

# BRYOPHYTE PHYLOGENY POSTER

## Systematics and Characteristics of Nonvascular Land Plants (Mosses, Liverworts, Hornworts)

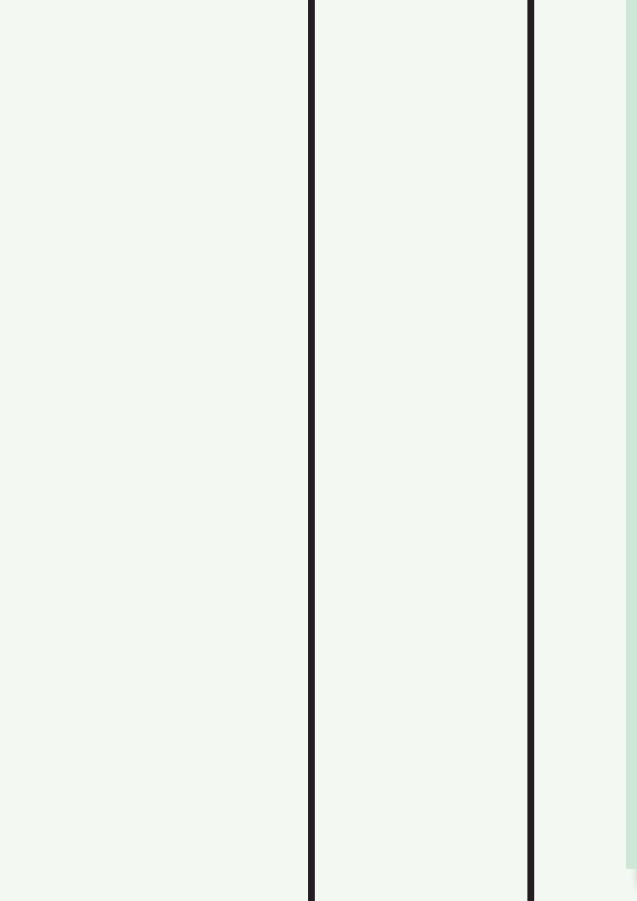


**BRYOPHYTE PHYLOGENY POSTER**  
**TRACHEOPHYTE PHYLOGENY POSTER**  
**ANGIOSPERM PHYLOGENY POSTER**

**Liverworts**  
**MARCHANTIOPHYTA**  
thallose or foliose rhizoids + oil bodies + perforated water-conducting cells mycophallous with endophytic Glomeromycota gametangial protective structures + gametangial ontogeny without apical cells blepharoplast: plastid and associated posterior mitochondrion positioned at cell terminus zygote division transversal: epic- and hypobasal cells CAP without columella elaters (unicellular) stomata - ca. 5,000 spp. lunularic acid

**Mosses**  
**BRYOPHYTA**  
protonema thallose plant foliose PS (metalloid) hydrolysis rhizoids multicellular mycorrhiza - gametangial ontogeny with apical cells blepharoplast: plastid and associated posterior mitochondrion positioned along inner nuclear surface occurrence of stray microtubules CAP with PS and columella elaters - stomata on S ca. 13,000 spp.

**Hornworts**  
**ANTHOCEROTOPHYTA**  
thallus orbicular or strap-like, often rosettes Nostoc in schizogenous slime cavities (mostly ventral via mucilage ducts) chloroplast us. 1/cell with pyrenoid oil droplets + water-conducting cells - AN 1+ many of endogenous origin AR single, embedded on dorsal thallus surface blepharoplast: spine of 12 microtubules (paravertic), lamellar strip monobasal, basal bodies 2 of equal size, lobe by side zygote division longitudinal, three-tiered embryo seta - S chlorophyllous, mostly horn-like, growing from basal foot by indeterminate, intercalary meristematic activity; columella wall of poorly defined stomata on S pseudolaters (mostly multicellular) spore production continuous lignans + flavonoids - ca. 200 spp.



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**COLE TCH, HILGER HH, GOFFINET B (2019) Bryophyte Phylogeny Poster**  
• hypothetical tree based on molecular phylogenetic data (2019)  
• branch lengths deliberate, not expressing actual time scale  
• position of many characters on tree unclear  
• some minor orders/families omitted  
• characters do not necessarily apply to all members of the clades  
• phylogenies: Cox et al. 2010, Flores et al. 2010, Knapp 2010, Li et al. 2019, Long et al. 2016, Puttick et al. 2010, Shaw et al. 2011, Söderström et al. 2016, Sousa et al. 2016, Vilmarin et al. 2010, 2012, 2016  
• characters: Coatsworth et al. 2008, Frey et al. 2008, Goffinet & Shaw 2009, Ligonis et al. 2012  
• abbreviations: G gametophyte, S sporophyte, AR archegonium, AN anteridium, CAP capsule  
CA central strand, CY calyptra, PP paraphysis, PPP pseudoparaphysis, PS peristome, PL leaves  
s.t. sometimes, usu. usually + present, - absent, +/- some with some without, 2 more or less  
\* the early diversification of the Dicranales gave rise to other groups, such as families in the internal Pottiaceae, or the Pseudoclethrales, Scissurellales and Pseudoclethrales. These lineages are not included here, for their relationships remain uncertain.  
† asterisks used s.l. here for terminal sporophyte (longy setae)

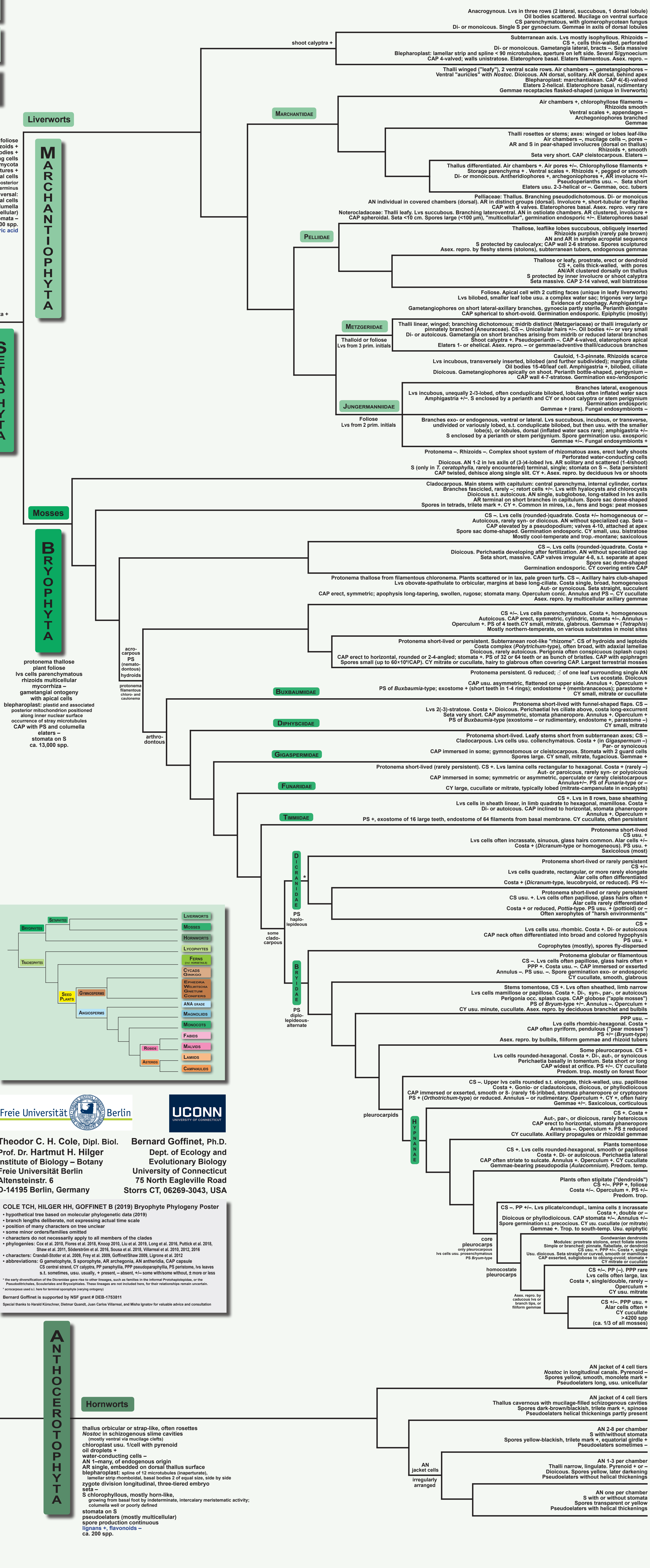
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**Anthocerotales**  
Anthocerotaceae (Anthoceros s.l., incl. Sphaerosporoceros and Folioceros)

**Notothyladales**  
Notothyladales (Notothylas, Mesoceros, Phaeoceros, Paraphymatoceros)

**Phymatocerotales**  
Phymatocerotaceae (Phymatoceros)

**Dendrocrotales**  
Dendrocrotaceae (Dendroceros, Megaceros, Nothoceros, Phaeomegaceros)



- Trebuiiales** Trebuiaceae
- Haplomitriales** Haplomitriaceae
- Blasiales** Blasiaceae
- Neohodgsoniales** Neohodgsoniaceae
- Sphaerocarpaceae** Sphaerocarpaceae Monocarpaceae Riellaceae
- Marchantiales** Aytoniaceae Cleveaceae Conocephalaceae Corsiniaceae Cyathodiaceae Dumortieraceae Exorhthaceae Lunulariaceae Marchantiaceae Monosoleniaceae Oxymitracaceae Ricciaceae Targioniaceae
- Pelliales** Pelliaceae Notoeciaceae
- Fossombroniales** Fossombroniaceae Calyculariaceae Petalophyllaceae Allisoniaceae Makinoaceae
- Pallaviciniales** Pallaviciniaceae Phyllothalliaceae Hymenophytaceae Moerckiacaceae Sandeothallaceae
- Pleuroziales** Pleuroziaceae
- Metzgeriales** Aneuraceae Metzgeriaceae
- Ptilidiales** Ptilidiaceae Herzogianthaceae Neotrichocoleaceae
- Porellales** Jubulaceae Frullaniaceae Lejeuneaceae Lepidolaenaceae Porellaceae Radulaceae
- Jungermanniales** Acrobolaceae Anastrophyllaceae Balantiopaceae Calypogonaceae Cephalozaceae Cephalozellaceae Geocalycaceae Gymnomitriaceae Jungermanniaceae Lepidoziaceae Lophoziaaceae Plagiothalliaceae Scapaniaceae Trichocoleaceae
- Takakiales** Takakiaceae
- Sphagnales** Sphagnaceae Flatbergiaceae Ambuchananiaceae
- Andreaeales** Andreaeaceae
- Andreaebryales** Andreaebryaceae
- Oedipodiales** Oedipodiaceae
- Tetraphidales** Tetraphidaceae
- Polytrichales** Polytrichaceae
- Buxbaumiales** Buxbaumiaceae
- Diphyscials** Diphysciaceae
- Gigaspermals** Gigaspermaceae
- Funariales** Disceliaceae Encalyptaceae Funariaceae
- Timmiales** Timmiaceae
- Grimmiales** Grimmiaceae Seligeriaceae
- Dicranals** Bruchiaceae Calymperaceae Catoscopiaceae Dicranaceae Ditrichaceae Fissidentaceae Leucobryaceae Rhabdoweisiaceae
- Pottiales** Pottiaceae Ephemeraceae
- Splachnals** Meesiaceae Splachnaceae
- Hedwigiales** Hedwigiaceae Helicophyllaceae Rhacocarpaceae
- Bartramiales** Bartramiaceae
- Bryales** Bryaceae Mniaceae Plagiomniaceae
- Rhizogonials** Calomniaceae Cyrtopodaceae Mitteniaceae Rhizogoniaceae Spiridentaceae
- Orthotrichals** Orthotrichaceae
- Orthodontials** Orthodontiaceae
- Aulacomnials** Aulacomniaceae
- Hypnodendrals** Hypnodendraceae Braithwaiteaceae Pterobryellaceae Racopilaceae
- Ptychomnials** Ptychomniaceae Garovagiaceae Rhabdodontiaceae Orthorrhynchaceae
- Hypopterygials** Hypopterygiaceae
- Hookeriales** Daltoniaceae Hookeriaceae Leucomiaceae Pilotrichaceae Saulomataceae Schimperobryaceae
- Hypnals** Amblystegiaceae Anomodontaceae Brachytheciaceae Calliergonaceae Cryphaeaceae Hypnaceae Hylacomniaceae Lembophyllaceae Leskeaceae Meteoraceae Miyabeaceae Neckeraceae Plagiotheciaceae Pterobryaceae Pyliasiaceae Pyliasiadelphaceae Sematophyllaceae Thuidiaceae Trachylomataceae
- Leiosporocerotals** Leiosporocerotaceae (Leiosporoceros)
- Anthocerotals** Anthocerotaceae (Anthoceros s.l., incl. Sphaerosporoceros and Folioceros)
- Notothyladales** Notothyladales (Notothylas, Mesoceros, Phaeoceros, Paraphymatoceros)
- Phymatocerotals** Phymatocerotaceae (Phymatoceros)
- Dendrocrotals** Dendrocrotaceae (Dendroceros, Megaceros, Nothoceros, Phaeomegaceros)

Vascular Plants see Tracheophyte and Angiosperm Phylogeny Posters