

# GLOSSARY

- 1n:** having only one set of chromosomes
- 2,4-D:** 2,4-dichlorophenoxyacetic acid; herbicide that mimics IAA
- 2n:** having two sets of chromosomes
- A horizon:** dark-colored soil layer with organic content and minerals intermixed
- ABA:** abscisic acid; plant hormone (growth regulator) associated with water stress, growth inhibition, stomatal closing, and seed dormancy in some plants; known from mosses
- abscisic acid:** ABA; plant hormone (growth regulator)
- abscission:** process where plant organs are shed; *e.g.* deciduous leaves in autumn
- accessory pigment:** pigment that captures light energy and passes it to chlorophyll *a*
- acetylcholine:** chemical formed by choline and acetyl group; neurotransmitter in nervous system used to transmit nerve impulses
- achlorophyllous:** lacking chlorophyll
- acid precipitation:** precipitation having pH less than 5.4
- acid:** substance with pH less than 7.0
- acrocarpous:** gametophyte producing sporophyte at apex of stem or main branch; generally upright mosses with terminal sporangia, usually unbranched or sparsely branched
- adaptation:** genetic change, arrived at through process of natural selection, which enables organism to compete more effectively under given set of conditions (L. *adaptare* = to fit in)
- adaxial:** on side toward axis (stem) of plant, such as upper surface of leaf
- adenine:** nitrogenous base; one member of base pair adenine-thymine in DNA
- alanine:** non-polar amino acid that is relatively insoluble in water
- alar cell:** cell at basal angle of moss leaf, usually different in size and shape from other leaf cells
- alginate:** viscous gum; general term for salts of alginic acid, especially sodium but also calcium or barium ions; composed of galuronic and mannuronic acids
- alkaloid:** basic organic compound containing nitrogen; toxic
- allele:** particular form of gene
- allelopathic:** having ability to inhibit growth of another organism through secondary metabolite
- allelopathy:** condition in which one organism makes environment chemically unsuitable to another through secondary metabolism
- alpine:** habitat above treeline of mountain
- alternation of generations:** alternating cycle of sporophyte (*2n*) and gametophyte (*1n*) generations
- amensalism:** interaction in which one species is harmed by other while other is neither harmed nor benefitted
- amidon:** macromolecule composed of glucose constituents; starch; (L. *amylum* = complex carbohydrate)
- amphigastrium** (pl. **amphigastria**): underleaves of leafy liverworts; few mosses where upper or lower leaves are differentiated from lateral leaves and smaller, as in *Racopilum*
- amyloid:** waxy translucent substance of various complex proteins in combination with polysaccharides and staining blue with iodine (like starch) deposited in tissues in different disease processes and tissue degeneration; builds up inside tissue in amorphous way
- amyloplast:** colorless plastid that forms starch granules in plants
- anastomosis:** condition of union of one structure with another, usually crisscrossing; interconnecting; may be applied to irregularly divided peristome teeth
- Andreaebryopsida:** class of mosses in Bryophyta
- Andreaeopsida:** class of mosses in Bryophyta
- anisosporous:** having bimodal distribution of spore sizes with smaller spores generally producing males
- anisospory:** condition having bimodal distribution in spore size; genetically determined condition of two spore sizes
- annual shuttle:** species that requires small disturbances that last 1-2 years; survive severe stress periods
- annual:** plant that germinates, reproduces, and dies all within one year
- annulus:** zone of differentiated cells between capsule urn and operculum, facilitating opening of capsule
- anterior whiplash flagellum:** thin whiplike structure on front end of cell (L. *flagellum* = whip)
- antheridiophore:** specialized antheridium-bearing branch
- antheridium** (pl. **antheridia**): male gametangium found in all sexual plants except seed plants; sperm container, multicellular globose to broadly cylindrical stalked structure producing sperm
- Anthocerotophyta:** phylum of hornworts, characterized by thallose gametophyte with hornlike sporophyte having continued growth at its base
- anthocyanin:** water-soluble blue, purple, or red flavonoid pigment found in cell vacuole of plants, especially flowers and autumn leaves
- apex:** tip; end farthest from point of attachment or from base of organ (L. *apex* = point)
- apical cell:** single meristematic cell at apex of shoot, thallus, or other organ that divides repeatedly
- apical:** at apex, or tip
- apogamous:** condition of producing sporophyte without union of gametes
- apoplastic:** outside cell membrane, such as cell walls and dead cells
- aposporous:** producing gametophyte from sporophyte tissue without meiosis
- appressed:** referring to leaves lying closely or flat against stem
- aquatic:** pertaining to water habitat
- arbuscule:** finely branched organ produced by endomycorrhizal fungi inside host cells; interface at which fungus and plant exchange phosphorus and photosynthates
- archegoniophore:** specialized archegonia-bearing branch

- archegonium** (pl. **archegonia**): multicellular egg-containing structure that later houses embryo; female gametangium; flask-shaped structure consisting of stalk, venter, and neck present in **Bryophyta** and all tracheophytes except flowers
- areola** (pl. **areolae**): small, angular or polygonal surface area differentiated on thallus and overlying chamber, forming pattern or network, as in *Conocephalum*
- areolate**: divided into chambers
- areolation**: cellular network of leaf or thallus
- arginine**: amino acid with basic group, alkaline in solution
- arthrodontous**: having lateral walls of peristome teeth eroded with uneven thickenings (*arthro* = jointed; *don* = tooth)
- ascending**: pointing obliquely upward, away from substrate
- aseptic**: free of disease-causing microorganisms
- asexual**: referring to reproduction without union of gametes, such as gemmae in *Marchantia*
- asl**: above sea level
- aspect**: compass direction a slope faces
- auricle**: earlike lobe, sometimes at base of moss leaf or liverwort underleaf; in *Blasia* houses the Cyanobacterial partner
- auroxanthin**: diepoxy carotenoid pigment known in *Fontinalis*
- autoclave**: oven-like equipment capable of high temperatures for heat sterilization
- autoicous**: having male and female reproductive organs in separate clusters on same plant
- autopolyploidy**: all chromosomes derived from same species, frequently same individual; in bryophytes, having more than 1 set of homologous chromosomes in gametophyte
- auxin**: plant growth-regulating hormone, usually referring to hormone indoleacetic acid (IAA); influences cellular elongation, among other things
- axenic**: pure culture, without other organisms
- axil**: angle at which leaf joins stem
- axillary**: forming in axis between stem and leaf
- B horizon**: dark soil layer of accumulated transported silicate, clay, minerals, iron, and organic matter, having blocky structure
- bar**: scientific unit of measurement of pressure; 1 bar  $\approx$  1 atmosphere of pressure (0.986923 atm)  $\approx$  14.503 psi = 750 mm Hg = 99.992 kPa
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- basipetally**: tissue or organs developing or maturing from apex toward base
- bet hedger**: organism that uses combination of two or more strategies, thus never having optimal adaptations to extremes but being prepared to lesser degree for most circumstances; plant that seems to have both good sexual reproduction and means of vegetative reproduction, e.g. bryophyte that produces frequent capsules but also produces gemmae, as in *Tetraphis pellucida* and *Marchantia polymorpha*
- biflagellate**: having two flagella; functions in cell motility
- binding site**: site for attachment, usually referring to ions; can occur on cell walls, soil particles, glass containers, etc.
- bioassay**: use of living organism for assessing effects of biologically active substances
- biomass**: quantitative estimate of total mass of organisms or parts being considered
- bisexual**: having both sexes on the same individual; dioicous (gametophyte) or dioecious (sporophyte)
- bog**: acidic, wet area in which nutrients are received by rainfall and groundwater flow is negligible; consists mostly of decaying moss and other plant material
- bole**: main trunk of tree
- boreal**: pertaining to north; life zone bounded on south by growth-season accumulated temperature above 6.1°C of 5538°C and mean daily temperature of 18°C for six hottest weeks (*L. boreas* = north)
- boreal forest**: predominantly conifer forest extending across northern North America and parts of Europe and Asia
- BOREAS**: climate model for boreal region
- bract**: modified leaf associated with gametangium or gemmaecup
- bracteole**: modified underleaf associated with gametangium in liverworts
- Bryobiotina**: subkingdom name to include Marchantiophyta, Anthocerotophyta, and Bryophyta; some people also include Lycopodiophyta
- Bryophyta**: phylum of mosses (previously defined to include liverworts); have embryos and lack organized, lignified vascular tissue; have alternation of generations with dependent sporophyte
- bryophyte**: member of phylum Bryophyta; also used to refer collectively to mosses, liverworts, and hornworts
- Bryophytina**: old subdivision/subphylum name originally to include mosses, hornworts, and liverworts
- Bryopsida**: class of Bryophyta including majority of mosses, all except Sphagnopsida, Takakiopsida, Andreaeopsida, Andreaebryopsida, and Polytrichopsida
- bulbiform**: describes swollen cells found in some grass leaves, such as wheat, that provide mechanical means to roll up or move
- bulbil**: small, bulb-like axillary vegetative propagule
- bulliform**: describes enlarged parenchyma cells of grasses that permit leaves to spread or roll; expansion cell
- C horizon**: soil layer of weathered parent (rock) material with little structure, comprised of mineral material
- C<sub>3</sub> photosynthetic pathway**: photosynthetic pathway in which CO<sub>2</sub> is immediately put into photosynthesis, initially forming a 3-carbon compound; pathway of all bryophytes
- calciphile**: growing on substrates rich in calcium
- callose**: complex, branched polysaccharide
- calmodulin**: (CaM) receptor protein for Ca<sup>++</sup> located within cytoplasm of target cells; appears to mediate effects of this ion on cellular activities
- calyptra** (pl. **calyptrae**): in bryophytes, haploid envelope covering developing sporophyte; developed from archegonium; covering over moss capsule (Gr. *kalyptra* = covering)
- cancellinae**: large, empty basal leaf cells, usually hyaline; may serve as water storage cells
- capillary water**: refers to water held loosely by soil particles and therefore readily available for uptake by roots or rhizoids
- capitulum**: terminal dense cluster of branches in *Sphagnum* in which stem has not yet elongated; head
- capsule**: sporangium of bryophyte; terminal spore-producing part of sporophyte
- carboxyl** (-COOH): chemical group occurring at end of many biological molecules, causing that molecule or that end of molecule to act as acid

- carotenoid:** fat-soluble pigment group that includes xanthophyll and carotene; 8-isoprene unit terpene synthesized by most plants (*L. carota* = carrot)
- carrying capacity:** maximum quantity of standing crop that can be maintained indefinitely on area
- cation exchange capacity (CEC):** ability of soils and plants to give up certain positively charged ion in return for different one; usually hydrogen is traded for nutrient or metal
- cation:** positively charged ion
- caulonema:** secondary portion of protonema that develops later and gives rise to upright gametophores; has longer cells with slanting cross walls, usually brownish cell walls, and fewer, less evenly distributed, smaller spindle-shaped chloroplasts compared to chloronema (Gr. *caulo* = stem or stalk, *G. nema* = thread)
- caulonema-specific protein:** CSP; proteins involved in ability of caulonema to respond to cytokinin and produce buds
- CEC (cation exchange capacity):** ability of soils and plants to give up certain ion in return for different one; usually hydrogen is traded for nutrient or metal
- cellulose:** polysaccharide of glucose units that constitute main part of cell walls in plants
- central stand:** small group of elongate cells forming central axis in some stems and thalli; also called axial strand
- charophytes:** algae in phylum Charophyta; highly advanced group of algae with chlorophylls *a* & *b*, starch storage, and antheridia and archegonia encased in multicellular covering
- chelator:** organic compound that binds metal by forming ring structure around it
- chloronema:** younger part of protonema, with perpendicular crosswalls, short cells, numerous chloroplasts, colorless cell walls, and irregular branching; primary photosynthetic part of protonema (Gr. *chloros* = grass green, *nema* = thread)
- chlorophyll *a*:** chlorophyll found in all green plants, algae, and Cyanobacteria; primary photosynthetic pigment found in plants; absorbs light maximally at 430 and 662 nanometers
- chlorophyll *b*:** chlorophyll found in all green plants and some algae phyla, but not Cyanobacteria; bluish-green pigment that absorbs light maximally at 453 and 642 nanometers
- chlorophyllose:** having chlorophyll, as in photosynthetic cells of *Sphagnum* leaf
- chloroplast:** plastid containing chlorophyll found within cells of plant leaves and stems; organelle where photosynthesis occurs
- chlorosis:** yellowing of plant tissue caused by loss of chlorophyll
- chlorotic:** yellow-looking (Gr. *chloros* = grass green, *osis* = condition)
- chromosome:** dense mass of chromatin containing DNA and bearing genes needed for reproduction; visible during cell division (Gr. *chroma* = color, *soma* = body)
- cilia:** delicate, hair-like structures mostly one cell wide and unbranched
- cladocarpous:** form of pleurocarpous moss in which sporophytes are borne terminally on short lateral branches
- cladoicous:** having archegonia and antheridia on different stems of the same clone, *i.e.* with stems adjoined by stolons/rhizomes
- cleistocarpous:** indehiscent; capsule lacking regular mechanism for opening
- clone:** aggregate of individuals produced asexually from single parental individual; created by fragmentation, specialized asexual reproductive units, or apomictic seeds (Gr. *klon* = twig or slip)
- CO<sub>2</sub> compensation point:** point (concentration) at which CO<sub>2</sub> release during respiration balances CO<sub>2</sub> intake during photosynthesis
- cohort:** group of individuals with same starting point
- colloid:** substance having particles (100-10,000 nm diameter) that remain dispersed in solution, intermediate between true solutions & suspensions
- colonist:** species that lives where habitat start is unpredictable and habitat lasts at least several years after disturbance; makes habitat suitable for perennial stayers
- columella (pl. columellae):** central sterile portion in sporogenous region of capsule in mosses, hornworts, and some fungi
- common garden:** where different populations are grown together under same conditions
- compensation point, CO<sub>2</sub>:** point (concentration) at which CO<sub>2</sub> release during respiration balances CO<sub>2</sub> intake during photosynthesis
- compensation point, light:** irradiance level (PAR) at which CO<sub>2</sub> release during respiration balances CO<sub>2</sub> intake during photosynthesis
- compensation point, water:** moisture level at which CO<sub>2</sub> release during respiration balances CO<sub>2</sub> intake during photosynthesis
- competition:** tendency of neighboring plants to utilize same resource – quantum of light, ion of mineral nutrient, molecule of water, or volume of space
- complementation:** two traits that complement or help each other
- conducting strand:** in bryophytes, the leptoids and hydroids that provide a conduit for sugars and water, respectively
- cortex:** stem tissue located between central strand and epidermis; in liverworts can refer to outer rind of differentiated stem cells
- costa (pl. costae):** non-vascular midrib of moss leaf, always more than one cell thick; may facilitate water movement but lacks tracheids and vessels
- costate:** having costa (moss version of midrib)
- cotransport:** process of bringing the oppositely charged ion along through a membrane; two substances crossing the cell membrane together through a single channel complex
- crispate:** variously curled, twisted, or contorted
- crista (pl. cristae):** inner projection or fold on inner membrane of mitochondrion
- cross fertilization:** transfer of sperm from antheridium of one plant to egg of different plant
- cross-section:** slice through object perpendicular to its long axis
- crosswall:** cell wall that goes perpendicular to long axis of plant organ
- cryopreservation:** freezing living material at very low temperatures to be "brought back to life" later (*crypto* = hidden)
- cryptic species:** literally, hidden species; populations that differ physiologically but not morphologically within a species, restricting them to different growing conditions
- cryptobiosis:** state of organism when no sign of life is visible; metabolic activity is immeasurable (*crypto* = hidden; *bios* = life)
- cryptochrome:** light-sensitive yellow pigment capable of sensing photoperiod; flavoprotein that regulates elongation, germination, and photoperiodism in plants (*crypto* = hidden, Gr. *chroma* = color)
- cryptogam:** plant or alga with "hidden" gametes; non-seed plants, algae, and lichens

- cryptogamic crust:** tightly bound mesh of various Cyanobacteria, lichens, bryophytes, and fungi on soil, especially in deserts and dry prairie; function to hold soil and prevent erosion
- cushion:** growth form with stems more or less erect, tightly clustered and somewhat radiating at edges
- cuticle:** extracellular fatty or waxy covering that forms from cutin on outermost layer of plant; in bryophytes, mostly fatty
- Cyanobacteria:** photosynthetic group of bacteria
- cyanophycean:** referring to member of Cyanobacteria
- cytokinin:** plant hormone (growth regulator) that promotes growth by stimulating cell division
- cytoplasm:** all protoplasm of cell except nucleus
- deciduous:** condition in which plant sheds its leaves during certain season
- decurrent:** basal leaf margins extend down stem past leaf insertion as ridges or narrow wings
- dedifferentiation:** process involved in return of cell to its embryonic (undifferentiated) state
- deficiency:** lack of something, such as having insufficient iron or other nutrient
- degree days:** unit of measure calculated as product of time (days) and temperature (°C), usually averaged over growing season or activity season for organism in question; number of degree-days that occur in one day is determined from average temperature for that day minus base temperature, which is minimum temperature above which activity occurs
- dehisce:** to split apart, as in liverwort capsule
- dehiscence:** splitting apart
- dehiscent:** capsule opening regularly by means of annulus and operculum or valves
- delayed fitness:** possessing trait that is not immediately expressed, *e.g.* recessive trait in heterozygous condition
- deliquescent:** liquefying in atmosphere; capable of absorbing atmospheric moisture and liquefying, as in *Sphagnum* pseudopodium
- dendroid:** tree-like; branched above and distinct trunk-like stalk, *e.g.* *Climacium*, *Hypnodendron*, *Hypopterygium*, *Leucoclepis*, *Pleurozopsis*, *Symphogyna hymenophyllum*
- denitrification:** process by which nitrogenous compounds are degraded and nitrogen is returned to gaseous form
- desiccation tolerant:** able to withstand periods of dry conditions
- desiccation:** process of drying out (L. *desiccare* = to dry up)
- determinate growth:** growth of limited duration, characteristic of many acrocarpous mosses where production of splash cups or seta and capsule terminates growth of stem
- detoxification:** clearing of poisons (Gr. *toxicon* = poison)
- diad:** grouping of two, as in two spores that remain stuck together
- diaspore:** agent of dispersal; any structure that becomes detached from parent plant and gives rise to new individual; asexual reproductive structure
- diatom:** single-celled or filamentous alga with silica shell made of two overlapping portions called valves
- dichotomous key:** tool that uses pairs of choices for identifying things
- dichotomous:** branching into two parts; describes forked branching, as in veins of fern and *Ginkgo* leaves or thallus of *Marchantia* (Gr. *dicha* = in two, *temnein* = to cut)
- dictyosome:** Golgi apparatus; series of organelles consisting of stack of membrane-lined vesicles
- dimorphic:** occurrence of organism in two forms
- dioecious:** having male and female reproductive structures on different plants; applied to sporophytes of tracheophytes
- dioicous:** having male and female reproductive structures on separate gametophyte individuals; corresponds to dioecious in sporophytes
- dipeptide:** compound consisting of two amino acid units joined together by single peptide bond, linking amino (-NH<sub>2</sub>) group of one with carboxylic acid group (-COOH) of other
- diploid:** cell, individual or generation with two sets of chromosomes (2*n*); typical chromosome level of sporophyte generation
- dispersal:** spreading out; process of dissemination
- disturbance:** partial or total destruction of plant biomass arising from herbivores, pathogens, human activity, wind damage, frost, desiccation, erosion, or fire.
- diterpene:** one of class of hydrocarbons produced by many plants; major component of resin and turpentine produced from resin
- diversity:** measure of number of different entities and distribution of individuals in system
- DNA (deoxyribonucleic acid):** molecule that carries genetic information
- domatium (pl. domatia):** modified part of plant for sheltering bacteria, insects, mites or fungi, such as *Nostoc* auricles of *Blasia*
- dominant generation:** generation in which species spends most active time; in bryophytes, gametophyte is dominant
- dominant allele:** allele that is always expressed, even in presence of different sister allele
- dominant:** life cycle strategy of species that become major species in ecosystem, like *Sphagnum*; have large spores and long life expectancy
- dormant:** in state of reduced physiological activity
- dorsal:** side directed away from axis; in liverworts, upper side
- dorsiventral:** having top-bottom orientation
- drought hardening:** process of increasing resistance drought in plants
- dwarf male:** nannandrous male; male plant that is considerably smaller than female and typically grows epiphytically on the female
- E horizon:** light-colored soil horizon with low organic content due to high degree of water transport
- ecostate:** lacking costa (midrib) in leaf, as in many mosses
- ecosystem:** interacting community of organisms and their environment
- ectohydric:** having water conduction predominantly on outside of plant
- egg:** non-motile female gamete that is larger than motile sperm
- elaiosome:** oil body used to attract animal dispersal agent
- elater:** dead, elongate cells with coiled thickenings in liverworts; sensitive to humidity; unequal wall thickenings cause twisting during drying; help disperse spores
- elongation:** lengthening
- embryo (pl. embryos):** multicellular developing organism in archegonium or seed; characteristic of plant kingdom
- embryogenesis:** formation of embryo
- embryophyte:** plant having zygote that divides to form embryo retained in archegonium or seed
- emergent:** projecting out of something, as aquatic plant out of water or capsule out of perichaetal leaves

- endodermis:** layer of tissue one cell thick between vascular cylinder of root and cortex; serves as filter that forces substances to go through cells, hence through cell membranes, before going to the xylem
- endogenous:** produced within the organism
- endohydric:** having water conduction predominantly on inside of plant
- endoplasmic reticulum:** complex system of membranous stacks involved in membrane production in cell
- endopolyloid:** condition in which cells have developed multiple sets of chromosomes
- endosporic germination:** early development of several mitotic divisions within spore wall
- endosporic:** early development of several mitotic divisions within spore wall
- ephemeral:** short-lived, such as desert plants that germinate from seed and bloom within few weeks; plants having more than one generation per year
- epilithic:** on rock
- epinasty:** leaf and stem curling
- epiphragm:** circular membrane positioned horizontally over capsule mouth of some mosses, *e.g.* *Polytrichum*
- epiphyll:** plant that grows on leaf of another plant
- epiphyllous:** growing on leaves of other plants
- epiphyte:** plant or alga that grows upon another plant without deriving nutrients from it
- ethylene:** C<sub>2</sub>H<sub>4</sub>; gaseous plant hormone (growth regulator) that modifies growth form, responds to wounding, and other physiological responses; responsible for suppression of growth in liverwort underleaves
- etiolation:** abnormal elongation of stems in response to insufficient light
- evacuolate:** lacking vacuoles
- evapotranspiration:** loss of water through evaporation from among plants and from plants themselves (transpiration)
- evergreen:** condition where plant remains green and retains its leaves for full year or longer
- evolution:** series of genetic changes (changes that are heritable) that causes organisms to change through time (*L. evolutio* = unrolling)
- exchange site:** location on plant cell wall or soil particle where ions are traded, such as replacement of hydrogen from -COOH by Ca<sup>+2</sup>; when charge of new ion is greater than that of one it replaces, it is shared by more than one exchange site
- exchanger:** organism capable of replacing one ion for another, usually replacing hydrogen with cation such as Ca<sup>+2</sup>
- exine:** outermost of two layers forming wall of certain spores
- exogenous:** generated by outside source
- exohydric:** having water transport essentially external by surface flow; including capillary flow between leaves or through surface papillae
- exosporic germination:** first mitotic division occurs outside spore after rupture of spore wall, typical of most bryophytes
- exosporic:** condition in which first mitotic division occurs outside spore after rupture of spore wall
- exotic:** foreign; introduced from foreign country (*L. exoticus* = foreign)
- explant:** portion of plant transplanted to artificial medium
- explerent:** non-competitive species that fills spaces between others
- extant:** existing today; opposite of extinct
- extensin:** glycoprotein thought to be involved in cell wall extension
- facultative aquatic:** having some degree of tolerance to desiccation and xerophytic conditions
- falcation:** curved like a sickle, as in leaves of many *Dicranum* species
- false anisospory:** condition of having small, non-viable spores found among dimorphic spores in certain species of bryophytes due to factors such as spore abortion; non-genetic condition of more than one spore size
- fan:** on vertical substrate, usually where there is lots of rain; creeping, with branches in one plane and leaves usually flat; *e.g.* Neckeraceae, Pterobryaceae, *Thamnobryum*, some *Plagiochila*
- fascicle:** small tuft or cluster of fibers, leaves, branches, or flowers; in *Sphagnum*, clump of branches on stem
- fecundity:** number of offspring produced by organism during its lifetime
- fecundity-advantage model:** need of species needs to produce large number of eggs
- female:** organism that produces egg
- fertilization:** fusion of gametes resulting in formation of zygote; act of adding nutrients by applying fertilizer to improve plant growth
- fibrilla (pl. fibrillae):** thickened bands across hyaline cells of *Sphagnum*, strengthen cell walls
- flagellate:** possessing flagellum
- flagelliform:** whiplike, gradually tapering from base to tip of branch
- flagellum (pl. flagella):** slender, whip-like appendage that enables cells to move through liquids; differs from cilia in having only one or two per cell; found on most sperm
- flavonoid:** group of plant pigments that absorb UV light and include anthocyanins
- fluorescence:** emission of light of longer wavelength due to absorbance of light from outside source; due to excited electrons returning to ground state
- Fm:** maximum fluorescence of dark adapted material
- foot:** basal portion of most bryophytes sporophytes, embedded in gametophyte
- forest gap:** opening in forest canopy, often due to a fallen tree
- fragmentation:** breaking into fragments (pieces)
- fugitive:** species that lives in unpredictable environment
- fungus (pl. fungi):** kingdom and common name for group of non-photosynthetic organisms; sometimes placed in kingdom Mycota; formerly classified as plants, but food reserves, cell wall components, and other biochemical differences have caused biologists to re-classify them into their own kingdom
- Fv:** variable fluorescence of dark-adapted material
- Fv/Fm:** measure of chlorophyll fluorescence; <80% is considered a stress response
- GA: gibberellic acid**
- GA3: gibberellin A<sub>3</sub>;** identical to gibberellic acid
- galacturonic acid:** organic acid that occurs in cell walls and has carboxyl group (-COOH) that provides cation exchange site; common in *Sphagnum* (peat moss), but less abundant in seed plants
- gametangium (pl. gametangia):** gamete-producing structure; *e.g.* archegonia, antheridia
- gamete:** sexual reproductive structure that has one set of chromosomes and must unite with another of same species but opposite strain to continue life cycle
- gametogenesis:** development of gametes

- gametophore:** gametangium-bearing stalk; used to refer to upright gametophyte plant produced from protonema
- gametophyte generation:** haploid ( $1n$ ) generation that reproduces by gametes in plants; in bryophytes dominant generation
- gametophyte:** haploid ( $1n$ ) generation that reproduces by gametes in plants; in bryophytes, dominant generation; generation that begins with meiospore and ends when it produces gametes that join; contains no lignified vascular tissue
- gemma** (pl. **gemmae**): asexual reproductive structure; uni- or multicellular, filamentous, globose, or discoid brood bodies, serving in vegetative reproduction; occurs in some liverworts, mosses, and club mosses
- gemmae cup:** cup-like structure producing gemmae; found in *Marchantia*
- genera:** plural of genus
- generation:** term applied to sporophyte ( $2n$ ) and gametophyte ( $1n$ ) phases of plant life cycle
- genet:** branching of gametophyte resulting from clonal growth of rhizome; free-living individual that develops from one original zygote, parthenogenetic gamete, or spore and that produces ramets vegetatively during growth
- genetic drift:** occurrence of random changes in gene frequencies, generally resulting in small, isolated populations and not due to mutation, migration, or selection
- genus** (pl. **genera**): taxonomic category for group of closely related species; category below family
- germination:** sprouting of seed or production of new growth stage from spore
- gibberellic acid:** carboxylic acid hormone; gibberellin  $A_3$
- gibberellin:** carboxylic acid plant hormone (growth regulator) affecting stem elongation and seed germination; produced by plants and commonly secreted by fungi
- glaucous:** whitish, grayish, or bluish overcast, hue or color, like a plum
- globose:** spherical
- glycine:** water-soluble amino acid
- glycoside:** plant ester containing sugar (glycol) and non-sugar (aglycone) component attached via oxygen or nitrogen bond and whose hydrolysis yields one or more sugars and non-sugar substance
- glyoxylate cycle:** pathway in which acetate and fatty acids can be used as sole carbon source, bypassing the  $CO_2$ -evolving step of Krebs's cycle (citric acid cycle)
- glyoxysome:** organelle in plant or microorganism cell, containing catalase, where acetate and fatty acids can be used as sole carbon source (glyoxylate cycle); cycle bypasses  $CO_2$ -evolving step of Krebs's cycle (citric acid cycle)
- granum** (pl. **grana**): stack of thylakoids within the chloroplast where light reactions of photosynthesis take place
- gravitropism:** bending (directional growth) of plant or plant part in response to gravitational pull (L. *grave* = heavy, *trope* = turning)
- growth form:** structural architecture of individual plant
- guard cell:** specialized cell flanking stoma in sporophytes of bryophytes
- habitat:** physical aspect of place where organism naturally lives (as opposed to niche, which includes functional aspect as well)
- hair point:** awn or extension of tip of leaf into a hair
- halophilic:** salt-loving
- halophytic:** salt-tolerant
- haploid:** cell, structure, or organism having single set of chromosomes;  $1n$ ; e.g., normal chromosome level of gametophyte generation
- hardening:** process of increasing resistance (to desiccation, cold, etc.) in plants
- haustorium:** cells at base of sporophyte foot; functions in absorption of nutrients from gametophyte to sporophyte
- hemicellulose:** long-chain polysaccharides; H-bonded to cellulose in plant cell walls; more soluble than cellulose
- Hepatophyta:** Marchantiophyta; alternate phylum name for liverworts
- herbaceous:** refers to above ground plants or plant parts that are not woody and do not persist (L. *herbaceus* = grassy)
- herbarium:** collection of dried and usually pressed plant specimens (bryophytes and lichens are usually not pressed) (L. *herba* = grass)
- heterocysts:** relatively large, thick-walled nitrogen-fixing cell produced within filaments of certain cyanobacteria
- heterosporous:** forming more than one kind of spore; having megaspores and microspores, as in *Selaginella*
- heterospory:** bearing two kinds of spores, generally large female and small male spores, genetically determined
- heterothallic:** having male and female reproductive structures on separate thalli
- heterozygous:** individual containing two different allelic forms of same gene
- Hill reaction:** light-driven splitting of water in Photosystem II of photosynthesis, releasing oxygen
- holomorphy:** literally, whole form; entire aspect of organism as it appears in environment, resulting from their adaptations to their environments; *Gestalt*
- homoiochlorous:** maintaining constant chlorophyll concentration, as in *Syntrichia ruralis* during desiccation
- homoiohydric:** state of hydration controlled by internal mechanisms in plant
- homologous recombination:** process in which cut pieces of DNA search for other homologous pieces and form an exchange with them
- homologous:** having alleles for the same kinds of traits; chromosomes that are capable of pairing
- homosporous:** having only one kind of spore, i.e. spores for two sexes, if differentiated physiologically, do not appear different (Gr. *homo* + same, *spora* = seed)
- homozygous diploid:** organism ( $2n$ ) having both alleles for same trait
- homozygous:** state of having two identical alleles of particular gene (e.g. AA, aa)
- hormogonium** (pl. **hormogonia**): short piece of Cyanobacterial filament that becomes detached and glides away, becoming an independent filament
- hormone:** organic compound active in very small amounts and normally produced in one part of plant and transported to another where its concentration exercises control in some phase of growth or development process (Gr. *hormaein* = to excite)
- hornwort:** common name for phylum of thallose plants (**Anthocerotophyta**) with photosynthetic, hornlike capsule
- HPLC:** high-performance liquid chromatography
- hummock:** small, rounded or cone-shaped, low hill or surface of other small, irregular shapes; raised hump as found in bogs and fens

- hyaline:** colorless or transparent; used with reference to dead cells, such as water-holding cells of *Sphagnum*
- hyalocyst:** large, empty water storage cell in leaves of *Sphagnum*, *Leucobryum*, and in many endohyalocysts; hyaline cell
- hydration:** adsorption of water on or by hydrophilic (water-loving or water-attracting) surfaces (Gr. *hydro* = water)
- hydric:** wet, referring to habitat
- hydroid:** water-conducting cell of bryophyte; tracheid-like conductive cell in central strand
- hydrome:** collective term for hydroids in moss stem, often forming central strand
- hydrophilic:** water-loving, typically attracting moisture, as is done by the outer surface of peristome teeth
- hydroxyproline:** crystalline amino acid obtained from hydrolysis of gelatin or collagen; abundant in major glycoprotein of plant primary cell wall
- hygrophytic:** of wet habitats, but not in water
- hygroscopic:** moving in response to moisture changes; absorbing water rapidly, as in moss leaves or elaters
- hypnaceous:** referring to complete peristome
- hypocotyl:** shoot of germinating seedling, located below cotyledons
- hypodermal:** one or more layers of differentiated cells beneath epidermis of stem
- hypophysis:** enlarged neck between seta and urn of capsule; apophysis
- IAA (indole-3-acetic acid):** C<sub>10</sub>H<sub>9</sub>NO<sub>2</sub>; naturally occurring auxin that induces cell division and elongation and many developmental processes; synthesized from tryptophan; often works in consort with ethylene and other hormones
- imbibition:** uptake of water due to water adsorption by colloidal particles such as cellulose, cytoplasmic proteins, or pectin
- immediate fitness:** few haploid individuals possessing particular trait are able to exploit new situation
- immobile:** unable to be translocated (moved) through plant or soil
- incubous:** lying upon; oblique leaf insertion in which distal leaf margins are oriented toward dorsal stem surface
- indicator:** that which indicates condition or presence of something else; chlorotic or unhealthy bryophytes can serve as indicators of air pollution
- indigenous:** born, growing, or produced naturally in country or region; native
- indoleacetic acid (IAA):** naturally occurring auxin that controls cell division and many developmental processes; often works in consort with ethylene and other hormones
- inflorescence:** reproductive organ group; gametoeonium
- innovations:** new shoots; in acrocarpous mosses, new branch
- inoperculate capsules:** capsules lacking operculum or lid
- inoperculate:** lacking operculum or lid on capsule
- intercalary:** situated at bases of leaves or branches but not apical
- intercellular:** between cells
- internode:** distance between leaf or branch insertions
- intine:** innermost of two major layers of spore, lying under exine bordering surface of cytoplasm
- involute:** protective sheath of tissue of thallus origin surrounding single antheridium, archegonium, or sporophyte; e.g. *Pellia*
- ion:** charged particle
- isocitratase:** enzyme of glyoxylate cycle
- isodiametric:** about as long as wide
- isospory:** condition of having spores with unimodal distribution or similar size.
- isotherm:** line connecting points of equal temperature
- Jungermanniidae:** subclass of mostly leafy liverworts in Jungermanniopsida
- Jungermanniopsida:** class including leafy liverworts and Metzgeriidae
- K selection:** characterized by slow growth rate, late reproduction, few, large offspring, and efficient use of resources; K strategist optimizes for high population density at environment's **carrying capacity**
- keel:** sharp ridge, as on the bow of a boat; seen in some moss leaves such as *Fontinalis antipyretica*
- kinetin:** N<sub>6</sub>-furfuryladenine; synthetic cytokinin that acts as growth hormone, promotes cell division, and prevents senescence in plants; degradation product of DNA
- kingdom:** grouping of all divisions or phyla; plants belong to kingdom **Phyta**, also known as **Plantae**
- Kreb's cycle:** citric acid cycle; tricarboxylic acid cycle; cycle that provides electrons for electron transport system where ATP is produced from ADP and inorganic cycle, thus being important in providing cellular energy
- K-strategist:** species that optimizes for high population density at environment's carrying capacity.
- LAI: leaf area index;** percentage of ground area covered by leaves, hence **(total leaf area) / (area of ground)**
- lamella (pl. lamellae):** cellular membrane such as that of chloroplast or that separating cell walls from one another; in bryophytes, stack of cells forming flaplike plates (parallel photosynthetic ridges) of tissue on leaf or dorsal surface of thallus; in mushrooms, gills
- lamina:** cells of blade portion of leaf, exclusive of costa and border
- leachate:** solution formed when water percolates through permeable medium such as soil; may be derived from particles washed from canopy leaves
- leaf hair:** threadlike projection on leaf
- leaf trace:** branch of vascular tissue or hydroids in stem, that goes to leaf
- leaf:** photosynthetic organ of plant; in bryophytes, phyllid; in tracheophytes, vascular structure with xylem on top and phloem on bottom – usually has palisade and spongy mesophyll
- lenticular:** lens-shaped
- leptoid:** cell in outer layer of conducting cells of bryophyte, used primarily for assimilates; similar to sieve cell
- leptome:** (=leptom); phloem-like tissue consisting of leptoids and parenchymatous cells; collective term for leptoids in bryophytes
- lichen:** symbiotic (mutualistic) organism composed of a fungus and a photosynthetic partner (algae or Cyanobacteria); classified as fungus
- lid:** operculum; top part of capsule of mosses that comes off for spore dispersal
- life cycle:** complete repeating sequence of reproductive events in life of plant necessary for continuation of species
- life form:** overall organization of growth form, branching pattern, and general assemblage of individuals or population as modified by environment; morphological characters
- life strategy:** life cycle characteristics and timing

- light compensation point:** irradiance level (PAR) at which CO<sub>2</sub> release during respiration balances CO<sub>2</sub> intake during photosynthesis
- light intensity:** unit of total energy or illumination, such as lux, foot candle, cal/cm<sup>2</sup>/min,  $\mu\text{Einstein m}^{-2}\text{s}^{-1}$
- light-saturated:** having obtained that intensity of light, or greater, at which photosynthesis is maximum
- lignified:** reinforced with lignin
- lignin:** complex polymer of phenolic substances impregnating cellulose framework of certain plant cells; provides strength and rigidity to secondary plant cell walls
- limiting factor:** that aspect in environment that would increase plant productivity if more of it were added
- liverwort:** common name of Marchantiophyta (=Hepatophyta); group of bryophytes with dorsiventrally oriented leafy or thalloid plant bodies
- lobule:** small lobe; *e.g.* smaller segment of unequally divided leaf in leafy liverworts
- LT<sub>50</sub>:** temperature at which 50% of cells die
- lumen:** central cavity of vesicles, ducts, chambers, etc
- lunularic acid:** plant hormone similar to abscisic acid; found in liverworts, causing growth inhibition and dormancy
- lutein:** orange-red carotenoid pigment with absorption at 470-500 nm (blue light); known to reduce the risk of macular degeneration and prevent damage from glare and bright light in humans
- lux:** intensity of light from one candle on surface 1 meter square and 1 meter from source
- male:** organism that produces sperm
- mammillose:** having strongly bulging cell surface
- mannose:** hexose monosaccharide (6-carbon sugar) with structure very similar to glucose
- Marchantiophyta:** = Hepatophyta, formerly Class Hepaticae; phylum of plants lacking lignified vascular tissue and having-dorsiventral organization
- Marchantiopsida:** class of thallose liverworts that is dichotomously forked and many cells thick
- mat:** densely woven, horizontal growth form
- maturation:** process of development and reaching reproductive stage
- megagamete:** female gamete; in bryophytes egg
- megasporocyte:** cell that will undergo meiosis to produce megaspores
- meiosis:** nuclear division that separates sets of chromosomes; reduction division; reduces 2*n* condition to 1*n* condition; nuclear process in which each of four daughter cells has half as many chromosomes as parent cell; in plants it produces meiospores or meiospore nuclei, in animals it produces gametes (Gr. *meioun* = to make smaller)
- meiospore:** 1*n* spore resulting from meiosis (Gr. *meioun* = to make smaller, *spora* = seed)
- meltwater:** water derived from snow or ice melt
- membrane:** thin layer of proteins and lipids surrounding cells and most cellular organelles; controls passage of substances into and out of cell or organelle (L. *membrana* = skin covering separate members of body)
- meristem tissue:** collection of cells capable of active cell division, thereby adding to plant body; embryonic or undifferentiated cells
- meristem:** collection of cells capable of active cell division, thereby adding to plant body; embryonic cells; growth region (Gr. *meristos* = divisible)
- mesic:** having moderate moisture or water supply
- mesophytic:** living in continually moist habitats; water and habitat requirements between hygrophytic and xerophytic
- metabolism:** sum total of all chemical activities of living organism (synthesis and breakdown)
- metapopulation:** group of partially isolated local populations of same species, but connected by migration
- methionine:** amino acid that is relatively insoluble in water and has non-polar R group
- Metzgeriidae:** subclass of mostly thallose liverworts in Jungermanniopsida
- microgamete:** male gamete; sperm in bryophytes; antherozoids
- microgametophyte:** male gametophyte
- micronutrient:** essential nutrient needed by plants in relatively small amounts
- microspecies:** populations within a species that differ physiologically but not morphologically, permitting them to occupy different growing conditions
- microtubule:** essential protein filament of cell structural skeleton
- mineral:** inorganic substance occurring naturally in earth and having consistent and distinctive set of physical properties
- mitochondrion** (pl. **mitochondria**): cell organelle used during respiration
- mitosis:** nuclear division where two daughter cells are produced from one parent cell with no change in number of chromosomes
- mixohydric:** bryophytes that utilize both internal and external methods in water conduction.
- molluscicidal:** killing molluscs such as snails, slugs, or clams
- monad:** grouping of one, as in single spore
- monitor:** to watch or check on; instrument (including plant) used to check on conditions
- monoecious:** bisexual; having both male and female reproductive structures on the same plant; applied to sporophytes of tracheophytes
- monoicous:** bisexual; with antheridia and archegonia on same plant
- monomorphism:** both genders look the same; literally, one form
- monophyletic:** referring to group of organisms that includes most recent common ancestor of all organisms and descendants of that common ancestor; having common ancestor (Gr. *mono* = one; Gr. *phyl* = tribe)
- monopodial:** growth pattern with single continuous axis
- morphological:** referring to characteristics of structure (Gr. *morphe* = form, *logos* = discourse)
- morphology:** discourse of form and structure (Gr. *morphe* = form, *logos* = discourse, doctrine)
- motile:** in plants, capable of moving by means of flagellum
- MPa:** unit of measure equal to 10<sup>6</sup> Newtons per m<sup>2</sup> or 1 N per mm<sup>2</sup> or 10 bars
- mRNA:** messenger RNA, used during protein synthesis
- mucilage:** polymer of galactan, which yield hexose sugar galactose on hydrolysis
- mucilage:** any thick, sticky substance secreted by cell
- multicellular reproductive structure:** characteristic of reproductive structures of plant kingdom
- multicellular:** having plant body composed of more than one cell wherein cells do not act as independent organisms
- multi-ranked:** having leaves coming from more than two sides of stem

- multistratose:** having multiple layers of cells
- mutualism:** interaction between organisms in which both partners benefit, such as alga and fungus of lichen (*L. mutuus* = reciprocal)
- mutualistic:** benefitting each other
- mycorrhiza** (pl. **mycorrhizae**): fungal association with root (or anchoring structure); characteristic of *Lycopodium* gametophyte and most pine roots (Gr. *mykes* = fungi, *riza* = root)
- neck canal cell:** cell of archegonium neck that will disintegrate and liquefy when archegonium is mature
- neck canal:** entry canal through neck to egg in base of archegonium
- nematodontous:** having peristome consisting essentially of whole dead cells, usually with thickened walls, non-jointed
- nemoral:** living in open woodland
- neoteny:** condition in which juvenile characters retained in adults
- neoxanthin:** hydrophilous carotenoid pigment
- nitrogen fixation:** conversion of gaseous nitrogen (N<sub>2</sub>) to ammonia and its incorporation into organic nitrogenous compound in cell; carried out by some bacteria and Cyanobacteria
- node:** location of leaf or branch junction with stem
- nodular:** having small masses of solid tissue
- non-tracheophyte:** plant lacking tracheids, *e.g.* bryophytes
- non-translocatable:** adjective to describe nutrients or other substances that do not usually move from original site of storage in plant
- nuclear condition:** number of sets of chromosomes, usually haploid (1*n*) or diploid (2*n*)
- nucleolus** (pl. **nucleoli**): apparent body on nucleus where extensive RNA formation is occurring
- nucleus** (pl. **nuclei**): cell organelle bounded by two membranes and containing DNA; occurs in most living eukaryotic cells (*L. nucleus* = kernel of nut)
- nunatak:** mountain top or rocky outcrop escaping glaciation regional glaciation
- nutiation:** spiral or circular growth pattern
- nutrient deficiency:** condition in which some nutrient is not available in sufficient quantity for plant to function properly
- nutrient:** element or compound useful to plant when in proper quantities
- O horizon:** organic soil layer including litter layer (**O1**), fermentation layer (**Of**), and humified layer (**Oh**)
- objective:** in microscope, series of lenses that produce magnified image of specimen and project it up into focal plane of ocular
- obligate aquatic:** having little or no tolerance to drought conditions
- oblique:** in protonemata; end wall is oriented on slant compared to axis of filament
- oil body:** membrane-bound, terpene-containing organelle unique to liverworts
- ombrotrophic:** receiving nutrients primarily from rainfall
- operculate:** having operculum
- operculum** (pl. **opercula**): in mosses, lid of capsule (spore-container) that comes off for spore dispersal (*L. operculum* = lid)
- opportunistic:** plant that takes advantage of most abundant or easily obtainable site of occupancy; one taking immediate advantage
- Ordovician:** geologic period of the Palaeozoic era dating ~441-504 million years ago
- organelle:** cellular subunit with structure and function
- osmiophilic:** refers to lipid-containing bodies in chloroplast; plastoglobuli
- osmiophilic globule:** lipid-containing body in chloroplast
- osmiophilic layer:** lipid layer; plastoglobuli
- outcrossing:** outbreeding; crossing individuals of different populations or less closely related than average pairs in the population
- overwintering:** persisting throughout winter
- palisade mesophyll:** columnar cells of inner leaf tissue
- paludification:** process of becoming marsh-like
- papilla** (pl. **papillae**): projection from cell or structure, as in cells of some mosses
- PAR:** photosynthetically active radiation, expressed as  $\mu\text{mol m}^{-2} \text{s}^{-1}$ , or as **watts** per meter square ( $\text{W m}^{-2}$ )
- paraphyllum:** leaflike appendage between leaves
- paraphysis** (pl. **paraphyses**): hyaline or yellowish, usually uniseriate, non-reproductive hair often associated with antheridia and archegonia in mosses; occur in fungi, algae, and bryophytes (Gr. *para* = beside, *physis* = a growth)
- parasite:** organism that derives nourishment from another species of living organism without benefitting other organism (Gr. *parasitos* = one who eats at table of another)
- parasitic:** living on or in and gaining nutrients from another living organism, to detriment of host organism
- parenchyma:** tissue composed of living cells with thin primary walls and no secondary walls, such as cortex cells; usually have large vacuoles (Gr. *parenkheim* = to pour in beside)
- paroicous:** with antheridia and archegonia in single gametocium but not mixed, antheridia in axils of bracts just below bracts surrounding archegonia
- patient:** tolerant species
- peat:** mass of semicarbonized plant tissue; often considered synonymous with *Sphagnum*, but actually includes grasses, sedges, and other plant types
- peg:** scaled, inward protrusions of cell wall, as in rhizoid of *Marchantia*
- pendant:** epiphyte with long main stem hanging down, with short side branches
- pendent:** hanging, pendulous
- perennating:** lasting from year to year
- perennial:** plant that overwinters and continues to grow for many years (*L. perennis* = lasting whole year through)
- perennial shuttle:** species that requires stable environments, such as epiphytes, where end of habitat is predictable
- perennial stayer:** species that becomes established and remains for many years
- perianth:** organ of foliar origin enclosing archegonia in most leafy liverworts
- perichaetium** (pl. **perichaetia**): modified leaves enclosing female reproductive structures; ensheathing cluster of modified leaves or underleaves and perianth, if present, enclosing archegonia
- perigonium** (pl. **perigonia**): modified leaves enclosing male reproductive structures
- perine:** sporoderm layer situated around exine of many spores
- periphyton:** organisms attached to submerged surfaces
- peristomate:** having peristome
- peristome tooth:** one unit of peristome

- peristome:** in mosses, fringe of teeth around opening of capsule (spore container); involved in spore dispersal (*peri* = around; *stoma* = mouth, opening)
- permafrost:** permanently frozen ground in arctic and subarctic
- permeability:** ability of membrane, cell, or cell system to permit substances to diffuse (*L. permeabilis* = that which can be penetrated)
- peroxisome:** microbody containing catalase in plant cell that carries out photorespiration
- pH:** negative log of hydrogen ion concentration; measure of acidity
- phanerogam:** seed plant
- phanerogamic:** referring to seed plants
- phenolic compound:** similar to lipid, but more soluble in water and less soluble in nonpolar organic solvents; appears to be by-product of metabolism with no known use to plant's own metabolism; many may serve as deterrents to predation by insects
- phenology:** discourse of life cycle events (growth & reproduction), or series of events themselves, as they relate to seasonal events; natural phenomena that occur periodically (Gr. *pheno* = appear, *logos* = discourse, doctrine)
- phenotype:** total appearance of organism
- phlobaphene:** flavonoid (anthocyanin) pigment formed by oxidation of tannic compounds
- phloem:** sugar-conducting cells of lignified vascular plants (tracheophytes)
- phloem loading:** movement of sugars from a source to a sieve element; cells in a sugar source "load" a sieve-tube element by actively transporting solute molecules into it
- photoinhibition:** decreased photosynthetic activity due to excess illumination
- photonegative:** in tropisms, bending away from light
- photoperiod:** plant response to duration and timing of day and night
- photosynthate:** product of photosynthesis
- phototropism:** growth in which direction of light is determining factor in orientation; turning or bending in response to light
- phycobilisomes:** cellular organelle located on surface of thylakoids of chloroplasts and in which biliprotein pigments (phycoerythrin, phycoerythrin) are present
- phyllid:** non-vascular leaf, as in mosses and liverworts
- phyllodioicous:** having dwarf male plants growing on leaves of female plants
- phyllodioicy:** spore germination on leaves of female plant
- phylloid:** leaflike
- phylogenetic:** referring to evolutionary relationships between groups of organisms
- phylum:** highest category in classification of plants and animals; equivalent to division in plants
- physiological races:** populations within a species that differ physiologically but not morphologically, permitting them to occupy different growing conditions (microspecies, cryptic species)
- Phyta:** Latinized name for plant kingdom (Gr. *phytum* = plant)
- phytochrome:** photosensitive pigments involved in photoperiodism, seed germination, and leaf formation; absorbs red and far-red light
- pigment:** substance that absorbs visible light and hence appears colored
- pioneer:** species able to colonize substrata not yet suitable for other species
- pit field:** location of pit that connects two cells through middle lamella and thin primary cell wall, but lacking secondary cell wall; location of concentrated plasmodesmata; known from moss *Hookeria lucens*
- pK:** pH at which equal concentrations of acidic and basic forms of substance are present; negative log (base 10) of dissociation constant of electrolyte
- placenta:** gametophyte-sporophyte interface
- plasmalemma:** cell membrane
- plasmodesma** (pl. **plasmodesmata**): tiny, membrane-line channel between adjacent cells
- plasmolysis:** separation of cytoplasm from cell wall due to removal of water from protoplast (Gr. *plasma* = something with form, *lysis* = loosening)
- plasmolyze:** condition of cell protoplasm shrinking away from cell wall
- plasticity:** capacity of organism to vary its morphology, physiology, or behaviour in response to environmental fluctuations
- plastid:** class of organelles, including chloroplasts, containing pigments, and amyloplasts, containing starch (Gr. *plastis* = builder)
- plastoglobulus:** globular structure found in plastids, containing primarily lipids
- pleurocarpous:** producing sporangia on short, specialized lateral branches or buds and typically prostrate, forming freely branched mats
- pligate:** fan-folded like a Japanese fan (WW), describing leaves of some mosses
- poikilohydric:** having state of hydration controlled by external environment
- poikilothermic:** having body temperature controlled by external environment
- pollutant:** unnatural human-related substance that is introduced to environment (*L. polluere* = to dirty, *lutum* = mud)
- pollution:** contamination of environment by unnatural human-related substance(s) (*L. polluere* = to dirty, *lutum* = mud)
- polyol:** group of chemical compounds (polymers or monomers) with hydroxyl functional groups; include polyethers and polyesters, including glycerin
- polyphenolic:** polyhydroxy phenol; group of plant chemical substances characterized by presence of more than one phenol group per molecule; cause coloring in some plants, including some autumn leaf coloring
- polyploidy:** plant, tissue, or cell with more than two complete sets of chromosomes
- polysomes:** two or more ribosomes joined by molecule of messenger RNA during protein synthesis
- polysporangiate:** having multiple sporangia on one sporophyte
- Polytrichopsida:** class of mosses containing Polytrichaceae, Tetraphidaceae, Buxbaumiaceae, and Oedipodiaceae; characterized by nematodontous (non-jointed) peristome teeth
- population:** group of interacting individuals of same species or lower taxon in common spatial arrangement with potential for gene flow
- pore:** small aperture, opening in wall of some cells; space or opening; in upper surface of thallose liverworts
- PPFD:** photosynthetic photon flux density, measured as  $\mu\text{mol m}^{-2} \text{s}^{-1}$ , or as **watts** per meter square ( $\text{W m}^{-2}$ )
- precocious germination:** cell division occurs while spore still within capsule

- primitive:** taxonomic trait thought to have evolved early in time (L. *primus* = first)
- primordium:** earliest stage in development of plant part
- productivity:** measure of new organic matter produced by group of organisms over period of time
- propagule:** see propagulum
- propagulum** (pl. **propagula**): propagule; diaspore that has apical cell and can grow directly into leafy shoot if apical cell is reactivated; reduced bud, branch, or leaf serving in vegetative reproduction
- prostrate:** lying flat on ground; creeping
- protandrous:** describes condition in which male parts of individual plant reach maturity before female parts do, such as in fern prothalli; helps insure cross-fertilization
- protandry:** condition in which maturation of antheridia occurs before that of archegonia
- protocooperation:** interaction between organisms that is mutually beneficial but not required
- protogynandry:** maturation of archegonia before antheridia on same plant
- protogynous:** having archegonia mature before antheridia on same plant
- protonation:** instance of substance gaining a proton, *i.e.* being acidified
- proton pump:** ATP-driven active transport of H<sup>+</sup> ions from cell into intercellular matrix, permitting cations to enter cell by charge gradient.
- protonema** (pl. **protonemata**): green, branched filaments produced from germinating spores, giving rise to leafy plant; literally "first thread"
- protoplast:** protoplasm of single cell
- PS II:** photosystem II of photosynthesis; system of molecules and enzymes in plant chloroplasts that absorbs energy of red light with wavelength of 680 nm, and uses it to produce ATP and to split water into protons and oxygen
- pseudoelater:** false elater; one, two, or four-celled sterile filament developed after several mitotic divisions and subsequent differentiation of diploid pseudoelater mother cell among spores in capsules of hornworts; outnumber spores
- pseudopodium:** in *Sphagnum*, watery gametophyte stalk that supports sporophyte; sporophyte foot is imbedded at apex
- pyrenoid:** proteinaceous body serving as nucleus for starch storage and common in green algae and Anthocerotophyta
- Q<sub>10</sub>:** ratio of ending to beginning reaction rates for a 10°C rise in temperature
- r and K selection:** selection for life cycle strategy based on high reproductive potential (r) or long life and high carrying capacity (K)
- r strategy:** life cycle strategy characterized by rapid growth rate, early reproduction, numerous, small offspring (spores or seeds in plants), and high resource uptake
- radiolabel:** to tag with radioactive tracer such as <sup>14</sup>C or <sup>15</sup>N
- ramet:** individual member of clone
- recessive allele:** trait that only shows when both alleles of gene are same
- refugium** (pl. **refugia**): area that has climate representative of past and different from that of surrounding area
- rehydrin:** protein involved in rehydration, thought to be responsible for production of anti-oxidants
- reproduction:** formation of similar offspring
- resorption:** to absorb (re-absorb) a tissue after it has been made
- respiration:** process by which sugars and other stored organic molecules are oxidized and broken down, with energy captured in formation of ATP
- reverse genetics:** genotype-driven technique in which genes are either knocked out or added to see the effect on phenotypic expression
- rhizoid peg:** cell wall protrusion into cell; found in Marchantiales
- rhizoid:** non-vascular anchoring and absorbing structure, one cell thick and one cell long in liverworts and hornworts, multicellular, generally with oblique end walls in mosses; found in gametophytes of Marchantiophyta, Anthocerotophyta, and Bryophyta (Gr. *rhiza* = root, *oides* = like)
- rhizoidosphere:** area immediately surrounding rhizoids; comparable to rhizosphere of tracheophytes
- rhizome:** horizontal (usually) underground stem, such as those connecting *Polytrichum* clones (Gr. *rhiza* = root)
- rhizosphere:** soil immediately around roots; root zone
- ribosome:** organelle where protein synthesis occurs in cell
- r-selected species:** organism characterized by rapid growth rate, early reproduction, numerous, small offspring (spores or seeds in plants), and high resource uptake
- r-strategist:** organism characterized by rapid growth rate, early reproduction, numerous, small offspring (spores or seeds in plants), and high resource uptake
- RUBISCO:** enzyme that catalyzes carbon fixation in plants
- ruderal:** referring to plant living on field or wasteland in built up areas
- saxicolous:** living on rock
- scarification:** abrasion process in which one "scars" the seed coat by scratching or nicking it; used to break dormancy in seeds with hard seed coats; mechanical means of breaking outer covering of propagule such as seed or spore for germination
- sciophyte:** plant growing in shady habitats
- sclerenchyma:** cell with thick walls that provides mechanical support to plant
- sclerophyll:** plant with stiff, leathery, evergreen leaves
- secondary compound:** chemical manufactured by plant that protects it; not used in any essential metabolic pathway
- secondary growth:** growth derived from lateral meristem, as in most trees; plant growth that does not occur at tips of stems or tip of roots; in seed plants, secondary growth produces bark and wood
- SEM:** scanning electron microscope
- semi-aquatic emergent:** being in locations where plants are partly in the water and partly out of it, but usually moist
- senescence:** process of aging
- sensu:** in sense of
- sensu lato:** in broad sense
- sensu stricto:** in strict or narrowest sense
- serine:** amino acid with polar R group and soluble in water
- seta** (pl. **setae**): stalk that supports moss or liverwort capsule; elongated portion of sporophyte between capsule and foot
- sex chromosome:** one pair of chromosomes that are different in two sexes and are involved in sex determination
- sexine:** outer layer of exine, *e.g.* in spore
- sexual reproduction:** reproduction that requires meiosis, formation of haploid state (having one set of chromosomes), formation of gametes, and union of gametes to complete life cycle

- sexual:** in plants, any reproductive stage involving meiospores or gametes
- shoot apex:** tip, usually growing tip, of plant
- shoot:** combination of stem and leaves of plant
- short-lived shuttle:** species that doesn't avoid periods of severe stress; habitat lasts 2-3 years
- shuttle species:** one that moves from place to place, occupying short-lived environments
- sieve cell:** long, enucleate conducting cell of phloem
- siliceous:** composed of silica (silicon dioxide, SiO<sub>2</sub>), which occurs in nature as chert, quartz, flint, and agate
- silicolous:** growing on sandstone or siliceous rock
- Silurian:** geologic period of the Palaeozoic era dating ~400-440 million years ago
- slime papilla:** mucilaginous projection on stem of liverworts
- soil degree days: (SDD);** unit of measure calculated as product of time (days) and temperature (°C) of soil, usually averaged over growing season or activity season for organism in question; number of degree-days that occur in one day is determined from average temperature for that day minus base temperature, which is minimum temperature above which activity occurs
- solifluction:** slow, downhill movement of soil and other materials in areas typically underlain by frozen ground; slump; mudflow
- somatic mutation:** mutation that does not affect gametes; mutation in body cells; usually non-heritable change
- somatic:** any (cell) except reproductive cells; vegetative (cell)
- species** (pl. **species**): taxonomic unit denoting those organisms that can potentially interbreed, yet are unable to breed with other groups; group of entities recognizably different from other entities but seeming to represent group with common characters (L. *species* = kind)
- species diversity:** measure of number of different species and distribution of individuals in system
- species richness:** measure of number of different species in system without regard to number of individuals in each species
- sperm:** male gamete that is smaller than female and motile
- spermatocyte:** cell that becomes converted into sperm
- spermatogenesis:** formation of sperm
- spermatogenous:** giving rise to sperm
- Sphagnophyta:** phylum name sometimes used for *Sphagnum* and *Ambuchanania* when separating them from the Bryophyta
- Sphagnopsida:** class of mosses with only one genus, *Sphagnum*
- sphagnorubin:** red pigment in cell walls of some *Sphagnum* species
- spiral thickening:** helical ridge on inner face of and part of secondary cell wall; found in elaters and secondary xylem tracheary elements or fibers
- splash cup:** container from which reproductive units (sperm, gemmae, spores) can be splashed by raindrops
- sporangium** (pl. **sporangia**): container that produces spores; capsule (Gr. *spora* = seed, *angeion* = vessel)
- spore mother cell:** sporocyte; cell that will undergo meiosis to produce meiospores
- spore:** reproductive cell that develops into plant without union with another cell, usually 1-celled
- sporeling:** all structures developed between germination and formation of adult gametophore
- sporocyte:** spore mother cell; cell that will undergo meiosis to produce meiospores
- sporogenesis:** process of giving rise to spores, starting with meiosis in plants
- sporophyte:** diploid ( $2n$ ) meiospore-bearing generation; initiated by fertilization of egg and ends with meiosis (Gr. *spora* = seed, *phyton* = plant)
- sporophyte generation:** diploid ( $2n$ ) generation in plants that begins with zygote and ends with meiosis that produces  $1n$  spores; dominant generation in all plants but bryophytes
- sporopollenin:** phenol-containing polymer that imparts high chemical resistance to exine (outer layer) of pollen
- squama** (pl. **squamae**): part arranged like scale; broad, flat surface (L. *squama* = scale)
- stalk:** seta in mosses; structure that supports capsule in mosses, liverworts, and some fungi
- statolith:** type of amyloplast used in sensing gravity
- stem:** main axis of plant
- stemflow:** solution that flows down tree trunks during precipitation
- stereid:** slender, elongate, fiber-like cell found in costa or stem in some mosses
- stereome:** (= stereom); refers to entire system of stereids in mosses
- sterile:** in botany, refers to organisms unable to reproduce sexually; free from living microorganisms
- sterile jacket:** term often applied to outer covering of sporangium; non-spore-producing tissue surrounding sporogenous tissue or spores
- sterome:** stereome; refers to entire system of stereids in mosses
- stolon:** stem that grows horizontally along ground
- stoma** (pl. **stomata**): minute opening in capsule wall of hornworts and capsule neck of mosses; surrounded by two guard cells (Gr. *stoma* = mouth)
- stratose:** in layers; denoting thickness of leaves
- stress:** external constraint that limits rate of dry matter production of all or part of vegetation
- stroma** (pl. **stromata**): colorless matrix of chloroplast in which packets of chlorophyll are embedded
- substrate:** molecule that is acted upon by enzyme in enzymatically controlled reaction; solid medium on which plant grows
- succubous:** lying under; oblique leaf insertion in which antical (distal) margins are oriented toward ventral stem surface
- sunfleck:** flashes or patches of sunlight on forest floor
- superoxide dismutase:** SOD; enzyme that destroys highly reactive superoxide; contains zinc and copper or manganese; known to enhance membrane integrity
- symbiont:** organism that lives in close association with another
- symbiosis:** close association of two species
- sympatric:** occurring in same geographic area
- symplastic:** through protoplasts and their intercellular connections (plasmodesmata)
- sympodial:** growth pattern where primary axis is superseded by succession of secondary axes
- synergism:** complementation or helping each other so result is greater than sum of parts
- syngamous:** archegonia and antheridia mixed in same gametoeonium
- taiga:** open forest, usually coniferous, bordering arctic tundra

- tail:** bryophyte growth form that occurs on trees and rocks, shade-loving; radially leafed, creeping, shoots stand away from substrate; e.g. *Cyathophorum*, *Leucodon*, *Spiridens*, some tropical *Plagiochila*
- Takakiopsida:** class of mosses with finely divided leaves and spirally valvate capsules
- taxon** (pl. **taxa**): general term for any taxonomic rank (Gr. *taxis* = order)
- teeth (peristome):** fringe of appendages about opening of sporangium in mosses
- teniola** (pl. **teniolae**): border-like row of differentiated cells, differing from true border by being intramarginal
- tensibility:** strength when pulled end-to-end
- tepuui:** flat-topped, sandstone mesas in Venezuela
- terminal bud:** bud located at tip of stem or branch
- terminal:** tip; at end of stem or branch
- terpenoid:** sometimes referred to as isoprenoids; class of naturally occurring chemicals similar to terpenes, derived from five-carbon isoprene units assembled and modified in thousands of ways; most are multicyclic structures which differ from one another not only in functional groups, but also in basic carbon skeletons
- terraforming:** technologies employed to convert a desert moon or planet into a habitable one
- terrarium** (pl. **terraria**): glass or plastic container in which plants are grown; often sealed and moisture recycles
- terrestrial:** pertaining to land
- tetrad:** group of four; in spores, these retain flat-face cell walls made when they cluster together as group
- thalloid:** having flat, blade-like growth form
- thallose:** non-vascular plant body form; resembling thallus; describes group of liverworts that are not leafy
- thallus** (pl. **thalli**): non-vascular plant body, usually considered flat and dorsiventrally oriented, as in *Marchantia*; plant body lacking roots, stems, or leaves; body type of algae, fungi, some liverworts (non-leafy), and gametophytes of lower vascular plants
- thigmotactic:** responding to contact
- throughfall:** precipitation that comes through canopy
- thylakoid:** flattened, membranous vesicle containing chlorophyll; where photochemical reactions of photosynthesis occur
- TIBA:** 2,3,5-triiodobenzoic acid; polar auxin transport inhibitor
- tmema:** abscission cell; cell that ruptures to release moss gemmae
- tomentum:** in bryophytes, dense woolly covering of rhizoids
- toxicity:** poisonous quality or state
- trace element:** micronutrient; element required by plant in very small quantities
- tracheid:** lignified vascular conducting unit of tracheophyte, usually having tapered ends and pitted walls without perforations
- tracheophyte:** plant with well-defined, lignified vascular system; any plant of Tracheophyta (Gr. *tracheia* = windpipe, *phyton* = plant)
- tradeoff:** losing one quality or aspect of something in return for gaining another quality or aspect
- transfer cell:** cells at gametophyte-sporophyte junction, found in foot of sporophyte and in adjacent gametophyte; endowed with extensive and complex wall labyrinth and intense enzyme activity
- transitivity:** relation between three elements such that if it holds between first and second and it also holds between second and third it must necessarily hold between first and third, i.e. if a is part of b and b is part of c, then a is also part of c
- translocatable:** adjective to describe nutrients or other substances that move easily through plant (L. *trans* = across, *locare* = to place)
- translocation:** in plants, movement of organic substances from one location to another within plant; more generally used to refer to movement of any substance from one place to another in plant
- transpiration:** loss of water as vapor from plants
- transplant:** to move something from place where it is growing and placing it in another place to grow
- transport system:** in botany, system of cells used for directed movement of substances throughout the plant
- transverse:** across
- trigone:** generally triangular or circular intracellular wall thickening, found at point where three (or more) cells meet; common in leaves of leafy liverworts
- tryptophan:** essential amino acid, C<sub>11</sub>H<sub>12</sub>N<sub>2</sub>O<sub>2</sub>, formed from proteins
- triterpene:** one of class of hydrocarbons produced by many plants
- tropism:** orientation of direction of growth in organ of plant, guided by external stimulus such as light or gravity (Gr. *trope* = turning)
- true starch:** polysaccharide carbohydrate composed of two forms of glucose elements, amylose and amylopectin; principal storage compounds of plants
- tuber:** in mosses, gemmae produced on rhizoids; in liverworts, a perennating structure produced by downward growing outgrowth of shoot apex
- tuberculate:** with peg-like projections of cell wall material into cell
- tufa:** porous limestone formed in streams and springs; rock formations resulting from carbonates built upon bryophytes and other plants due to addition of photosynthetic oxygen to dissolved minerals
- turf:** growth form with stems erect, parallel and close together; often covering extensive areas
- turgid:** swollen, distended; refers to cell that is firm and swollen due to water uptake (L. *turgidus* = swollen, inflated)
- turgor:** state of cell which has taken in maximum amount of water causing distention of protoplast.
- ultraviolet light (UV):** light waves less than 400 nm long; high energy light waves that are invisible (to humans)
- underleaf:** modified leaf on underside of plant, especially in leafy liverworts
- undifferentiated:** refers to tissue that has not become specialized
- unicellular:** having only one cell
- unisexual:** having male and female reproductive structures on different individuals; having only one sex on the individual
- unistratose:** one-layered; comprised of single cell layer
- vacuole:** space or cavity in protoplasm, filled with watery solution
- valvate:** separating into sections or flaps upon dehiscence
- valve:** in liverworts & some mosses, sections of capsule that split apart at maturity
- vector:** in biology, carrier, such as flies that carry spores in *Splachnum*; in genetic engineering, bacterium, virus, or other

organism used to deliver new gene to cell of different organism

**vegetative propagation:** reproduction from non-sexual parts of plants, such as fragments

**vegetative:** asexual parts of plant

**venter:** swollen basal portion of archegonium, containing egg

**ventral canal cell:** cell at base of neck of archegonium; disintegrates before fertilization

**ventral:** lower or under surface

**vernalization:** change in physiological state induced by chilling; requirement in germination in some plant species

**vesicle:** membranous sphere involved in transport or storage in cell

**violaxanthin:** xanthophyll pigment in plants, formed in dark and converted to zeaxanthin in red light

**violent:** aggressive species

**vitricification:** preservation at extremely low temperatures without freezing; involves formation of glassy or amorphous solid state which, unlike freezing, is not intrinsically damaging even to most complicated of living systems; *e.g.* when sucrose is cooled slowly it results in crystal sugar (or "rock candy"), but when cooled rapidly it can form syrupy "cotton candy" or lollipops

**volatile:** evaporating rapidly; diffusing freely into atmosphere, as attractant in *Splachnum* capsule

**wax:** long chain hydrocarbon with little oxygen; contained in cuticle covering vascular plant surfaces

**WC<sub>50</sub>:** percent water content at which 50% of the plants would recover if dried to their compensation point

**weft:** loosely interwoven, often ascending growth form

**whiplash flagellum:** type of flagellum that lacks lateral appendages

**windthrow:** fallen tree(s) resulting from wind

**xanthophyll:** yellow or orange carotenoid pigment found in algae and plants (Gr. *xanthos* = yellowish brown; *phyllos* = leaf)

**xeric:** very dry; referring to habitat

**xerophytic:** describes plant adapted to dry habitat

**xylem:** vascular tissue that conducts water and mineral nutrients in lignified plants; composed of tracheids, and in flowering plants (and a few others) also vessels

**zeaxanthin:** carotenoid pigment; one of xanthophyll pigments; able to deactivate antenna chlorophylls when there is surplus light energy

**zygospore:** thick-walled resting zygote in some algae

**zygote:** product of fusion of two gametes; fertilized egg before it has undergone mitosis or meiosis (Gr. *zygon* = yoke)