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Home Science Plants Ferns & Other Lower Vascular Plants lower vascular plant, formerly pteridophyte, also called vascular cryptogam, any of the spore-bearing vascular plants, including the ferns, club mosses, spike mosses, quillworts, horsetails, and whisk ferns. Once considered of the same evolutionary line, these plants were formerly placed in the single group Pteridophyta and were known as the ferns and fern allies. Although modern studies have shown that the plants are not in fact related, these terms are still used in discussion of the lower vascular plants. The Pteridophyte Phylogeny Group (PPG I) recognizes two unrelated classes of extant lower vascular plants: Polypodiopsida, the ferns and horsetails, and Lycopodiopsida, the lycophytes. Vascular plants are those that possess a specialized conducting system for the transport of water, minerals, and food materials, as opposed to the more primitive bryophytes—mosses and liverworts—which lack such a system. They include both the seed plants—angiosperms and gymnosperms, the dominant plants on Earth today—and plants that reproduce by spores—the ferns and other so-called lower vascular plants. Plants: From Cute to Carnivorous You may know that rice is the seed of a plant, but what is the world’s oldest known plant? Which kind of plant can be an annual, biennial, or perennial? Dig deep and unearth the answers in this quiz. fern © chungking/FotoliaThe lower vascular plants represent the oldest of land plants. In their early evolution (during the Devonian and Carboniferous periods, 419.2 million to 298.9 million years ago), there were many forms that are now extinct. The sphenophytes, for example, were once a large and diverse group of herbs, shrubs, vines, and trees but are now limited to only 15 species of horsetails; the woody lycophytes (club mosses) are entirely gone, leaving only a faint trail in their reduced modern representatives. Much of the fossil fern foliage of the Carboniferous Period is of the uncharacteristic seed ferns, which are the probable antecedents of the flowering plants. Modern ferns represent an explosion of evolution in Cretaceous times (145 million to 66 million years ago).The lower vascular plants are not an economically important group. Though they are used locally by peoples around the world for medicines and food, their greatest value today is in horticulture (ferns). Their remains, however, provide the bulk of the world’s coal beds, and their relatively simple structure and life cycle make them extremely valuable to researchers in understanding the overall picture of plant structure and evolution. Get a Britannica Premium subscription and gain access to exclusive content. Subscribe Now A discussion of all types of plants is found in the article plant. For a discussion of the other types of vascular plants, see gymnosperm and angiosperm. For a discussion of the nonvascular plants, see bryophyte. The conduction system of vascular plants includes the xylem, composed largely of tracheids (tubular cells) in the lower vascular plants and gymnosperms and vessels in angiosperms, for conduction of water and minerals; and the phloem (sieve cells) for conduction of food materials. These vascular tissues are arranged in different patterns in different plant groups and in different parts of the plant. The vascular cylinder of a stem or root is called the stele. The simplest and apparently most primitive type of stele is the protostele, in which the xylem is in the centre of the stem, surrounded by a narrow band of phloem. It in turn is bounded by a pericycle of one or two cell layers and a single cell layer of endodermis. The pericycle is generally the layer giving rise to the branches in roots, and the endodermis seems to regulate the flow of water and dissolved substances from the surrounding cortex. More common in fern stems are siphonosteles, having a pith in the centre with the vascular tissue forming a cylinder around it. Where a fern leaf is attached to a stem, a part of the vascular tissue of the stem goes into it (a leaf trace), making a slight gap, filled by parenchyma cells (generalized plant cells), in the vascular cylinder. If the leaves are distant and the stem long and creeping, a single gap will be seen in cross section; if leaves are close together or numerous, the gaps overlap, causing the cylinder to appear in cross section as a ring of disconnected round or elongate bars of vascular tissue. Generally in lower vascular plants, when the young organs mature, no further growth in diameter takes place. In several extinct groups a special ring of cells, the cambium, produced additional xylem to the inside and phloem cells to the outside (secondary growth as opposed to primary growth achieved by apical activity of the stem and root), resulting in increased diameter and a truly woody plant. This is common in many seed plants today, but in the extant lower vascular plants only two genera (Botrychium and Isoetes) show a slight vestige of secondary growth. Even in today’s tree ferns (Cyathea, Dicksonia, Cibotium), with trunks up to 25 metres (80 feet) tall, the tissues are entirely the result of growth from the stem apex. Their strength is derived not from woody growth in diameter but by strengthening tissues surrounding the vascular bundles and in some cases by a mantle of roots. xylem tracheidsJ. M. LanghamThe cells of the vascular strands in lower vascular plants are mainly tracheids, sieve cells, parenchyma, and endodermal cells. The tracheids, which comprise the xylem, or water-conducting tissue, are normally long, narrow, and attenuated at the tips. Their secondary walls display ladderlike (scalariform) thickenings. The largest tracheids are several centimetres long, but most are much smaller. Vessel cells, which have evolved in several lines of fern evolution and are the principal water-conducting cell type of flowering plants, are modified tracheids in which the end walls have lost their primary membranes, thus providing direct, unimpeded connections for water transport between the cells. Vessels, longitudinal channels composed of linear series of such perforated cells, have been reported from such diverse ferns as waterclover (Marsilea) and bracken (Pteridium). The phloem is composed mainly of sieve cells—narrow, elongated units that differ from the tracheids in having persistent protoplasts and nuclei (i.e., they are still alive at functional maturity) and in lacking secondary walls with elaborate pitting. Sieve cells usually display more or less distinguishable sievelike areas, through which, presumably, organic foods pass in their travels through the stem and other plant organs. There are various arrangements of xylem and phloem, but usually a single strand composed of both is surrounded by parenchyma cells, the pericycle (a thin zone of living cells just within the endodermis), and an outer layer of cells with specialized walls, the endodermis. Endodermal cells in young stems are provided with special strips of secondary wall material known as Casparian strips on their radial walls (i.e., on all the cell walls except the two that face toward the stem axis and the stem surface). As the stems age, however, there is a tendency for the endodermal cells to become thick-walled around the entire circumference. The pith is made up of parenchyma cells as a rule, but, in some fern genera, scattered tracheid-like cells are found as well. The cells of the stems differ from those of many seed plants in lacking collenchyma (modified parenchyma cells with expanded primary walls) and true stone cells. Latex-producing cells in lower vascular plants are rare. fern anatomyDrawing by M. PahlTaproots are unknown in lower vascular plants. All roots are referred to as adventitious, in the sense that they arise at points along the stem. In internal structure, the roots are generally regarded as being much less diverse than the stems. They are protostelic, lacking pith and gaps, and they grow from one or more apical initials (cells that divide to produce all the cells and tissues of an organ), producing a root cap outwardly and the permanent tissues of the root inwardly. They entirely lack secondary growth (continued growth in thickness). The surface cells of the epidermis produce root hairs near the root apex. These cells are generally thin-walled, in contrast to the cells of the cortex, lying below the surface, which ultimately may become very thick-walled. The root hairs have fundamental importance in absorption of water and nutrients and in attachment of the plant to the soil or other growing surface. The endodermis of the root is well marked, and Casparian strips are present, as in the stem. There is also a tendency for the endodermis in older parts of the roots to become thick-walled and hardened (sclerified). The production and development of xylem tissue in the steles of most pteridophyte roots is diarch; that is, the first matured xylem appears along two lines at the outer periphery of the xylem strand. The xylem is surrounded by phloem, and the branch roots arise from the pericycle. New from Britannica There are 34,000 different species of fish. That’s more than all the other vertebrates (amphibians, birds, reptiles, and mammals) combined. See All Good Facts peacock fernWalter DawnStem appendages known as leaves take various forms that evolved independently in different groups of lower vascular plants. The simplest are scalelike emergences, or enations, that are not served by vascular tissue (i.e., they have no veins), found in some extinct groups and in modern whisk ferns (Psilotum). The lycophytes have scalelike, needlelike, or awl-shaped "microphylls" with a single, unbranched vein. The sphenophytes have "sphenophylls"—scalelike leaves with a single vein in the modern Equisetum or wedge-shaped leaves with a dichotomously forking vein system in many of the fossil forms. These leaf forms are all so simple that the vascular connection with the stem stele does not affect the stele configuration and causes no leaf gap. On the other hand, the complex leaves of ferns (pteridophylls, or megaphylls) probably evolved from a branching stem system and affect the stele by drawing out enough vascular tissue to cause a leaf gap.

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