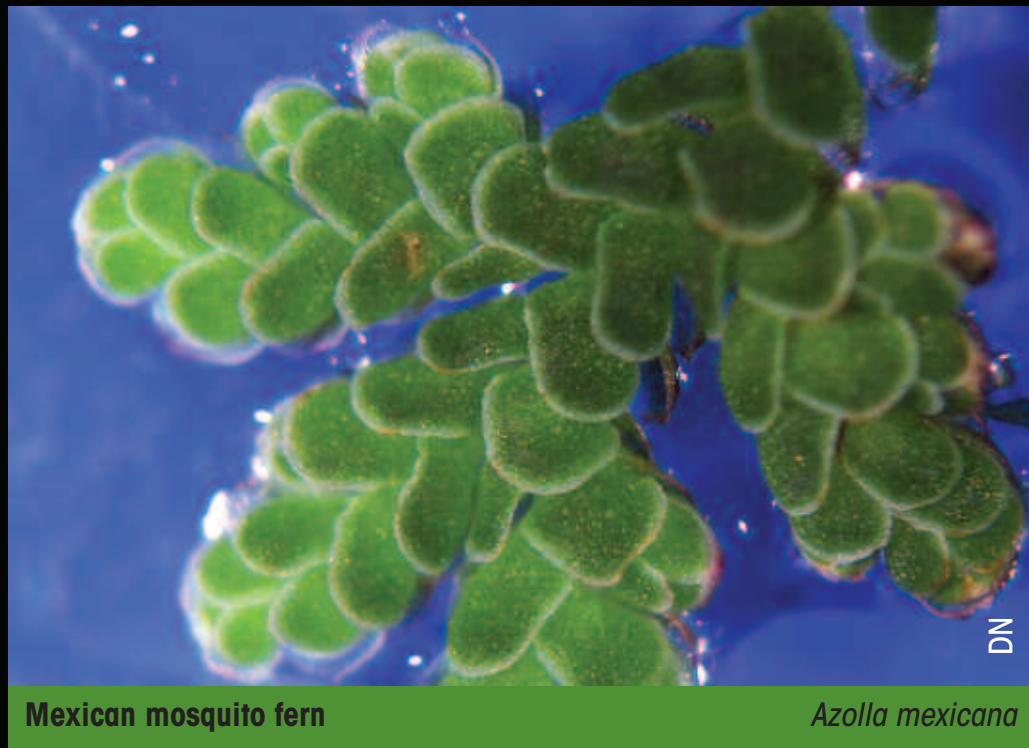
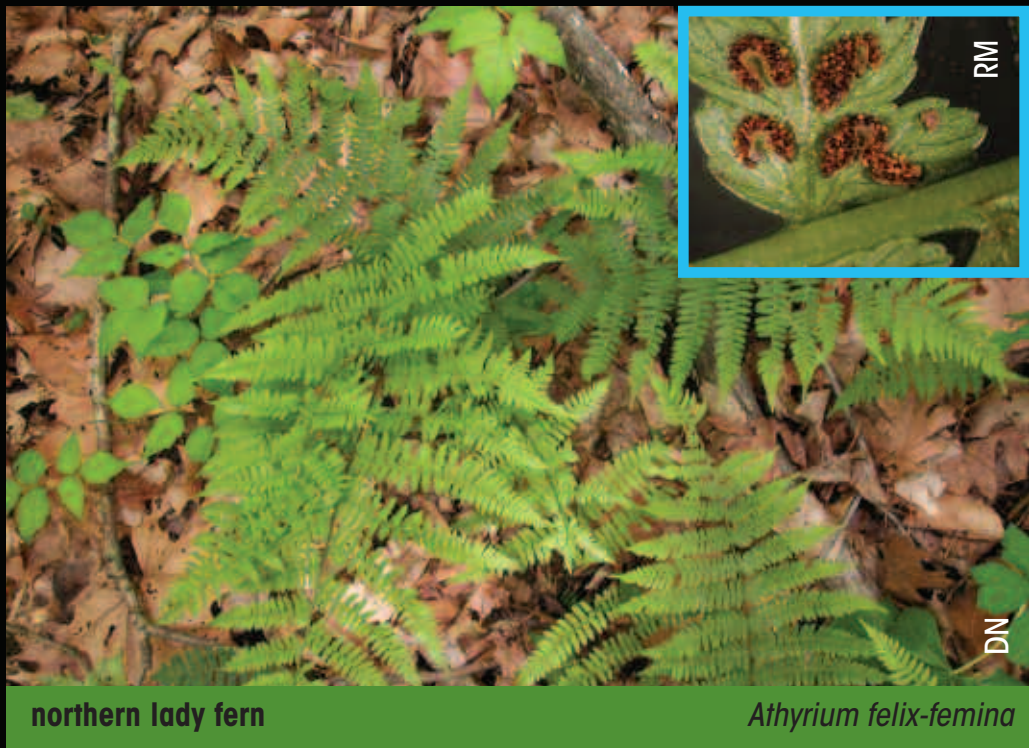
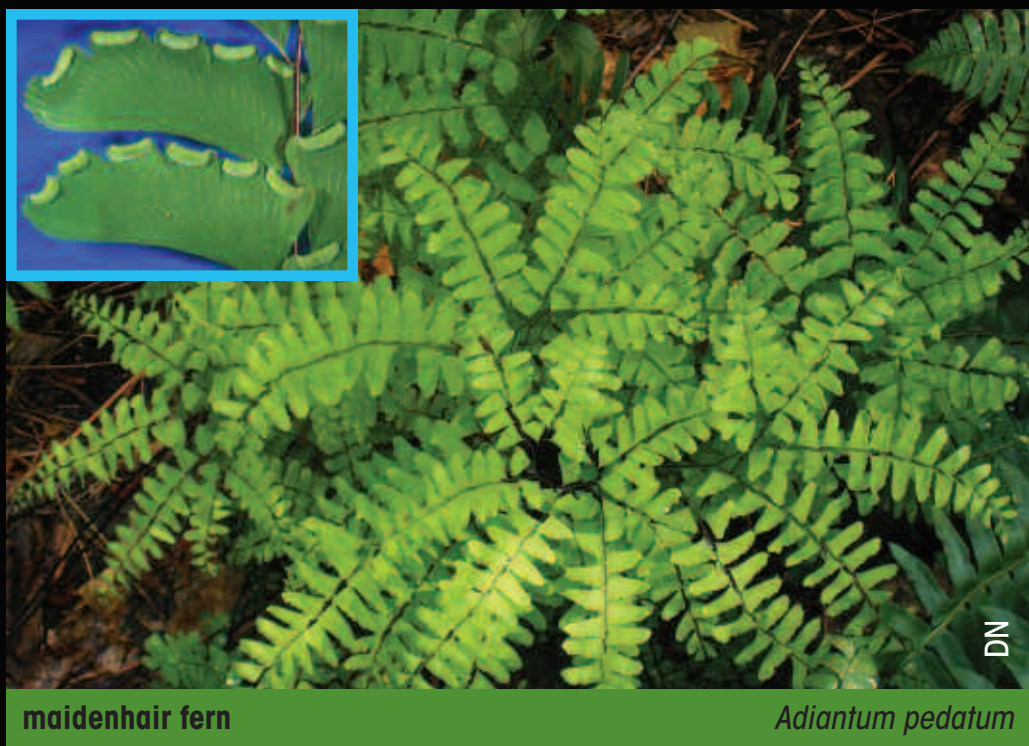
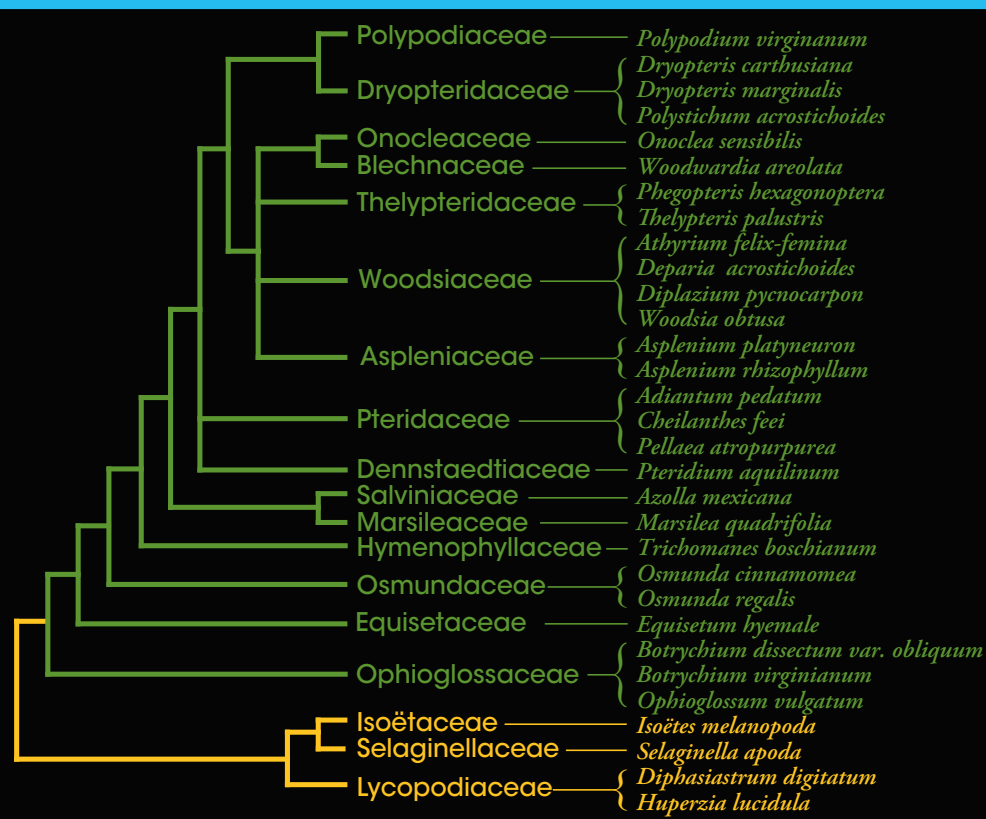


# Illinois

## FERNS



This tree shows a current concept of the evolutionary relationships among Illinois fern (green) and lycophyte (yellow) families (modified from Smith et al. 2006). *Diphasiastrum*, *Selaginella*, and *Isoetes* are members of an earlier branching group called lycophytes. Although sometimes called “fern allies,” they are only distantly related to ferns. In contrast, *Equisetum*, once considered distinct, is indeed a fern! These relatively new concepts come from sperm structure and DNA data.



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Illinois Department of  
Natural Resources  
Division of Education



Illinois  
Wildlife  
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Text by: Daniel Nickrent, Southern Illinois University Carbondale

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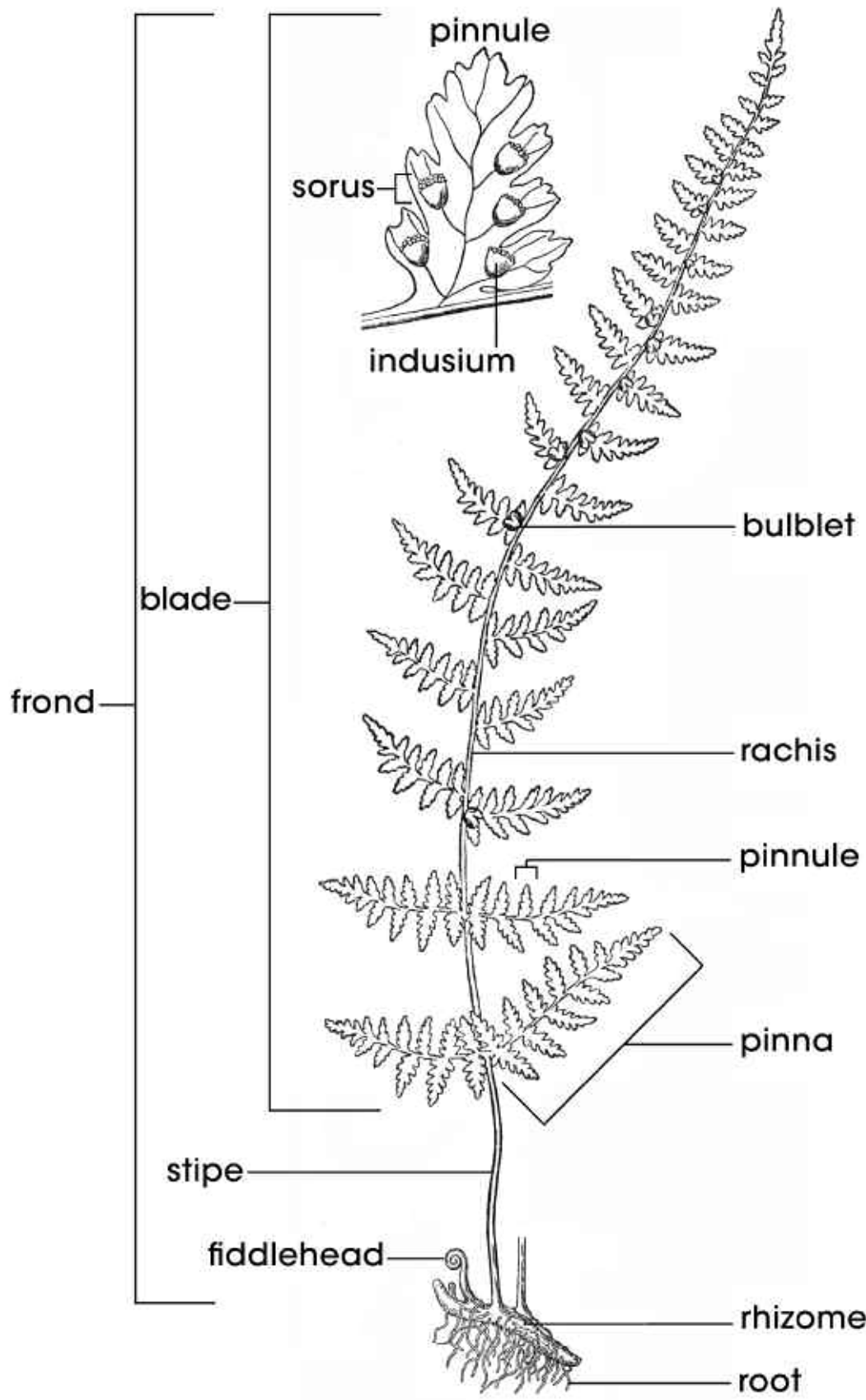
Daniel Nickrent (DN), Southern Illinois University Carbondale  
Peter Pelter (PP), University of Canterbury, New Zealand  
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John Taft (JT), Illinois Natural History Survey

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# Morphology

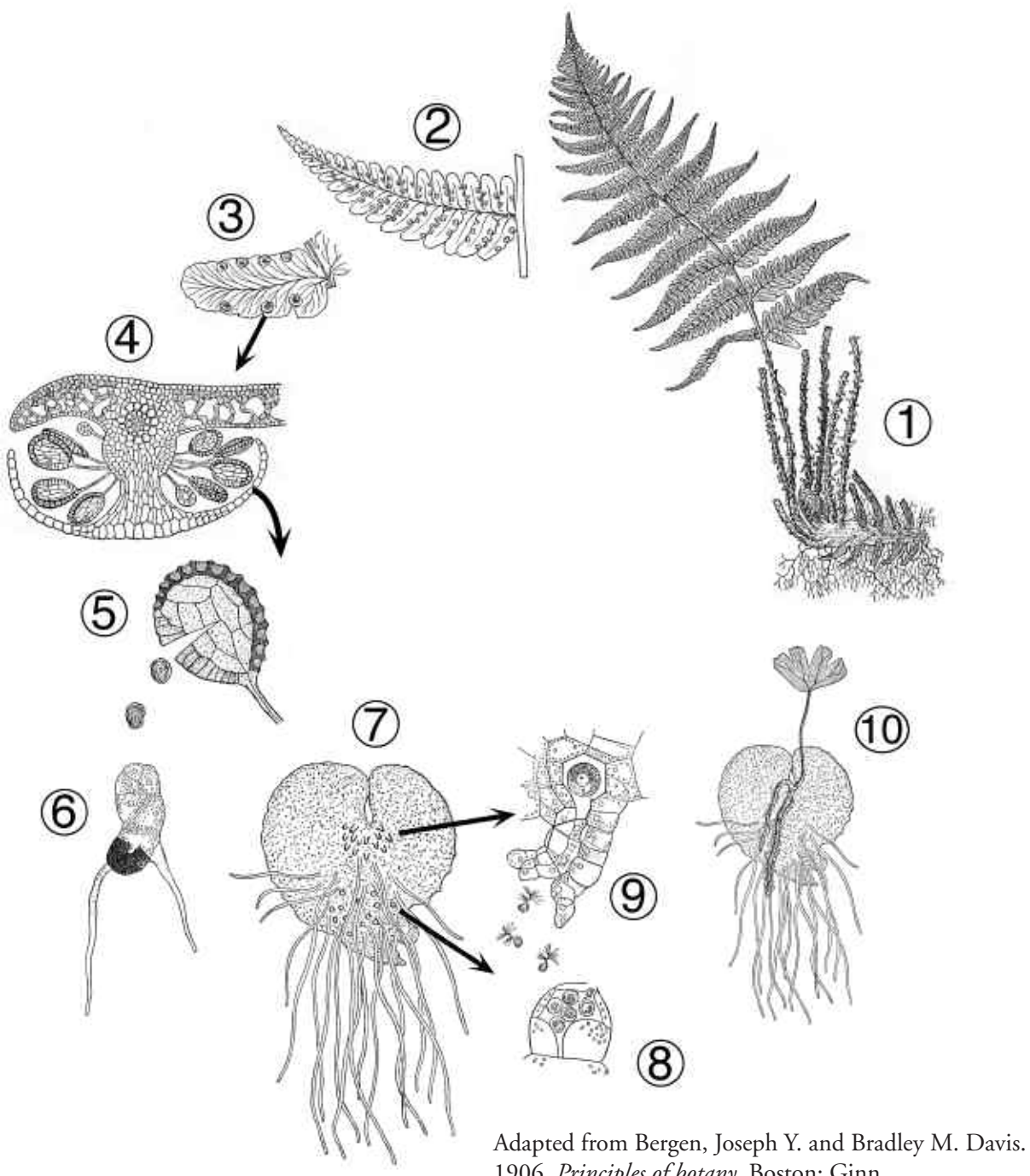
People who study ferns (pteridologists) use some special terms to refer to the parts of a fern. The fern leaf is called a **frond** and is composed of the **stipe** and **blade**. When the frond is young, it unfurls from a coiled shape that resembles the curled end of a fiddle, thus the name **fiddlehead** is used. The fronds of many ferns arise from a horizontal stem that bears roots, a **rhizome**. If the fern frond is compound, the blade is divided into subdivisions called **pinnæ** that attach to the **rachis**. In some species, the pinnæ are further subdivided into **pinnules**. On the underside of the pinnule, small structures called **sori** are present. The sorus is sometimes covered by a protective tissue called the **indusium**. Inside are the **sporangia** that produce **spores**.



Adapted from Coulter, John M. 1904. *Plant structures: a second book of botany*. D. Appleton and Company, New York. Twentieth Century Text-books.

# Life Cycle

The life cycle of ferns and lycophytes involves two very different looking stages: the **haploid gametophyte** that makes gametes (**sperm** and **egg**) and the **diploid sporophyte** that makes **spores**. These plants do not produce seeds as are seen in flowering plants. The sporophyte is the phase familiar to most people. A typical life cycle, that of the marginal wood fern (*Dryopteris marginalis*), is illustrated. The **frond** (1) is composed of **pinnæ** (2) which are divided into **pinnules** (3). This fern gets its name from the **sori** that are along the margins (edges) on the underside of the pinnules. The sorus (shown cut in half in 4) protects its **sporangia** by an umbrella-shaped **indusium**. One sporangium (5) contains 64 haploid spores that are produced by **meiosis**. The spores are dispersed from the sporangium by a catapult type mechanism. When they land on a moist surface, they germinate (6) and eventually form a **prothallus** (7) through a cell division type called **mitosis**. This **gametophyte** phase of the life cycle, seldom seen by people, is small, green and thin. On the underside of the prothallus two organs may form: the **antheridium** (8) and the **archegonium** (9). The antheridium produces many sperm that require water to swim to the archegonium that holds a single egg cell. When a sperm fertilizes an egg, a single-celled diploid **zygote** is produced. Although the prothallus shown here has both antheridia and archegonia, most ferns have mechanisms to prevent self fertilization. The zygote undergoes mitotic cell divisions to form an **embryo** and, with further development, a young sporophyte (10) that at first remains attached to the prothallus. With time the gametophyte disintegrates, and the sporophyte grows into the large, leafy fern plant.



Adapted from Bergen, Joseph Y. and Bradley M. Davis. 1906. *Principles of botany*. Boston: Ginn.

# Fern Facts

- All of the fossil fuel (coal, oil, natural gas) used today derives from the fossil remains of large lycophytes and ferns that lived during the Carboniferous Period 300 million years ago.
- The water fern (*Salvinia molesta*) can double its population size in just over two days. Three years after it was introduced to Kariba Lake in Africa, it covered over 390 square miles of water.
- Bracken fern (*Pteridium*) and water clover (*Marsilea*) produce an enzyme called thiaminase that destroys thiamine, an important vitamin. Improper amounts of thiamine can cause nutritional problems and the disease called beriberi.
- Some species in the genera *Vittaria*, *Hymenophyllum* and *Trichomanes* are known in North America only as gametophytes. The sporophyte generation (with fronds) never forms.
- Some tropical fern and *Selaginella* species live in deep shade and glow an iridescent blue-green.
- A single plant of the marginal wood fern (*Dryopteris marginalis*) can produce 67 million spores.
- About half of the fern species on earth today are polyploid, that is, they have extra sets of **chromosomes** (often following hybridization). Despite this, many of these “extra” genes are silenced, and the species behave genetically like diploids.

# Glossary

<b>antheridium</b>	the male organ on the <b>prothallus</b> that produces <b>sperm</b> cells
<b>archegonium</b>	the female organ on the prothallus that produces the <b>egg</b> cell
<b>blade</b>	the broad, upper part of the leaf, as opposed to the <b>stipe</b>
<b>chromosome</b>	structure within the cell nucleus that contains DNA
<b>diploid</b>	with two sets of <b>chromosomes</b>
<b>egg</b>	the female sex cell
<b>embryo</b>	the young <b>sporophyte</b> that forms from the <b>zygote</b>
<b>fiddlehead</b>	the young leaf that is still coiled
<b>frond</b>	the fern leaf, composed of a stipe and a <b>blade</b>
<b>gametophyte</b>	the <b>haploid</b> plant that produces sex cells (gametes)
<b>haploid</b>	having one set of chromosomes
<b>indusium</b>	a tissue that covers and protects the <b>sorus</b>
<b>meiosis</b>	a cell division type that halves the chromosome number in the four resulting cells
<b>mitosis</b>	a cell division type where the chromosome number of the two resulting cells remains the same as the original cell
<b>pinna</b>	(pl. pinnæ) – a subdivision of the leaf blade that is fully separated from the <b>rachis</b>
<b>pinnatifid</b>	a frond or pinna that is cleft or lobed only part way to its axis
<b>pinnule</b>	a subdivision of the <b>pinna</b>
<b>prothallus</b>	the flat, often heart-shaped gametophyte
<b>rachis</b>	the upper stalk of the blade where the <b>pinnæ</b> attach
<b>rhizome</b>	a horizontal stem, often just below ground
<b>sorus</b>	(pl. sori) – a grouping of <b>sporangia</b> on the underside of the <b>pinnæ</b> or <b>pinnules</b>
<b>sperm</b>	the male sex cell
<b>sporangium</b>	the small capsule that bears the <b>spores</b>
<b>spore</b>	small, single-celled body produced via <b>meiosis</b> that forms within sporangia
<b>sporophyte</b>	the <b>diploid</b> plant that produces spores
<b>stipe</b>	the lower stalk of the blade
<b>zygote</b>	the cell that is the immediate product of fertilization (egg plus sperm)

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# Agency Resources

The Illinois Department of Natural Resources provides additional information and resources about ferns and lycophytes in our state. The Division of Natural Heritage monitors populations of plant species and makes and implements management options. The Division of Ecosystems and Environment reviews development plans proposed by state and local governments and recommends measures to reduce or avoid adverse impacts to threatened or endangered species and their habitats. The Education Section provides educational materials and teacher training on a variety of natural resources topics and offers grants for schoolyard wildlife habitat development and field trips for students. Many publications related to plants and wildlife habitat development are available through the publications order form at <http://dnr.state.il.us/teachkids>.

## Illinois Department of Natural Resources

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<http://dnr.state.il.us/education>

**Division of Natural Heritage**  
217-785-8774  
<http://dnr.state.il.us/conservation/naturalheritage>

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# Species Descriptions

**northern maidenhair fern** *Adiantum pedatum* – This delicate fern is found in shaded woodlands throughout Illinois. It can be recognized by its triangular **pinnæ** with a “false **indusium**.” Here the edge of the pinna wraps around the **sorus**, thus enclosing it.

**ebony spleenwort** *Asplenium platyneuron* – Despite its name, this fern’s **rachis** is most often dark brown, not black. It is common in the southern part of the state, being found in both dry and moist habitats. The sori are “canoe-shaped” with the indusium being attached along one edge.

**walking fern** *Asplenium rhizophyllum* – This evergreen fern gets its name from the elongated leaves that form small plantlets at the tip. It grows on limestone, usually in dense colonies because older plants remain attached to their family of plantlets. It is found mainly in southern Illinois and along the Mississippi River.

**northern lady fern** *Athyrium filix-femina* – The finely cut fronds make this a very attractive fern. Two varieties of this species are found in moist woodlands throughout the state.

**Mexican mosquito fern** *Azolla mexicana* – This aquatic fern (and its close relative *A. caroliniana*) grows on mud or floating on water. The fronds harbor cyanobacteria that remove nitrogen from the air and thereby make it available to the plant in a symbiotic relationship.

**bronze grapefern** *Botrychium dissectum* var. *obliquum* – This variety is commonly found throughout Illinois in open oak-hickory woods and pastures. The **fronds** have two different looking portions: a photosynthetic part and a fertile part that bears the **sporangia**.

**rattlesnake fern** *Botrychium virginianum* – Found statewide, this species has bright green, deciduous fronds that appear early in the spring. The fertile part of the frond arises from the same point as the sterile parts.

**slender lip fern** *Cheilanthes fei* – This woolly little fern with rounded pinnules grows on exposed limestone cliffs in counties bordering the Mississippi River in the southern part of the state.

**silvery glade fern** *Deparia acrostichoides* – This fern can be recognized by its pinnate fronds with **pinnatifid** pinnæ. The sori are elongated, initially silvery and arranged in a herringbone pattern. The species can be found throughout much of Illinois.

**southern running-pine** *Diphasiastrum digitatum* – Unlike the ferns, this lycophyte produces spores in small, yellowish cones arranged like a candelabra at the stem tip. The leaves are small and narrow on branched stems. This species is rarely seen in Illinois.

**narrow-leaved glade fern** *Diplazium pycnocarpon* – This tall fern has separate sterile and fertile fronds that are narrow, bright green, and once pinnately compound. It has elongated sori arranged in a herringbone pattern. This species is occasionally found in the southern three-fourths of the state in moist ravines and canyons.

**spinulose wood fern** *Dryopteris carthusiana* – The **rhizome** and lower **stipe** of this fern are densely scaly, the blade twice or three times pinnately compound. The sori are positioned inward from the margin of the **pinnules** and have a kidney-shaped indusium.

**marginal wood fern** *Dryopteris marginalis* – This species gets its name from the position of the sori along the margin (edge) on the undersides of the pinnæ. The evergreen fronds are more leathery than *D. carthusiana*. It is most common in the southern one-fourth of the state.

**scouring rush** *Equisetum hyemale* – This species grows in every Illinois county, often seen along roads, fields and railroad embankments. The leaves are tiny (reduced to scales) and occur as sheaths at the stem nodes. The grooved stems have silica embedded in the epidermis, making them sturdy and abrasive. The sporangia are borne on umbrella-shaped scales within a terminal cone.

**shining fir-moss** *Huperzia lucidula* – This lycophyte forms tufted stems with small, lustrous, evergreen leaves. The kidney-shaped sporangia are inconspicuous, occurring only in defined zones along the stem. This plant occurs in cool, shady, moist forests on acidic soils at scattered locations in Illinois.

**black-footed quillwort** *Isotetes melanopoda* – This aquatic species is easily overlooked because it resembles a small, tufted onion plant. The linear leaves arise from a short stem and among their swollen bases can be found the sporangia. Black-footed quillwort can be found in scattered locations throughout Illinois.

**water clover** *Marsilea quadrifolia* – These aquatic plants, also called water shamrock, have floating leaves that resemble a four-leaf clover.

Native to Europe but introduced, water clover occurs in ponds and lakes in a few locations in the state.

**sensitive fern** *Onclea sensibilis* – This fern gets its name from the deciduous, pinnatifid sterile fronds. The separate fertile fronds have stiff pinnules that tightly enclose the sori. These fronds persist through the winter, eventually releasing the spores. Sensitive fern is found in nearly every Illinois county.

**southern adder's-tongue** *Ophioglossum vulgatum* – This fern has a fertile sporangium-bearing stalk that emerges above the elliptical, succulent sterile **blade**. This arrangement looks like a snake with its tongue out! The sporangia occur in rows that also look a bit like a rattlesnake rattle. *Ophioglossum* species have the highest chromosome numbers of any plants - some up to 1,440.

**cinnamon fern** *Osmunda cinnamomea* – Reaching three feet in height, this fern is named for the color of the fertile fronds. Sterile fronds have up to 30 pairs of pinnatifid, pointed pinnæ with wooly hairs at their base. It is found in swamps and moist woods in the northern third of Illinois.

**royal fern** *Osmunda regalis* – Royal fern can be identified by its twice-pinnate fronds with sterile pinnæ below but “crowned” with fertile pinnæ above. It is found in moist woods and swamps and on sandstone ledges.

**purple cliff brake** *Pellaea atropurpurea* – This fern prefers limestone cliffs and is well adapted to dry conditions. Its twice pinnate, leathery fronds are blue-green in color and the pinnule margins are curved inward. This species occurs in counties bordering the Mississippi and Ohio rivers in the southern half of the state.

**broad beech fern** *Phegopteris hexagonoptera* – Broad beech fern has triangular fronds that are twice pinnatifid. The rachis is winged down to the lowest pair of pinnæ. The sori are round and without an indusium. The presence of this fairly common species may indicate high-quality woodland habitat.

**rock polypody** *Polypodium virginianum* – This common polypody has pinnatifid fronds with round sori that lack an indusium. It grows on sandstone in the southern third of the state.

**Christmas fern** *Polystichum acrostichoides* – The name of this fern derives from the harvest of the evergreen leaves at Christmas time and because the pinnæ are shaped like a Christmas

# Conservation and Cultivation

There are more than 100 species of ferns and lycophytes in Illinois, but half of them occur in nine or fewer counties and 30 of them grow in only one county. As with most plant conservation situations, a critical factor when protecting a species is preservation of its habitat. Natural habitats are continually being converted to other uses, resulting in the loss of native fern species. Other species may be at the edge of their natural range. The hay-scented fern (*Demissaedra punctilobula*) is rare in Illinois but more abundant in the eastern United States. Illinois represents the extreme western edge of this species’ distributional range. Many fern species grow only in specific areas and can thus serve as indicators of critical habitats. For example, cinnamon fern (*Osmunda cinnamomea*), sensitive fern (*Onclea sensibilis*) and netted chain fern (*Woodwardia areolata*) all prefer wetland habitats. Others such as walking fern (*Asplenium rhizophyllum*) and purple cliff brake (*Pellaea atropurpurea*) prefer limestone substrates. The presence of broad beech fern (*Phegopteris hexagonoptera*) in an area may be a predictor of the presence of rare ferns and orchids.

Fern enthusiasts, collecting for home and garden, can negatively impact wild fern populations. In his book *The Ferns of Florida* (2000), Gil Nelson says “Given the number of responsible native nurseries that propagate and sell native fern species, coupled with the relatively low cost of such nursery-grown specimens, there is neither need nor justification for taking specimens from the wild.” A number of Illinois fern species can be easily cultivated. Growing ferns from spores provides an inexpensive means to assemble a diverse collection. For common species, such as maidenhair and Christmas fern, plants can readily be located outside of parks and natural areas. A single frond placed on paper for a day or so releases thousands to millions of spores that can be sown on moist, sterile potting soil. The gametophytes that result reproduce sexually thereby producing sporophytes that can be transplanted to pots or outdoor locations. The American Fern Society Web page (<http://amerfernsoc.org/>) and other sources give detailed instructions on how to grow ferns from spores. There are many advantages to landscaping with native plants, including drought tolerance, few predators, disease resistance and little required maintenance.