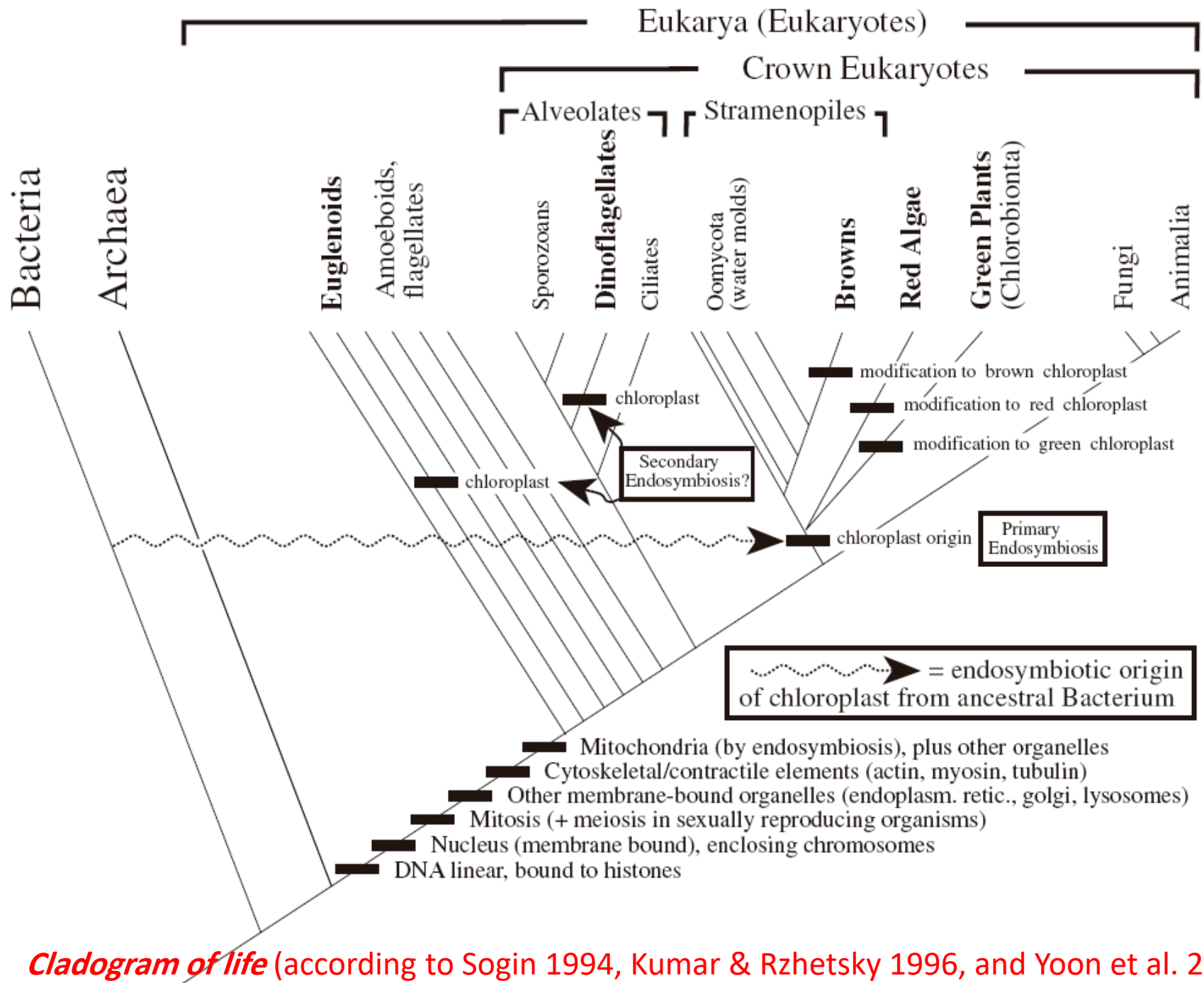


Plant Systematics

Firouzeh Bordbar



Cladogram of life (according to Sogin 1994, Kumar & Rzhetsky 1996, and Yoon et al. 2002)

Chlorobionta - green plants

Embryophytes - land plants*

Tracheophytes - vascular plants

Monilophytes

Spermatophytes - seed plants

Gymnosperms

Angiosperms

"Green Algae"

Liverworts

Hornworts

Mosses

Lycophytes

Equisetales

Marratiales

Polypodiales

Ophioglossales

Psilotales

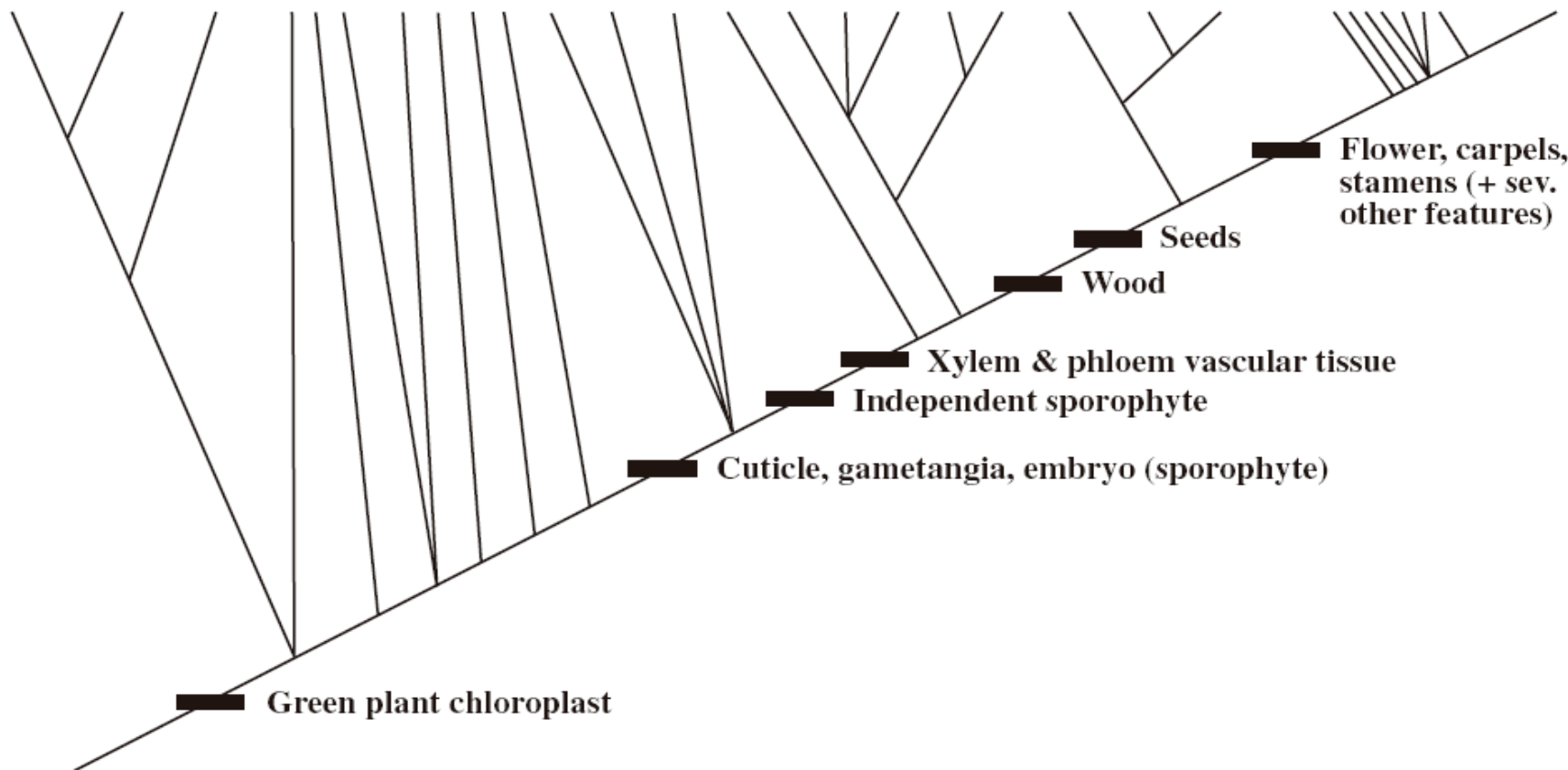
Cycads

Ginkgo

Conifers
(incl. Gnetales)

Monocots

Eudicots



Green plant chloroplast

Cuticle, gametangia, embryo (sporophyte)

Xylem & phloem vascular tissue

Independent sporophyte

Wood

Seeds

Flower, carpels,
stamens (+ sev.
other features)

A summary of the different kinds of proposed classification schemes presented in this article is summarized in the table below.

The kingdom-level classification of life is still widely employed as a useful way of grouping organisms

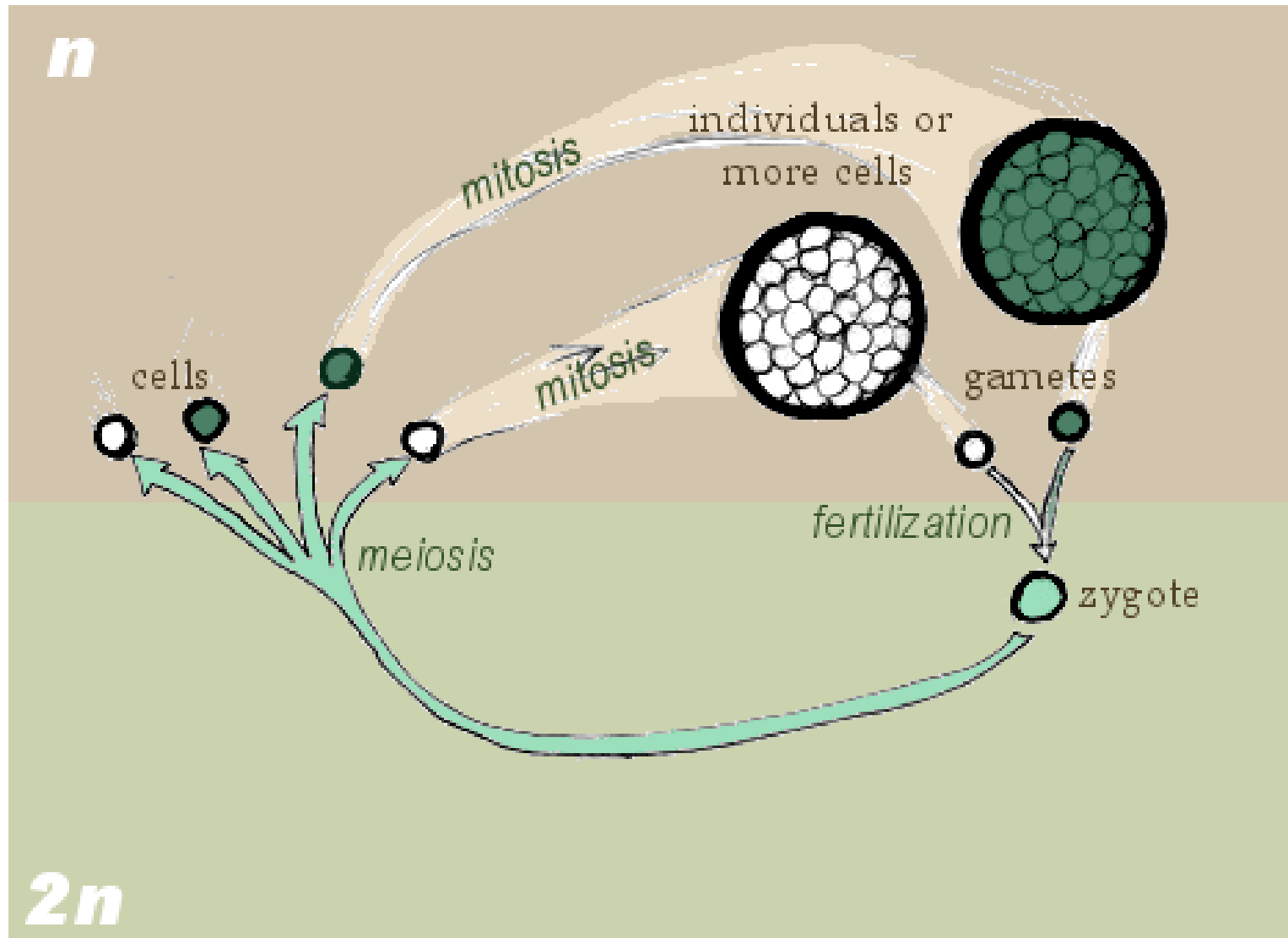
Linnaeus 1735 ^[1]	Haeckel 1866 ^[29]	Chatton 1925 ^{[30][31]}	Copeland 1938 ^{[32][33]}	Whittaker 1969 ^[22]	Woese et al. 1977 ^{[4][34]}	Woese et al. 1990 ^[35]	Cavalier-Smith 1993 ^{[36][37][38]}	Cavalier-Smith 1998 ^{[39][25][40]}
---	---	---	--	---	---	--	--	--

2 kingdoms	3 kingdoms	2 empires	4 kingdoms	5 kingdoms	6 kingdoms	3 domains	8 kingdoms	6 kingdoms
					Eubacteria	Bacteria	Eubacteria	
		Prokaryota	Monera	Monera	Archaeobacteria	Archaea	Archaeobacteria	Bacteria
<i>(not treated)</i>	Protista						Archezoa	
			Protista	Protista	Protista		Protozoa	Protozoa
		Eukaryota				Eucarya	Chromista	Chromista
Vegetabilia	Plantae		Plantae	Plantae	Plantae		Plantae	Plantae
				Fungi	Fungi		Fungi	Fungi
Animalia	Animalia		Animalia	Animalia	Animalia		Animalia	Animalia

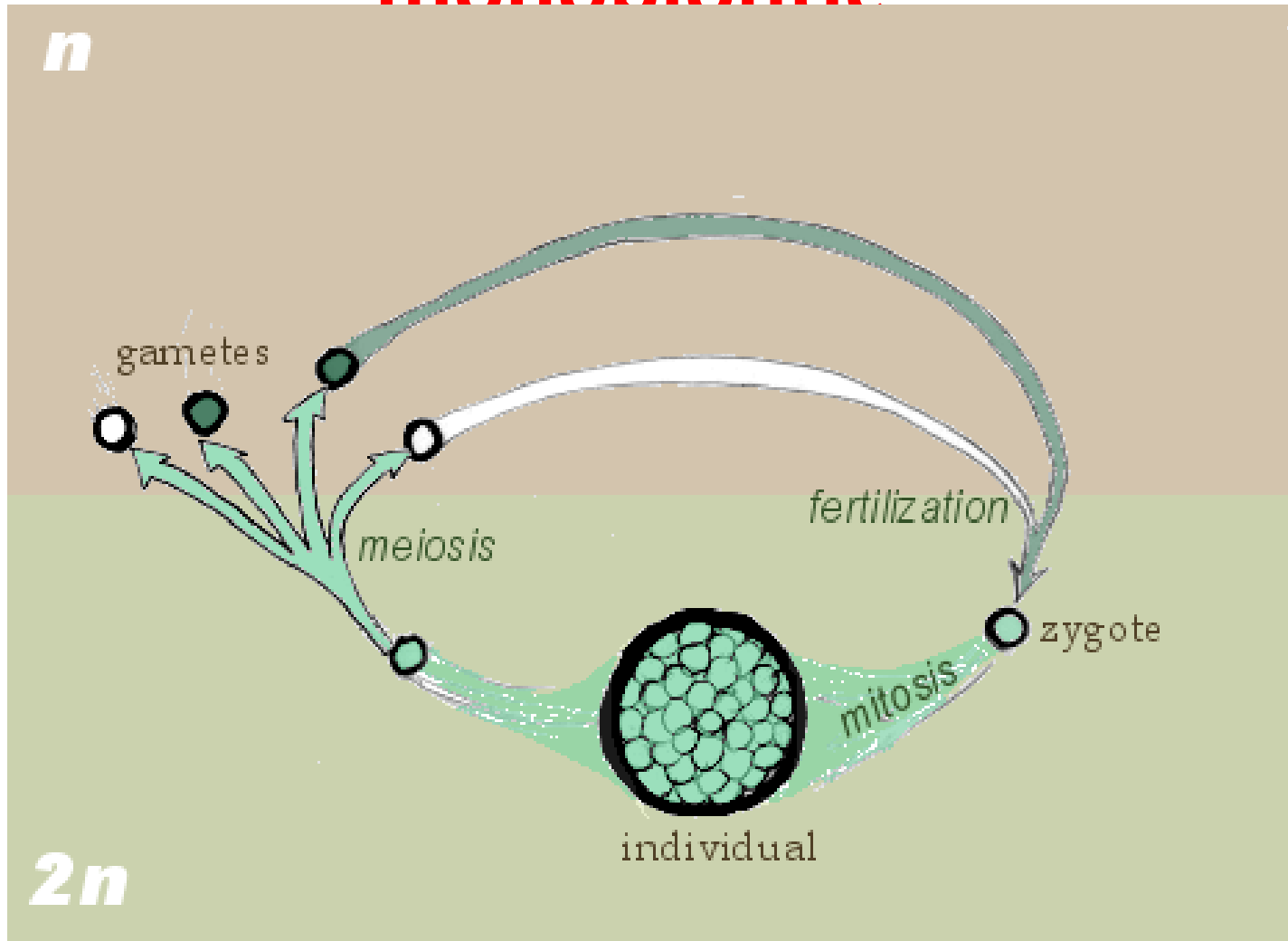
Life cycles

- **monobiontic** - a life cycle of one free-living phase
- **diplobiontic** - a life cycle of two free-living phases.
- **haplontic**- a life cycle in which the dominant phase is haploid
- **diplontic** - a life cycle in which the dominant phase is diploid

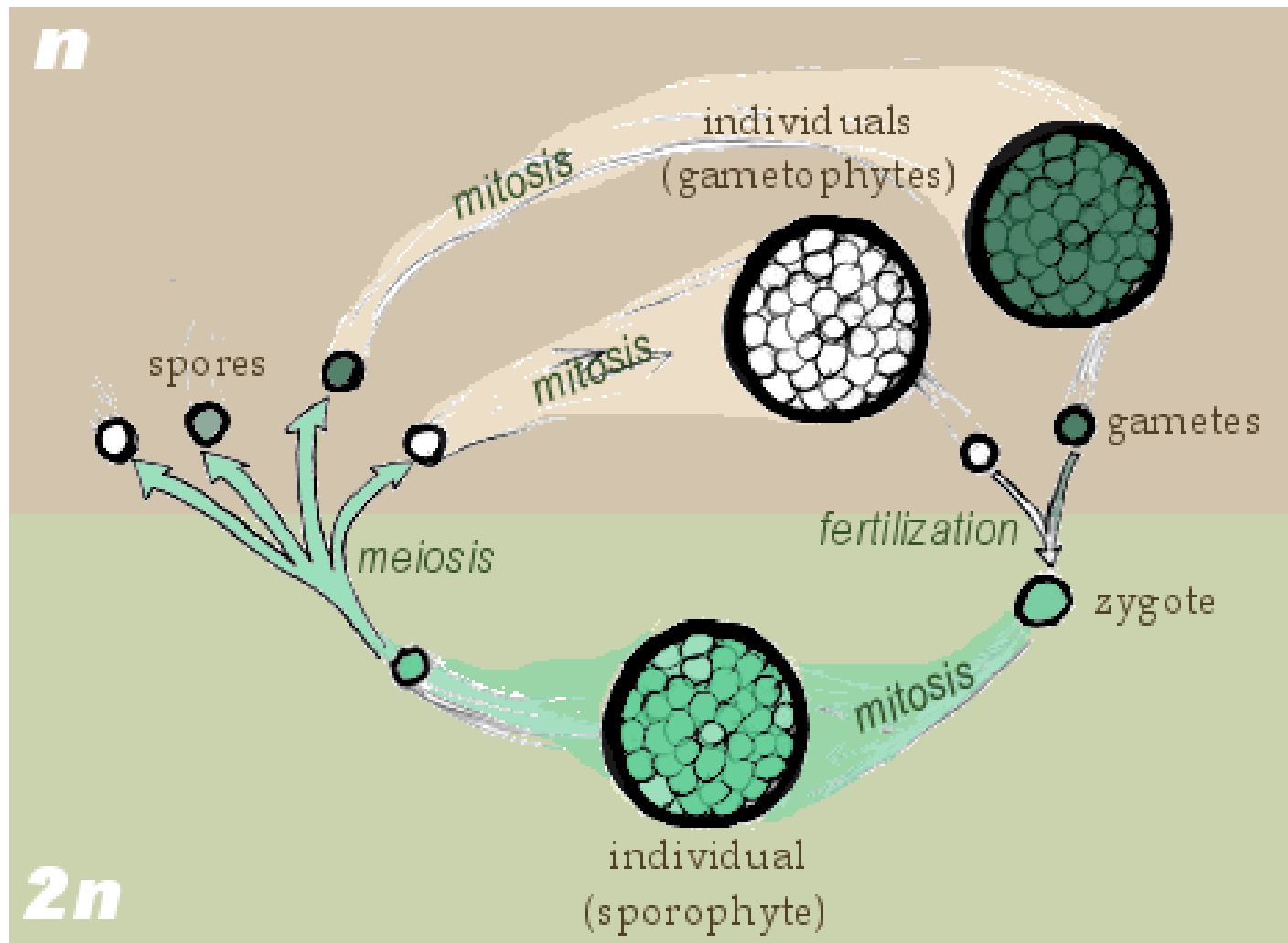
Haplontic monobiontic



Diplontic monobiontic



Haplodiplontic diplobiontic dibiontic





Anthocerotopsida

علفهای شاخی

Hornworts

Anthoceros laevis



Hepaticopsida
علفهای جگری
Liverworts

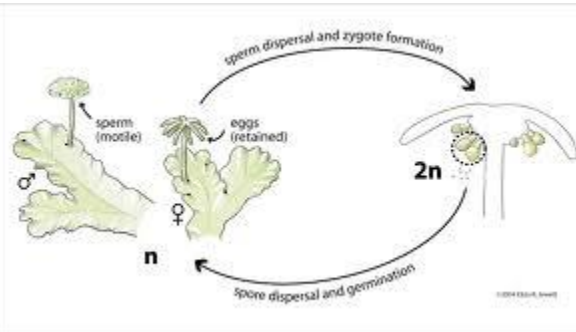
Marchantiidae



Jungermanniidae



پروپاگول



Machantia polymorpha

Jungermannia sp.

Bryopsida

Sphagnidae



Sphagnum sp.

Andreaeidae

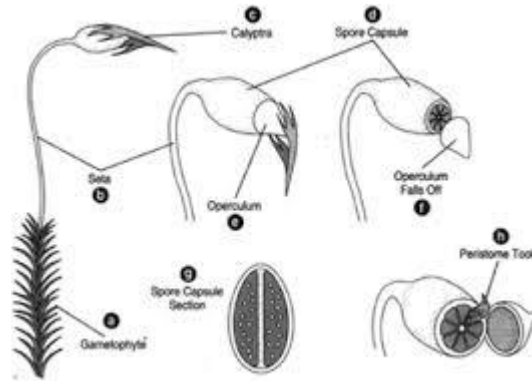
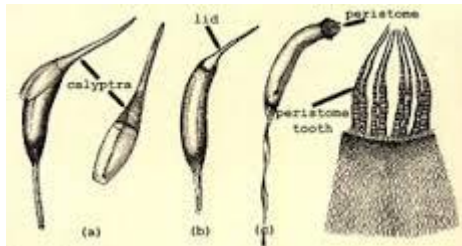


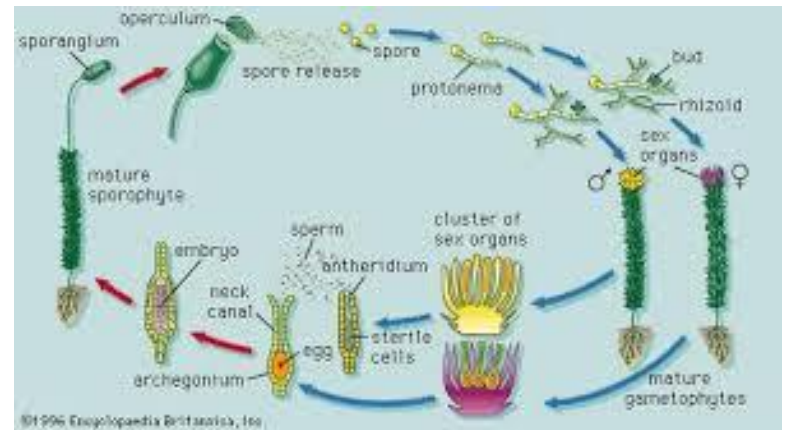
Andreaea sp.

Bryidae

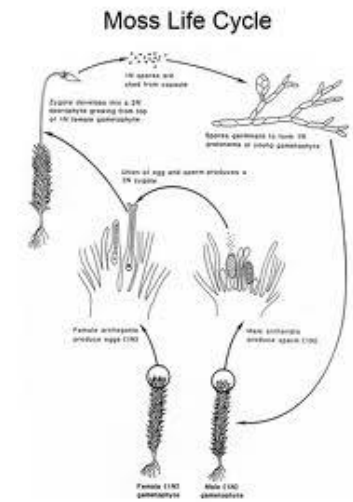
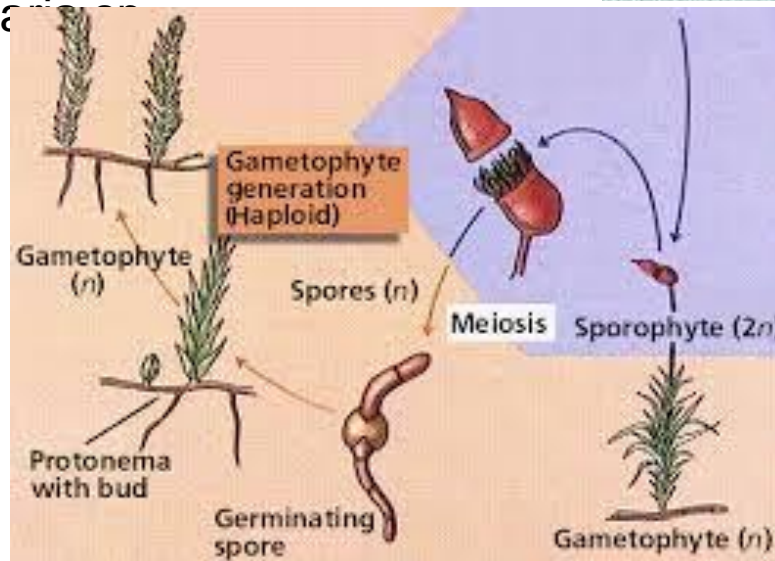


Polytrichum sp.





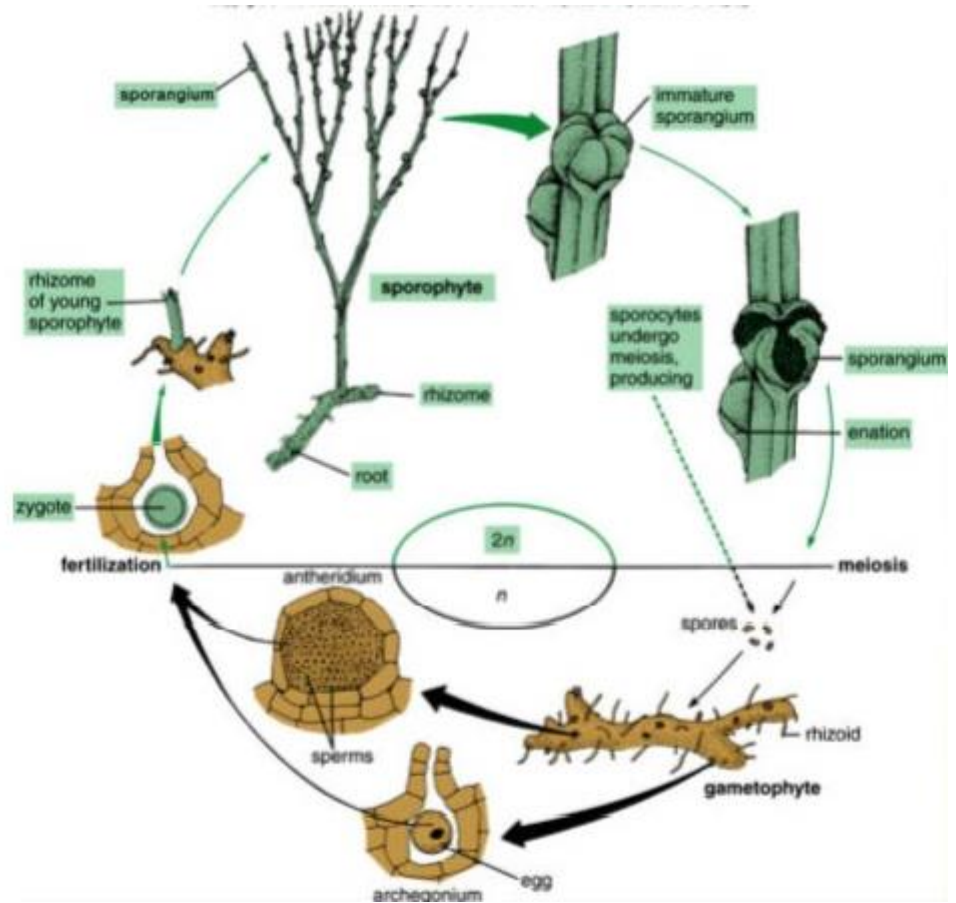
Function



Psilotophyta



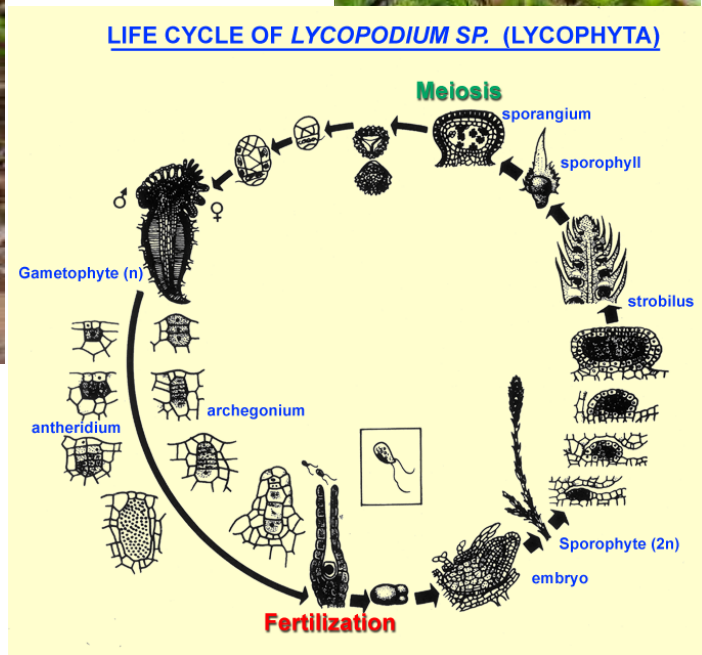
Psilotum nudum



Tmesipteris tannensis

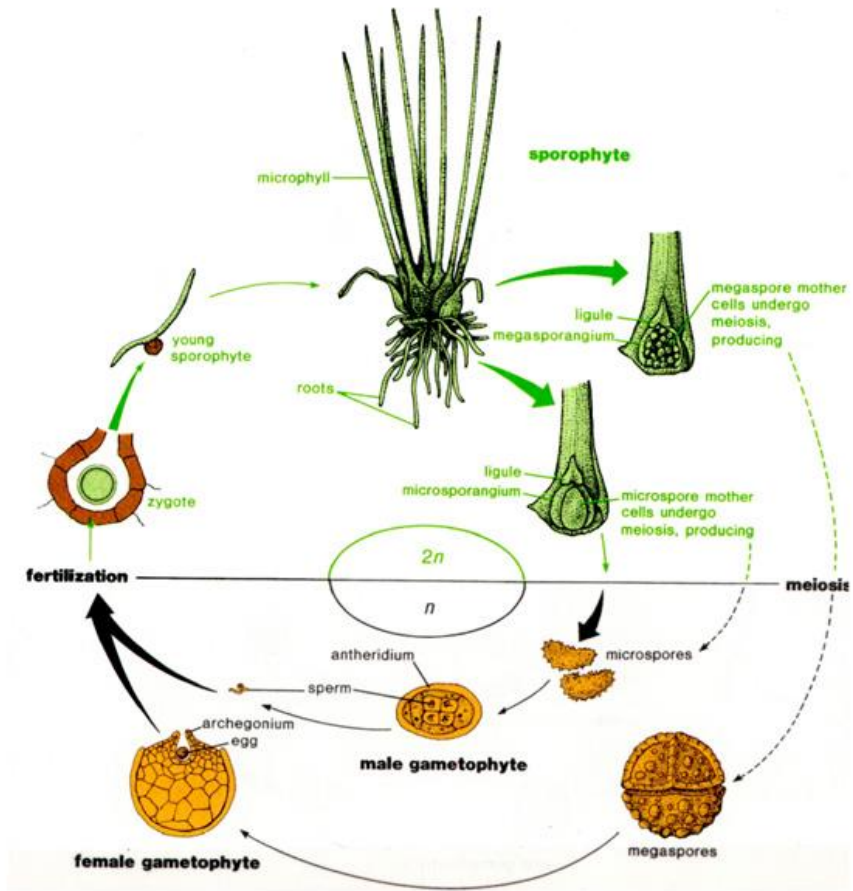


Lycopodiophyta
 Lycopodiopsida
 Lycopodiaceae
Lycopodium

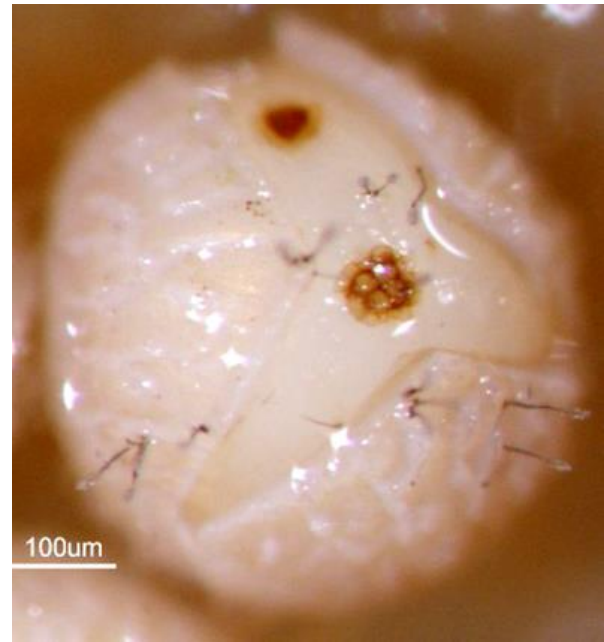


Isoetopsida
Isoetaceae
Isoetes

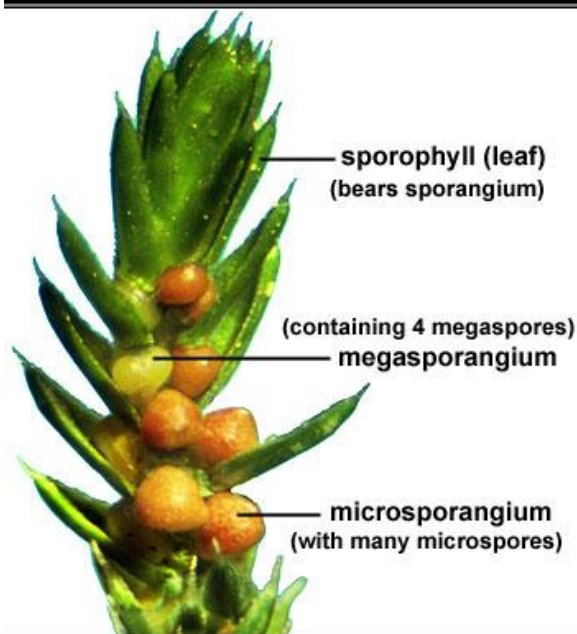




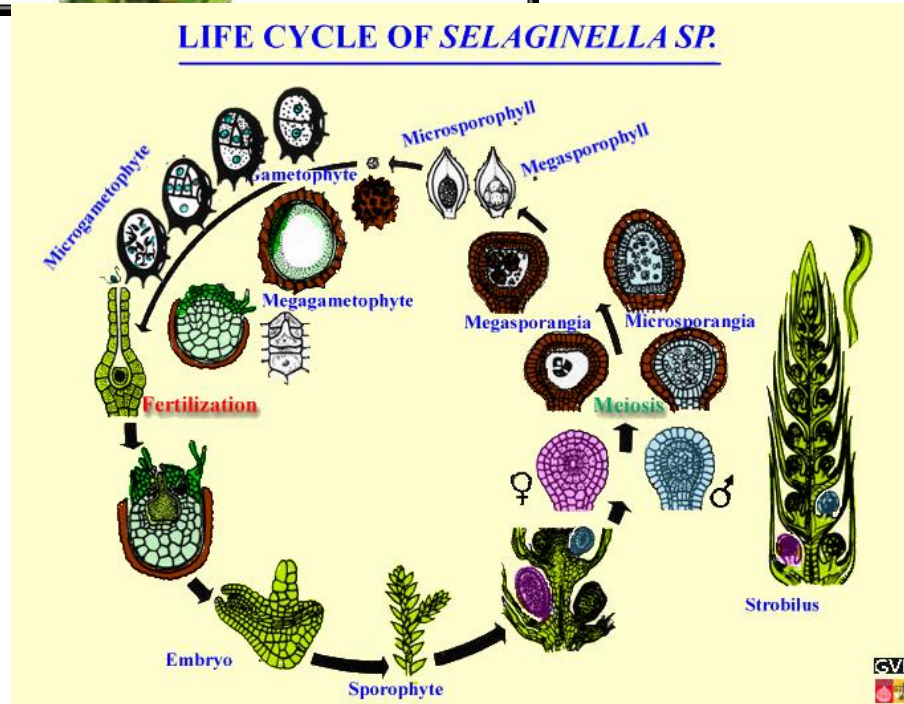
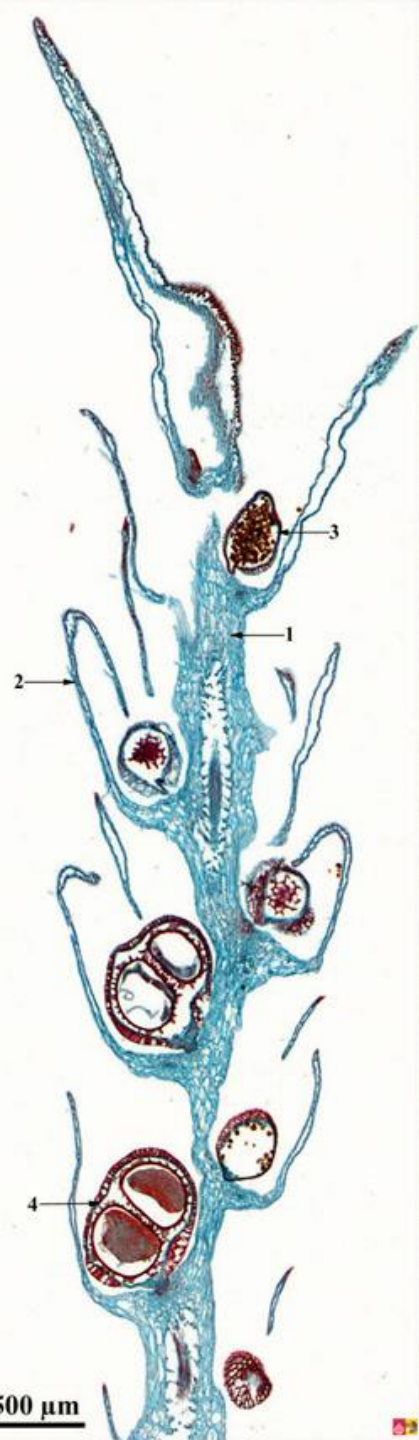
megaspore (female) illustrating small gametophyte (dark orange). Dark filaments are fungal hyphae.



Selaginellaceae



Selaginella sp.



Equisetophyta

Equisetaceae

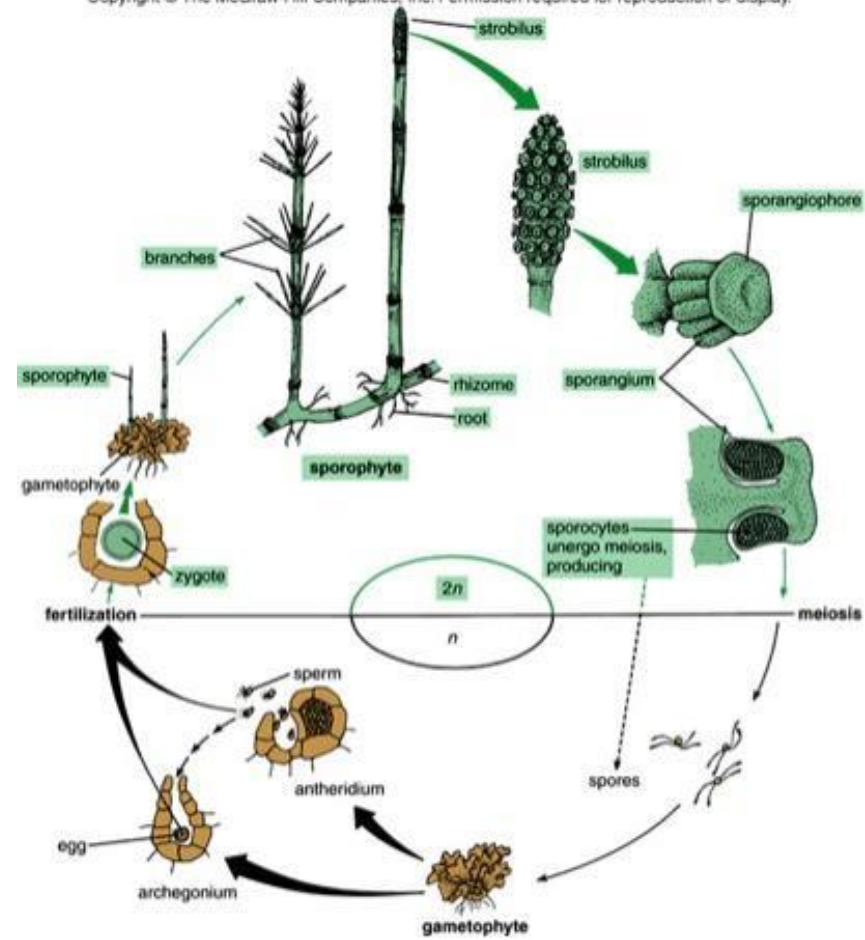
Equisetum



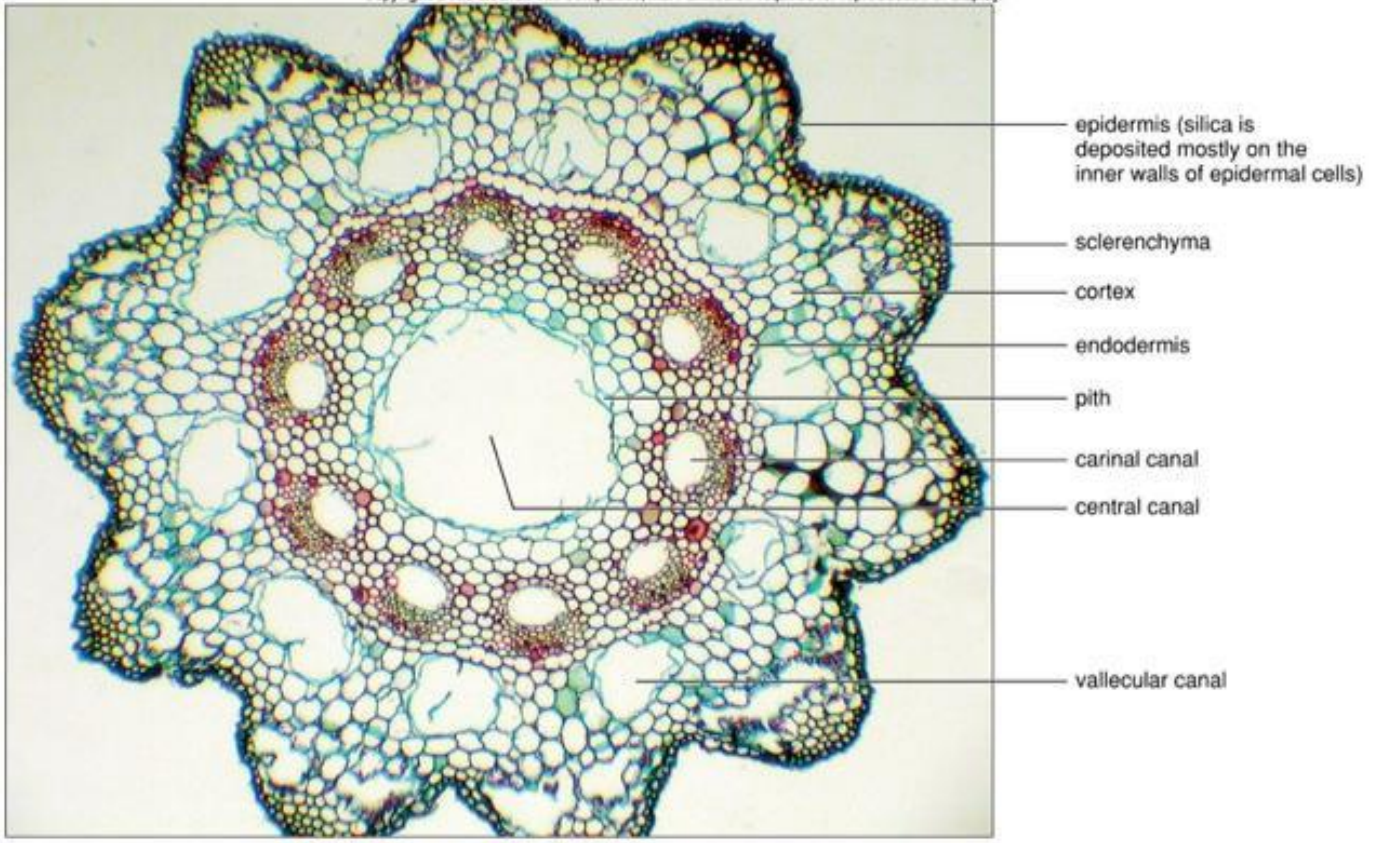
Equisetum x schaffneri
Equisetaceae
© G. D. Carr

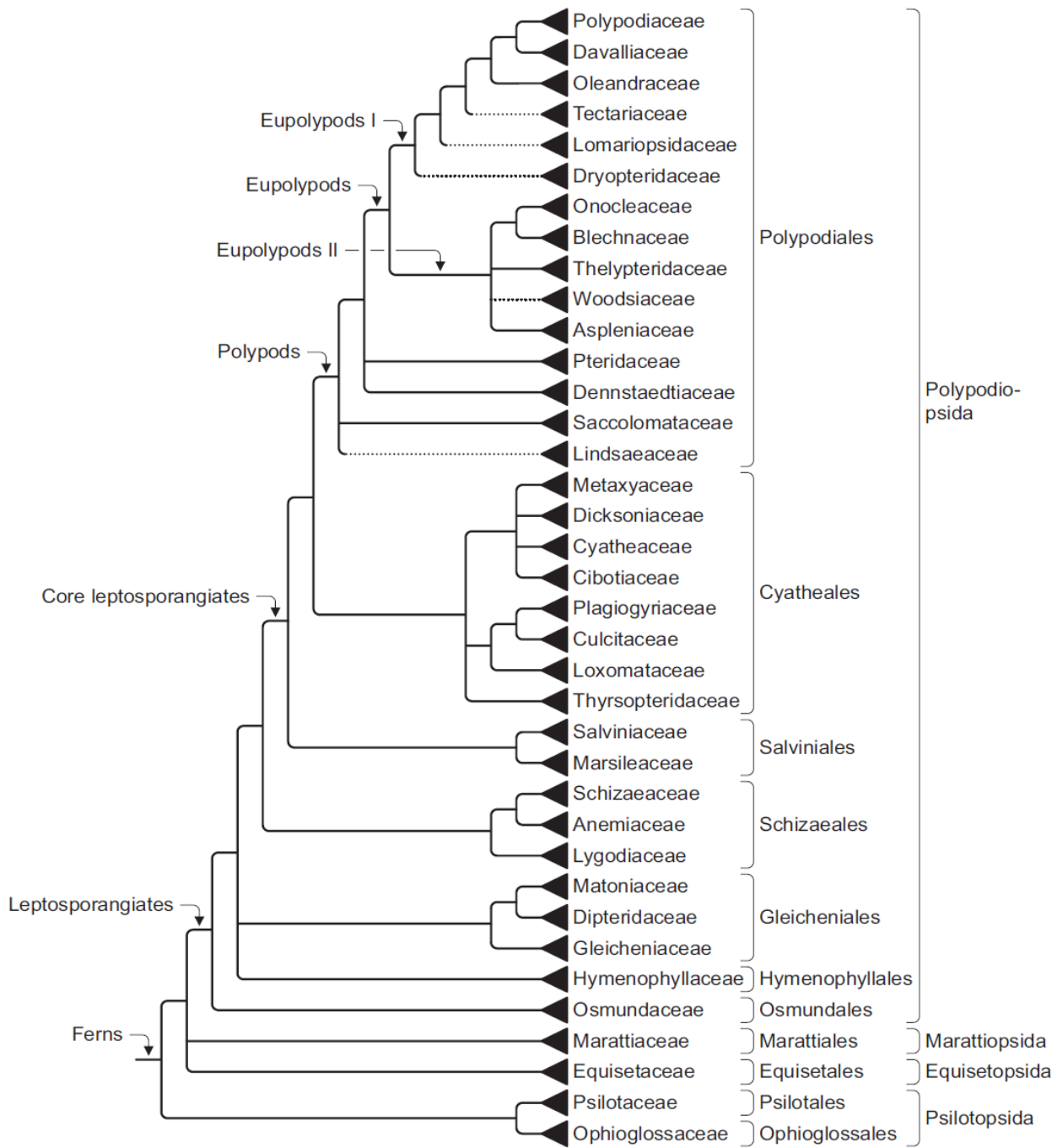


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Polypodiophyta
Ophioglossopsida
Ophioglossaceae



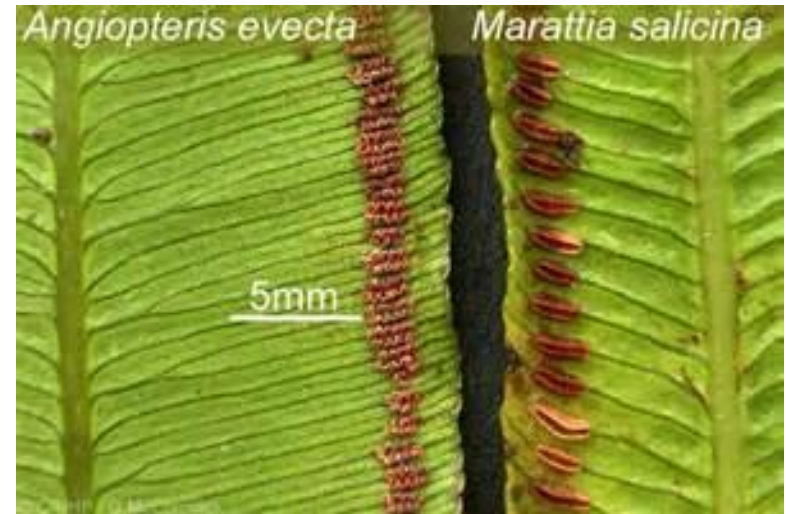
Ophioglossum sp.



Botrychium sp.

Marattiopsida

Marattiaceae



Polypodiopsida
Filicopsida
Polypodiidae
Osmundaceae



Osmunda regalis



Aspleniaceae



Asplenium adiantum-nigrum



Asplenium trichomanes



Phyllitis scolopendrium

Polypodiaceae



Polypodium vulgare
P. interjectum

Pteridaceae



Pteris sp.



Adiantum capillus veneris

Marsileidae
Marsiliaceae



Marsilea sp.

Salviniaceae



Salvinia sp.



Azolla sp.

Cyatheaceae



Dryopteridaceae



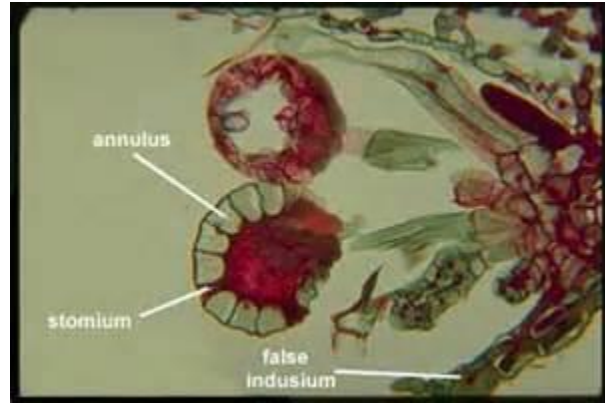




FIGURE 4.24 Polypodiales Leptosporangiate ferns. A. *Polypodium californicum*, an indusiate species. B. *Polypodium aureum*, sorus close-up. C. *Cibotium* sp., a tree fern, showing indusia at margin of pinnules. D. *Dryopteris arguta*, with orbicular-reniform indusiate sori on leaf surface. E. *Nephrolepis cordifolia*, close-up of indusium and sorus of leptosporangia. F. *Adiantum jordanii*, with false indusia. G. *Adiantum capillus-veneris*, close-up of false indusia. H. Close-up of leptosporangia. I. Leptosporangium in sagittal section, showing annulus and internal spores. Note single cell layer of wall.

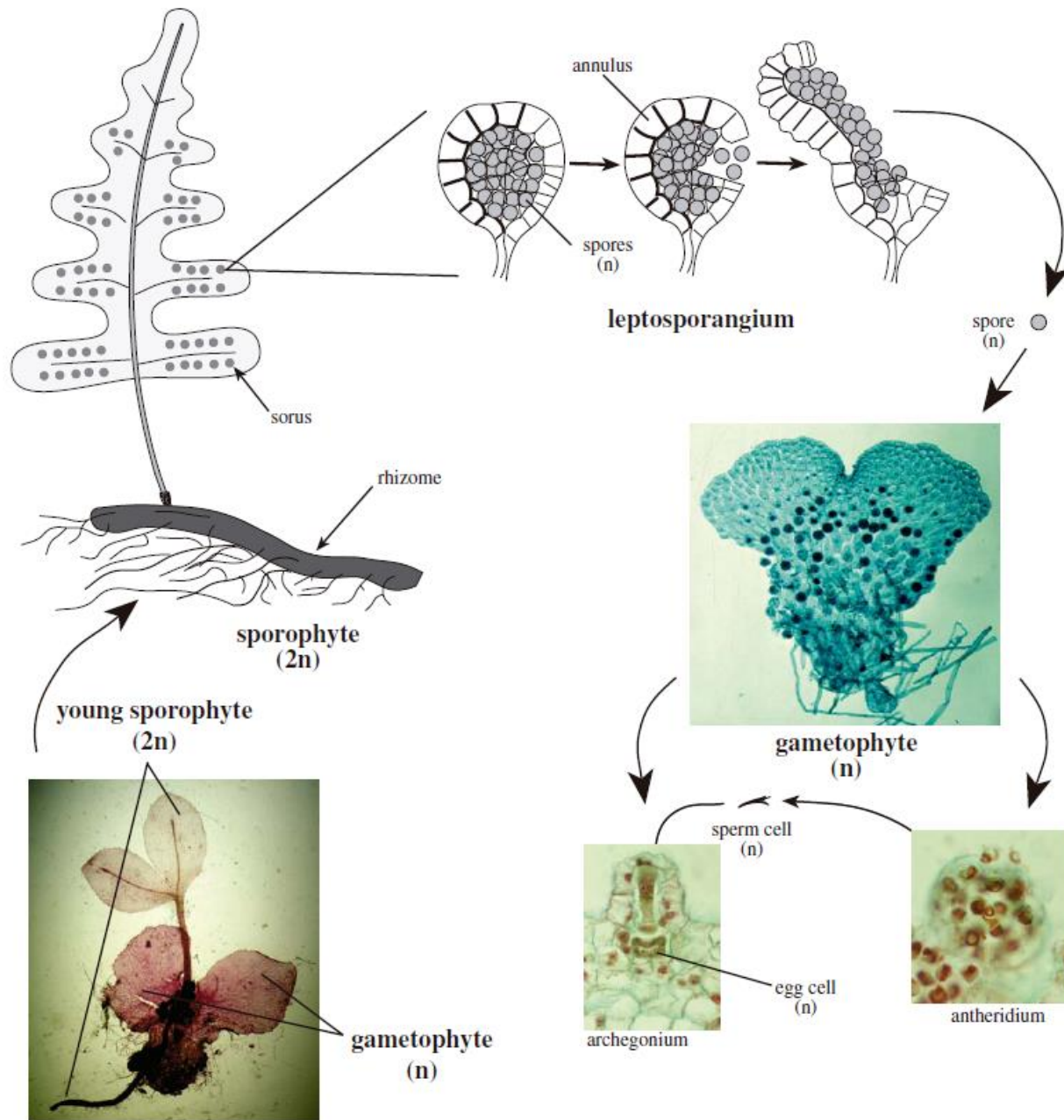
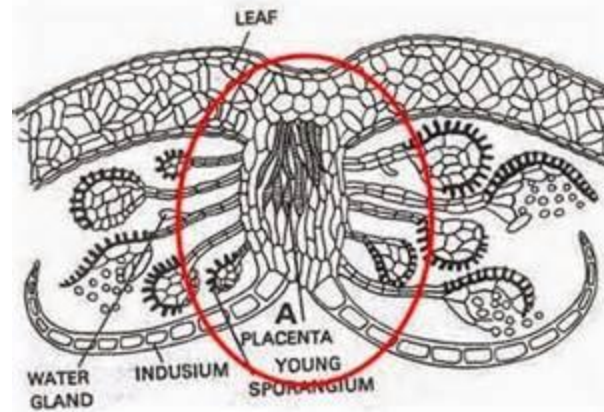
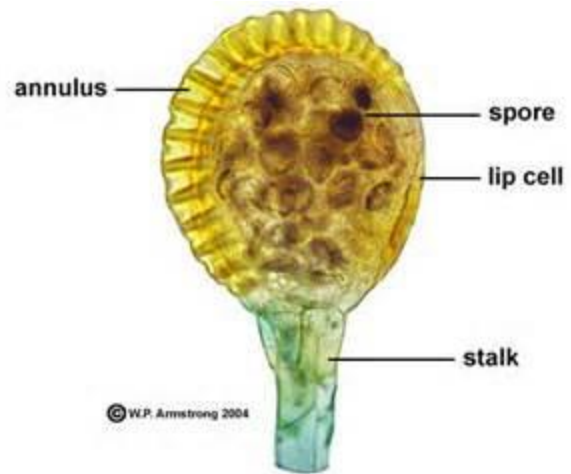
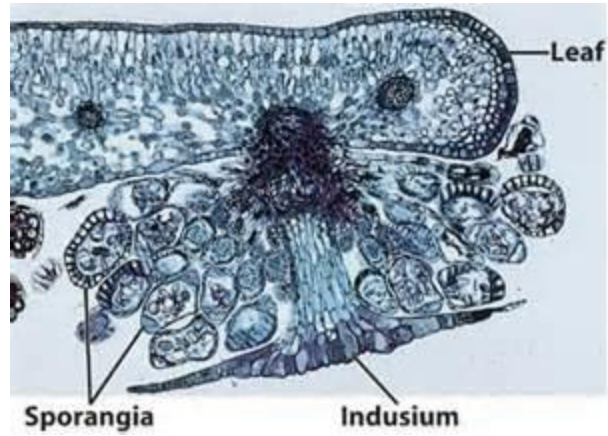
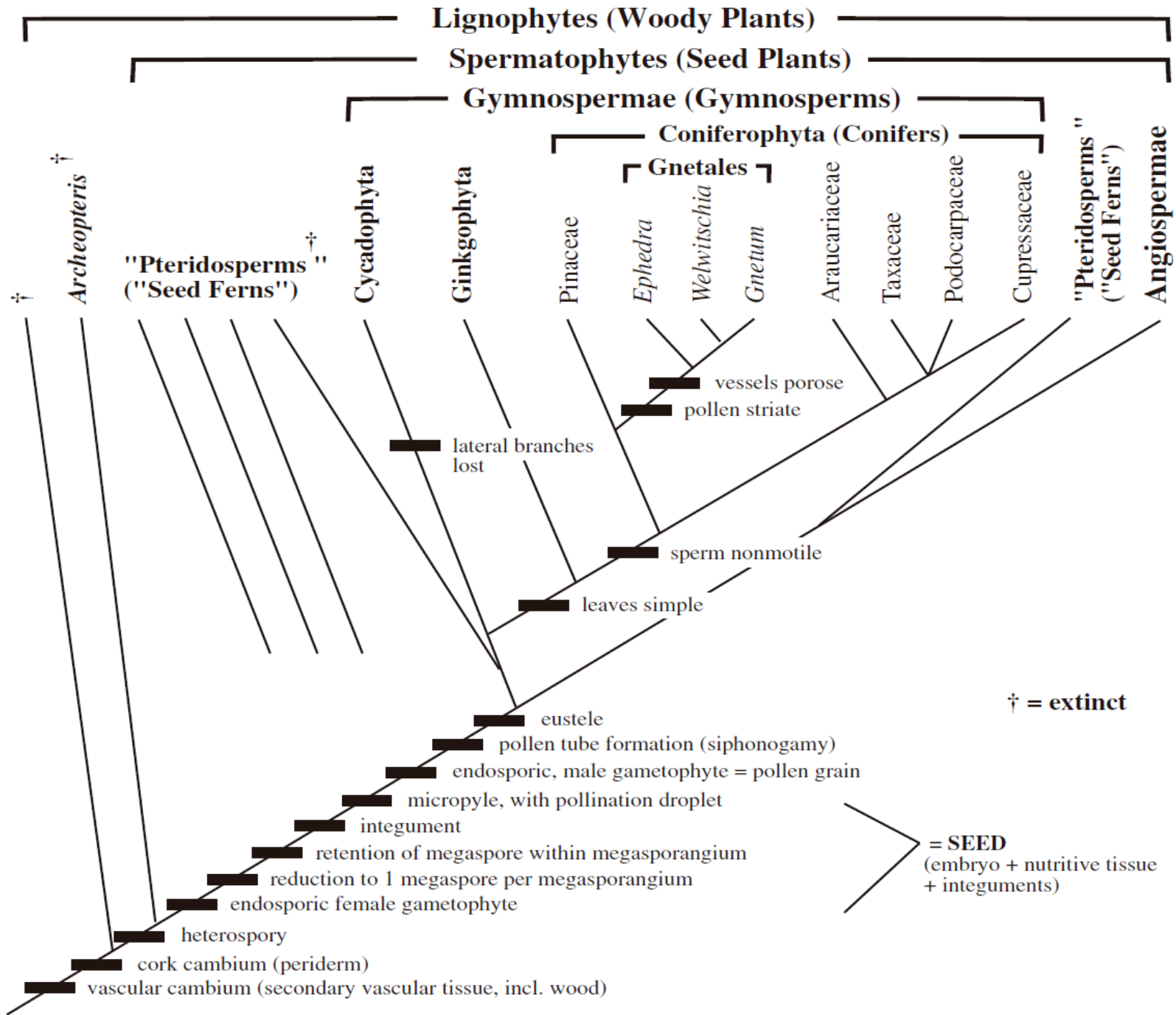


FIGURE 4.25 Life cycle of leptosporangiate ferns. Note mechanism of spore dispersal, gametophyte development, fertilization, and sporophyte development.

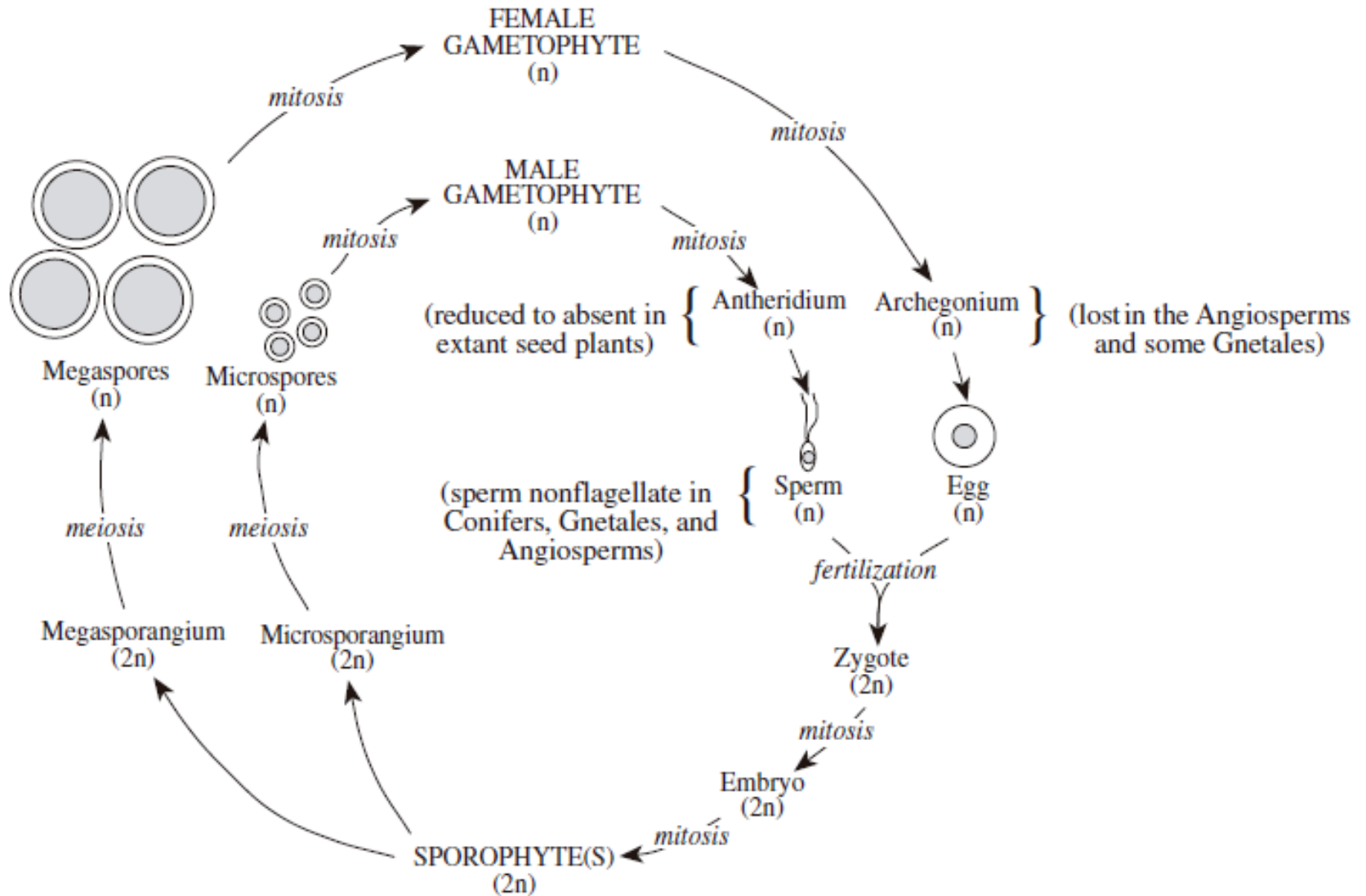


بازدانگان

Gymnospermae
(Gymnosperms)



Life cycle of heterosporous plants



Cycadophyta
Cycadopsida
Cycadales
Cycadaceae
Cycas revoluta
C. circinalis

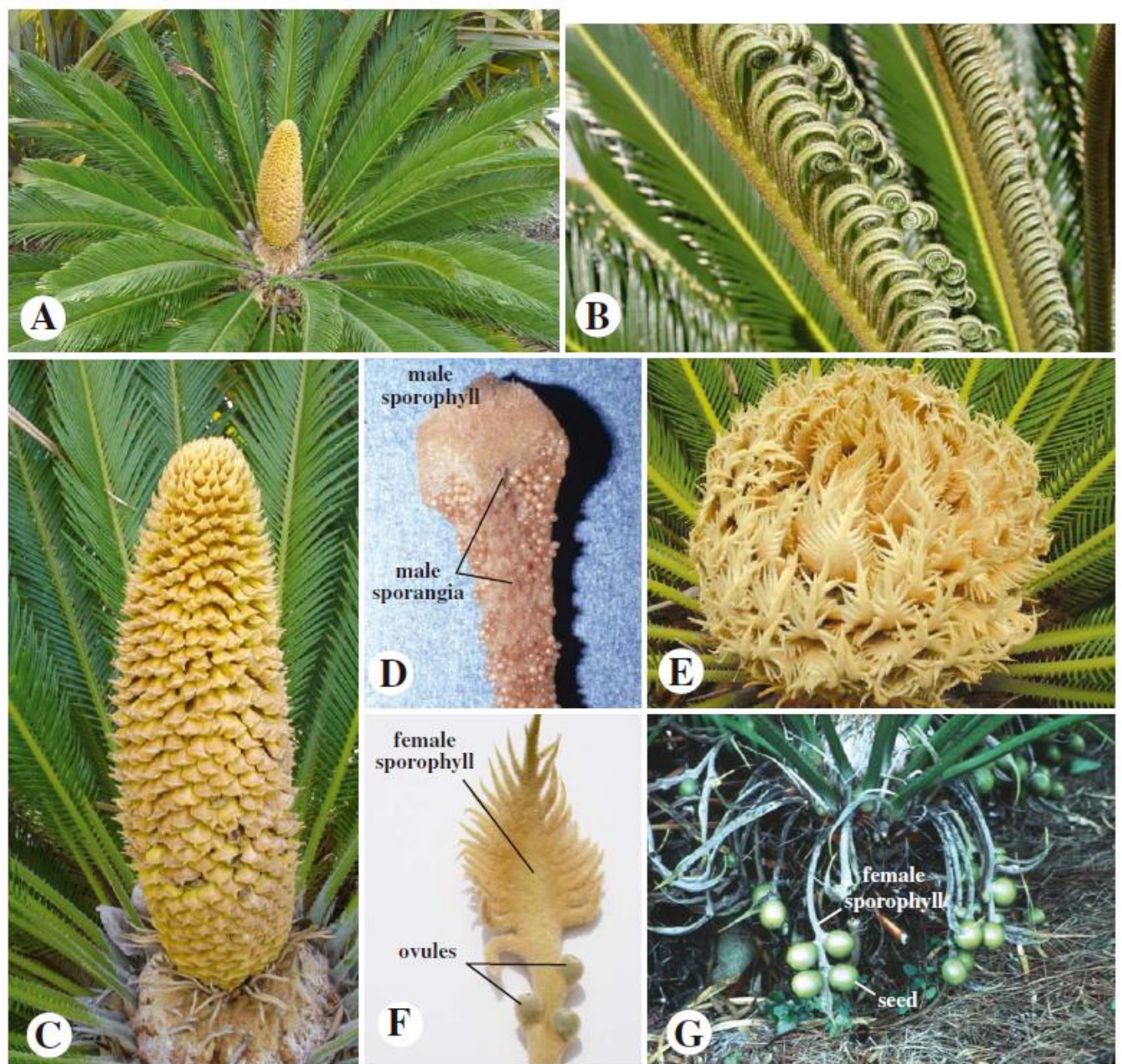
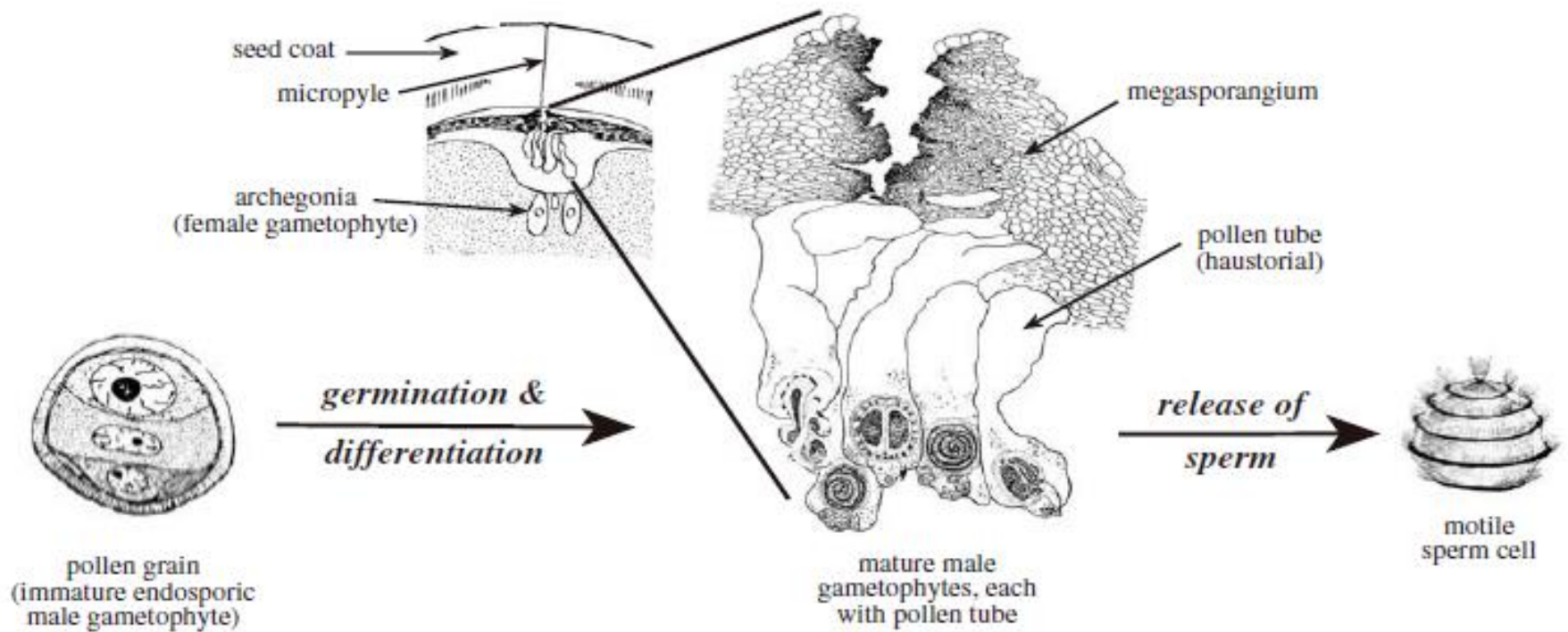


FIGURE 5.17 Cycad reproduction. Cycadaceae (*Cycas*). A–F. *Cycas revoluta*, sago palm. A. Male individual with male cone. B. Leaves with circinnate vernation. C. Close-up of male cone. D. Male sporophyll with sporangia. E. Female individual, showing aggregate of female sporophylls (cones lacking). F. Female sporophyll with marginal, immature seeds. G. *Cycas circinalis*, female, showing mature female sporophylls with seeds (cones lacking).



Male gametophyte morphology and development in the non-flowering Spermatophytes; *Cycas* sp.

Ginkgophyta
 Ginkgopsida
 Ginkgoales
Ginkgoaceae
Ginkgo biloba

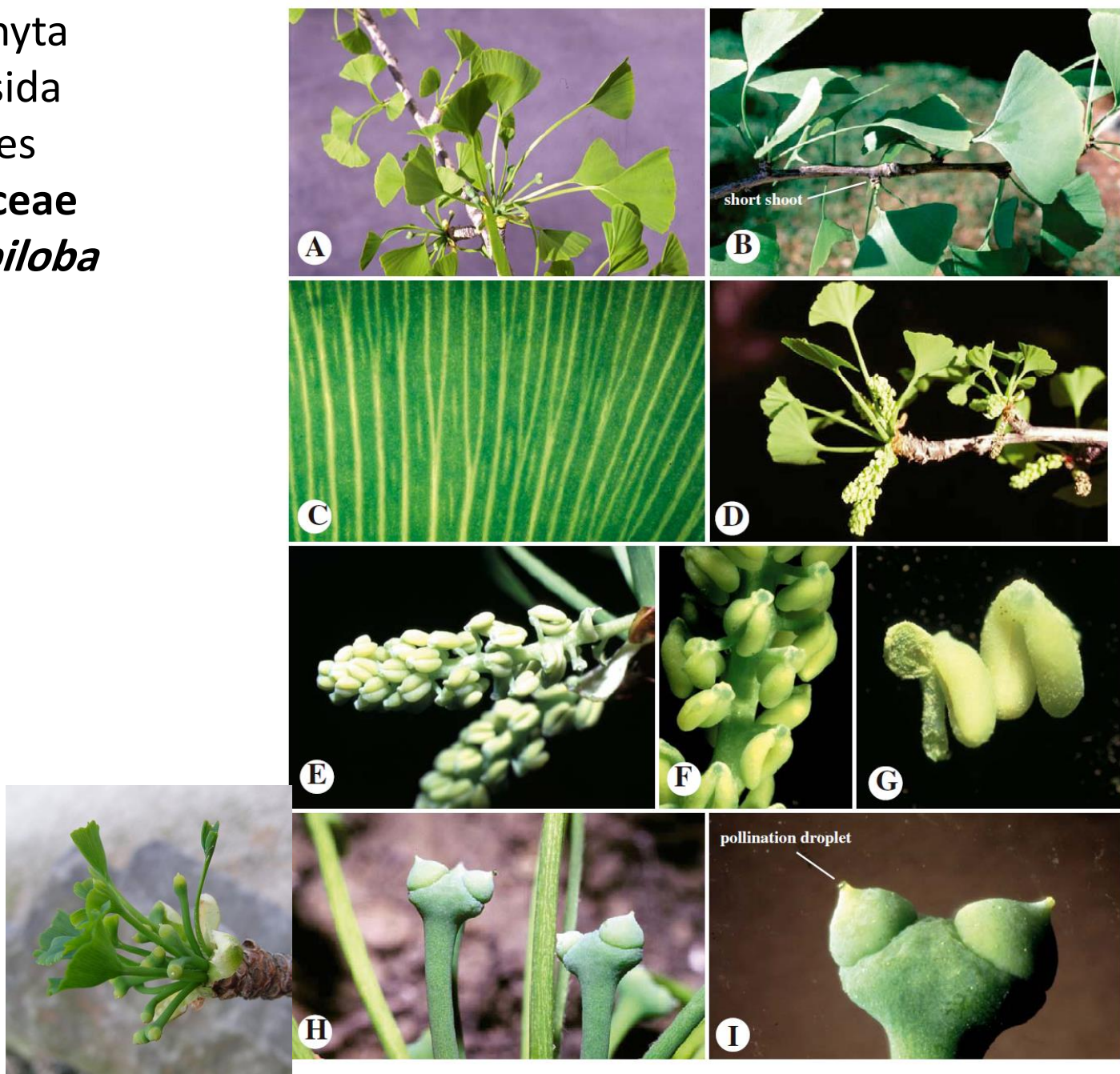


FIGURE 5.19 *Ginkgo biloba*. A,B. Vegetative growth. Note fan-shaped leaves, clustered into short shoots. C. Leaf close-up, showing dichotomous venation. D. Male tree bearing male cones. E. Male cone. F,G. Close-up of male sporangia, born in pairs on stalk arising from central axis of male cone. H. Female plant bearing stalk with pair of ovules. I. Close-up of ovule pair. Note pollination droplet from micropyle.



Ginkgo biloba [Eocene](#) leaf from the McAbee, [BC](#), Canada



Coniferophyta

Pinaceae



Abies sp.



Picea sp.



Pinus sp.



Cedrus sp.



Larix sp.



Araucaria sp.
Araucariaceae

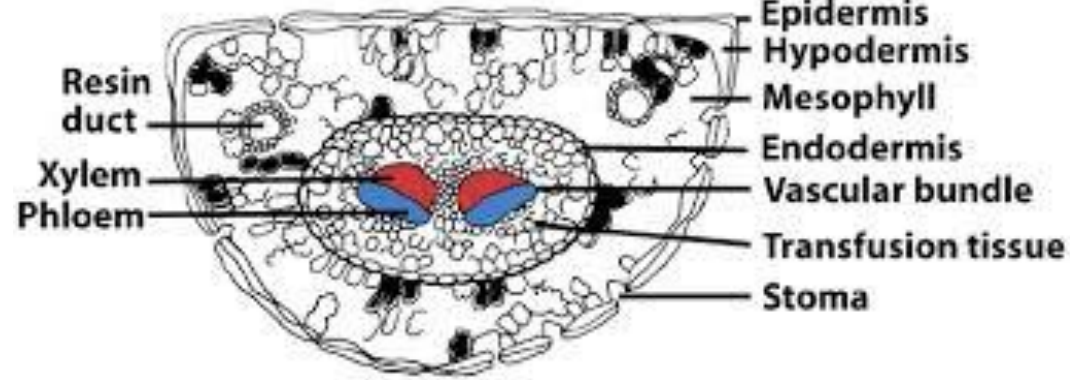
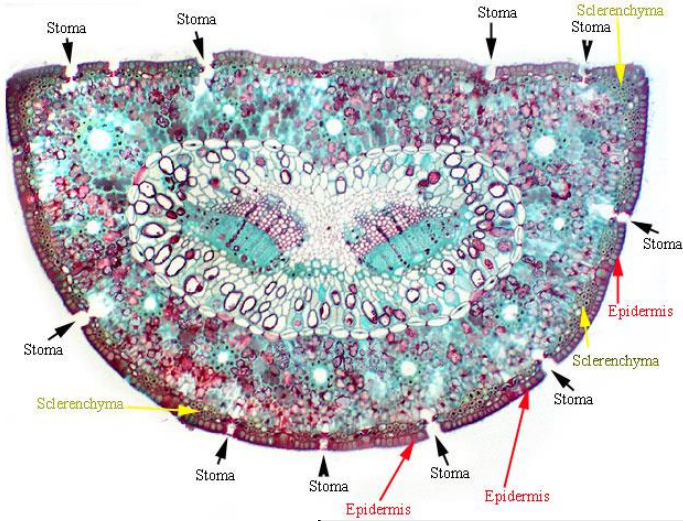


Figure 18-12b
Biology of Plants, Seventh Edition
© 2004 Sinauer Associates, Inc.

SHAPE

Acicular needle shaped	Falcate hooked or sickle shaped	Orbicular circular	Rhomboid diamond-shaped
Acuminate tapering to a long point	Flabellate fan shaped	Ovate egg-shaped, wide at base	Rosette leaflets in tight circular rings
Alternate leaflets arranged alternately	Hastate triangular with basal lobes	Palmate like a hand with fingers	Spatulate spoon-shaped
Aristate with a spine-like tip	Lanceolate pointed at both ends	Pedate palmate, divided lateral lobes	Spear-shaped pointed, barbed base
Bipinnate leaflets also pinnate	Linear parallel margins, elongate	Peltate stem attached centrally	Subulate tapering point, awl-shaped
Cordate heart-shaped, stem in cleft	Lobed deeply indented margins	Perfoliate stem seeming to pierce leaf	Trifoliate/Ternate leaflets in threes
Cuneate wedge shaped, acute base	Obovate heart-shaped, stem at point	Odd Pinnate leaflets in rows, one at tip	Tripinnate leaflets also bipinnate
Deltoid triangular	Obovate egg-shaped, narrow at base	Even Pinnate leaflets in rows, two at tip	Truncate squared-off apex
Digitate with finger-like lobes	Obtuse bluntly tipped	Pinnatisect deep, opposite lobing	Unifoliate having a single leaf
Elliptic oval-shaped, small or no point	Opposite leaflets in adjacent pairs	Reniform kidney-shaped	Whorled rings of three or more leaflets

MARGIN

Ciliate with fine hairs	Crenate with rounded teeth	Dentate with symmetrical teeth
Denticulate with fine dentition	Doubly Serrate serrate with sub-teeth	Entire even, smooth throughout
Lobate indented, but not to midline	Serrate teeth forward-pointing	Serrulate with fine serration
Sinuate with wave-like indentations	Spiny with sharp stiff points	Undulate widely wavy

VENATION

Arcuate secondary veins bending toward apex	Cross-Venulate small veins connecting secondary veins	Dichotomous veins branching symmetrically in pairs
Longitudinal veins aligned mostly along long axis of leaf	Palmate several primary veins diverging from a point	Parallel veins arranged axially, not intersecting
Pinnate secondary veins paired oppositely	Reticulate smaller veins forming a network	Rotate in petaliole leaves, veins radiating

Cupressaceae



Cupressus sempervirens

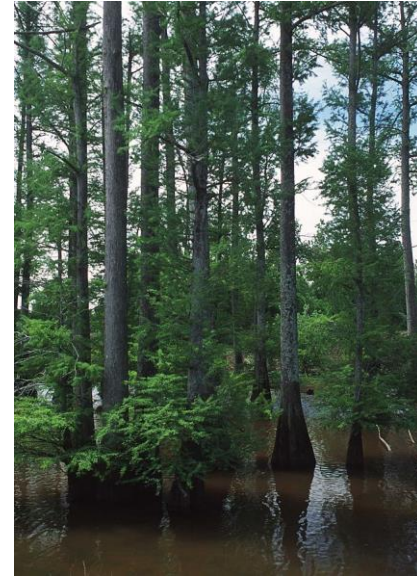
Thuja sp.

Juniperus sp.



Chamaecyparis sp.

Taxodiaceae



Taxodium sp.



Sequoia sempervirens
Taxodiaceae
Gerald D. Carr

Sequoia sp.



Sequoiadendron sp.





Cryptomeria sp.



Taxus baccata

Taxus baccata
Taxaceae



Genetales
Ephedraceae
Genetaceae
Welwitschiaceae



TopTropicals.com
© Marina Khaytarova



TopTropicals.com
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Genetum sp.



Welwitschia mirabilis

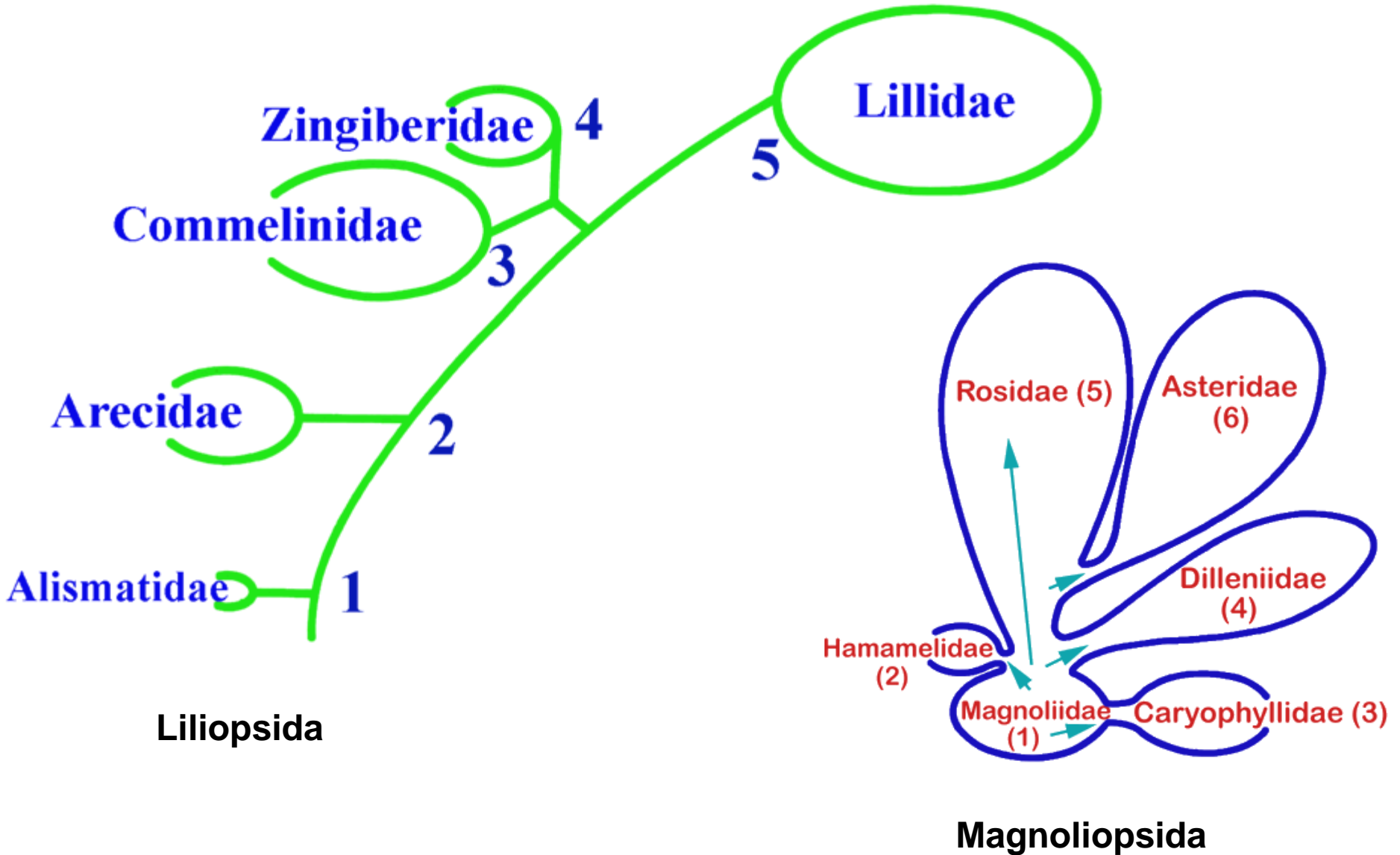




Ephedra sp.

Magnoliophyta

نهاندانگان



Alismatidae

- 1- Alismatales
- 2- Hydrocharitales
- 3- Najadales
- 4- Triuridales

Alisma plantago-aquatica





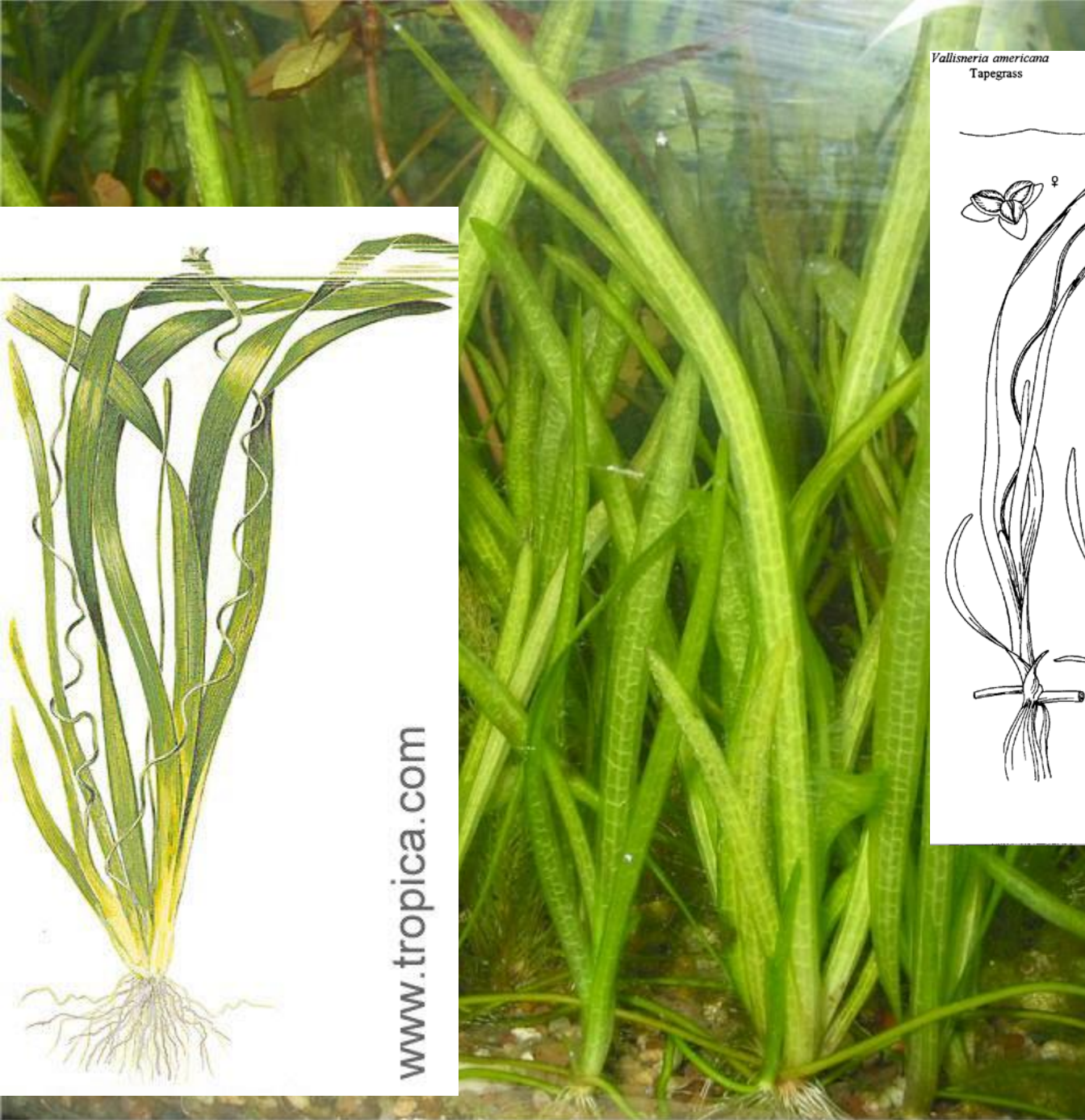
Sagittaria trifolia





Damasonium





www.tropica.com

Vallisneria americana
Tapegrass

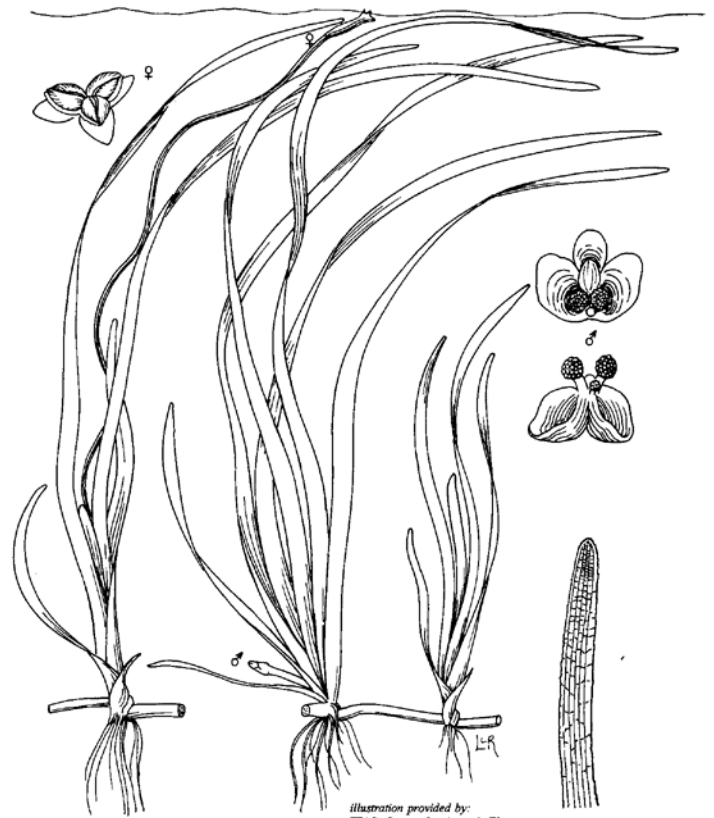


Illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

Vallisneria



Blyxa



Halophila

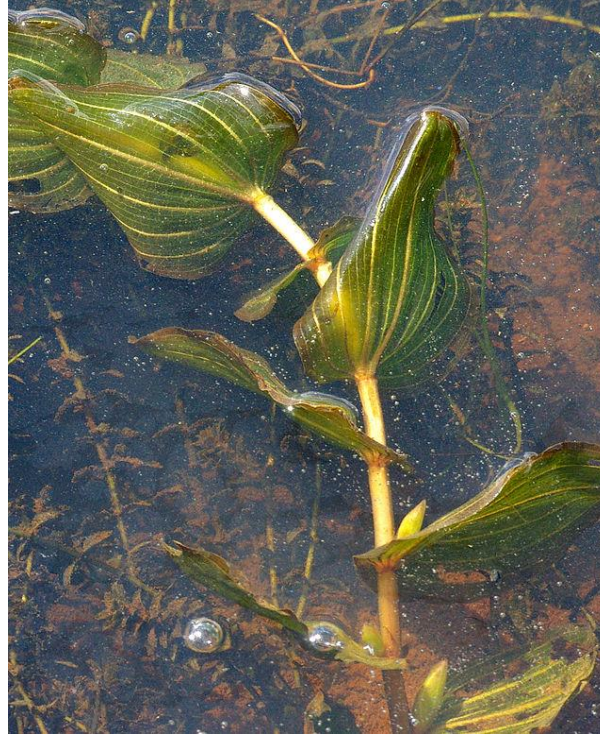


Hydrilla



Hydrocharis

Potamogeton



Groenlandia





Butomus umbellatus





***Najas* sp.**



Arecaceae

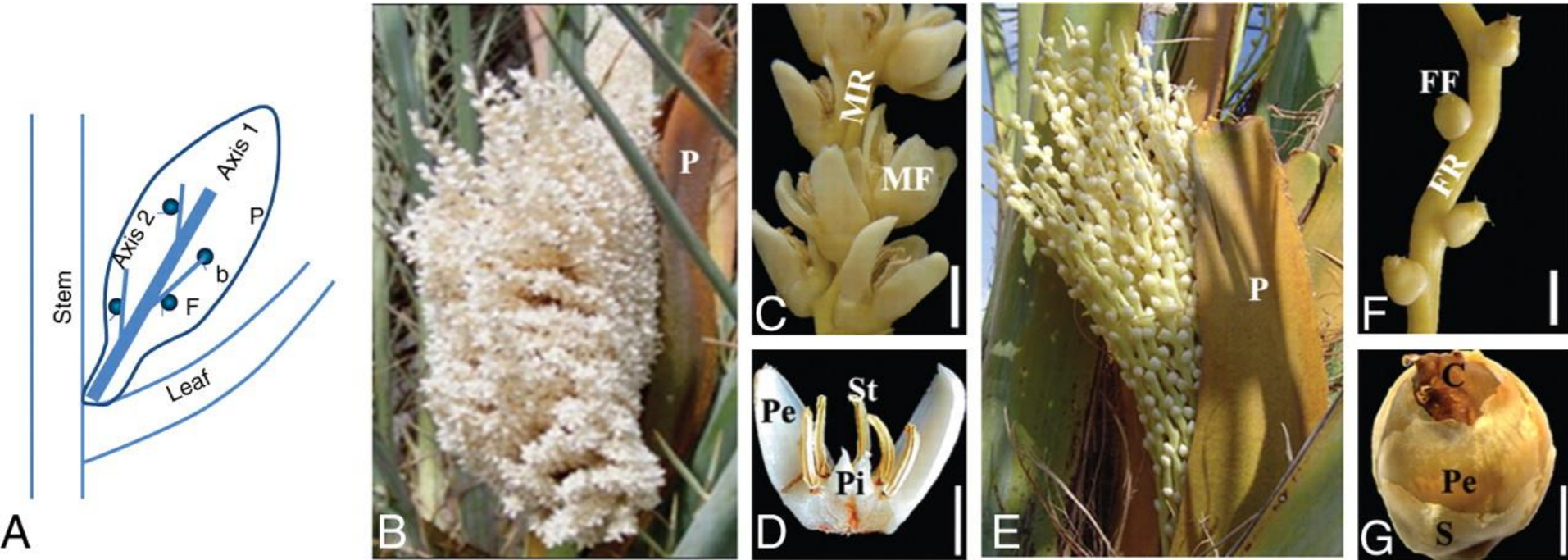


Nannorrhops ritchiana



Cocos nucifera

Phoenix dactylifera



Reproductive development in date palm. (A) Structure of inflorescence. Axis 1 and axis 2 correspond to the rachis and rachilla respectively. (B) Male inflorescence at anthesis. (C) Mature flowers densely distributed on axis of staminate rachilla. (D) Longitudinal section of mature staminate flower. (E) Female inflorescence. (F) Pistillate rachilla. (G) Mature pistillate flower. Abbreviations: b, bract; C, carpel; F, flower; FF, female flower; FM, male flower; FR, female rachilla; MR, male rachilla; P, prophyll; Pe, petal; Pi, pistillode; S, sepals; St, stamens. Scale bars: (C, F) = 500 μm , (D, G) = 250 μm .

Pandanaceae



Arecaceae



Arum



Biarum



Eminium



Anthurium



Spathiphyllum

Lemnaceae



Wolffia



Spirodela



Lemna

Commelinaceae



Tradescantia albiflora



Tradescantia pallida

Juncaceae

Juncus sp.



Luzula sp.



Cyperaceae



Cyperus alternifolius

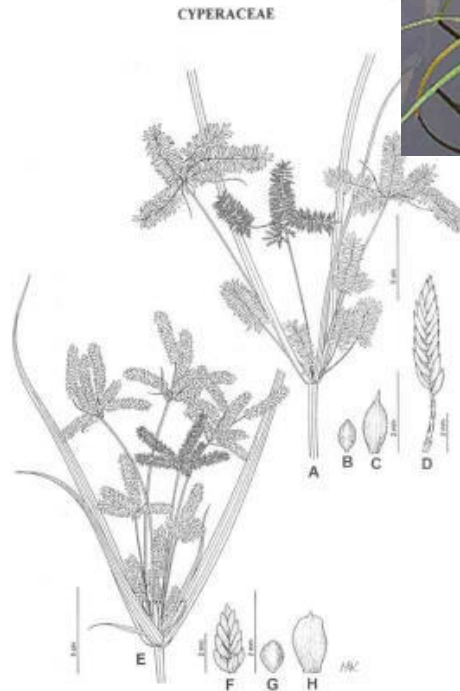


Fig.14 *Cyperus exaltatus*: A, inflorescence; B, nut; C, glume; D, spike (Naithani 3183, H). *C. alopecuroides*: E, inflorescence; F, spike; G, nut; H, glume (Natk 266, H).

Scirpus sp.



Eleocharis sp.



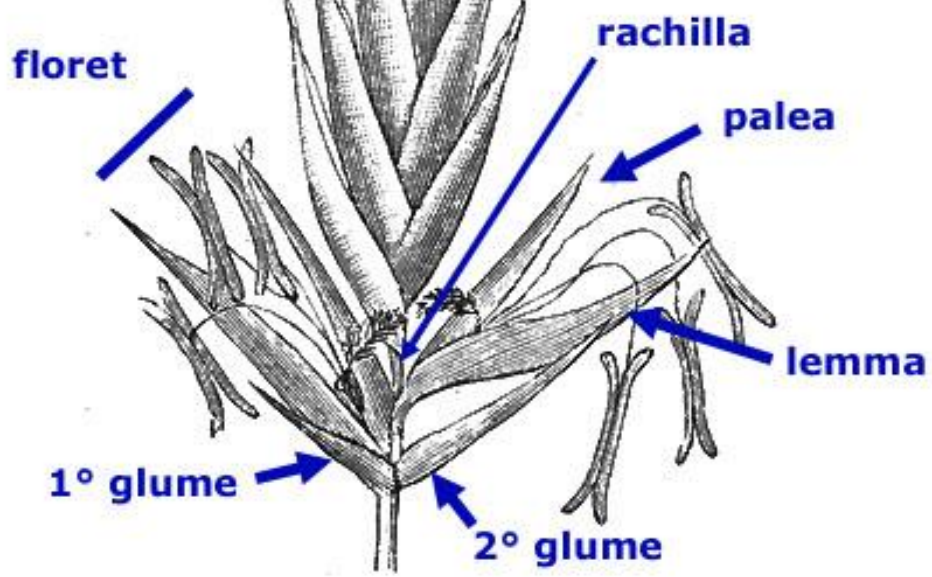
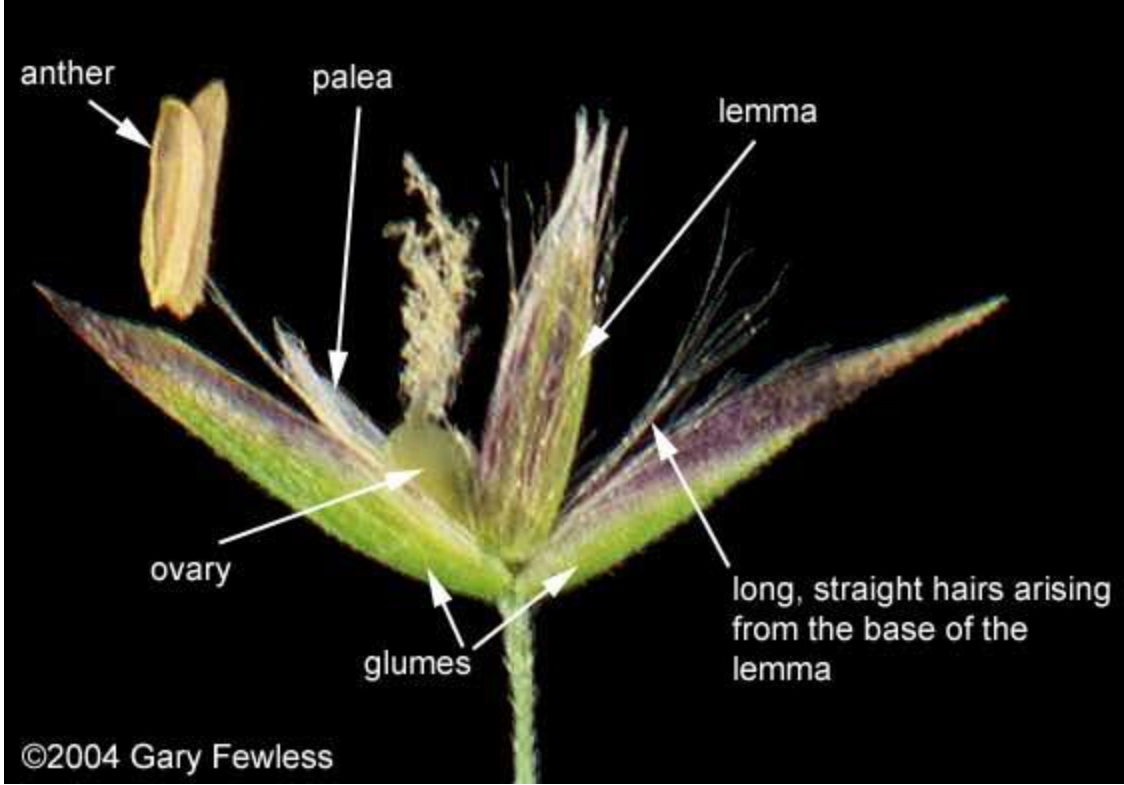
Poaceae=Graminae



Panicum sp.



Grass spikelet



Sparganiaceae

