Pinopsida	Gnetum	Welwitschia	Ephedra
Cycadopsida	0.5714286					
Pinopsida	0.5714286	0.6666667				
Gnetum	0.7142857	0.7777778	0.7777778			
Welwitschia	0.9090909	0.6000000	0.7272727	0.5555556		
Ephedra	0.6250000	0.8181818	0.5555556	0.6666667	0.7500000	
Angiospermae	1.0000000	0.8181818	0.9166667	0.6666667	0.3333333	0.7272727

Make the dendrogram 2: dendrogram



Summary

- Starting from Pinopsida, seed plants lost flagellate spermatozoa and micropylar chamber, and develop pollen tube
- Three genera of Gnetopsida are very divergent and morphologically close to angiosperms whereas molecular data place them close to conifers

For Exam 4



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

**Chapters 14, 21–24 + lecture notes 25–31 + Lab 10 +
knowledge about life cycles of land plants,
heterosporic plants and seed plants.**