

Ferns & Allies (Seedless Vascular Plants)

"God made ferns to show what he could do with leaves" - Thoreau

11,000 species

mostly terrestrial, a few are aquatic

include ferns, horsetails, clubmosses, whisk ferns, etc

General Characteristics of Ferns

1. mostly terrestrial, a few are aquatic

range from tropics to arctic but most are tropical epiphytes

in temperate regions ferns typically inhabit swamps and moist areas

2. have true vascular tissues

all plants other than mosses and allies are referred to as **vascular plants**

vascular tissue is differentiated into a cylindrical network of xylem and phloem

phloem on outside

xylem on inside of vascular ring

vascular plants have true **roots, stems** and **leaves**

vascular system enables plants attain greater size:

→ some ferns (tropical) grow to 75' today

can live in drier habitats

→ some even live in desert

eg. resurrection ferns

3. still require water for sexual reproduction

Fern Anatomy

since ferns have all three tissues they also have true organs

1. Stems

rhizome = underground stem with wiry roots

in temperate areas rhizome produces new leaves each spring

ferns are easily propagated by rhizome cuttings

2. Roots

the roots are clearly differentiated from rhizome

3. Leaves

frond = large, compound leaves used for photosynthesis and reproduction

when each young frond emerges from ground it is tightly coiled

→ **fiddlehead**

as fiddlehead grows it unrolls and expands to form frond

Reproduction and Life Cycle

show clear alternation of generations

most ferns are annuals

fern life cycle 4-18 months

Sporophyte Stage

is dominant

the "fern" we see are sporophytes

fern sporophytes are perennial

sporophyte produces asexual spores

spore production occurs on underside of leaf in clusters of sporangia called **sori**

sometimes sori are covered by umbrella-like **indusium** [size of a pinhead]

as humidity changes sporangia break open throwing spores into air

Gametophyte Stage

gametophyte generation of ferns is completely separate and bears no resemblance to sporophyte

spores germinate into gametophytes called a **prothallium**

gametophyte is tiny (~1/4 inch)

often heart shaped

as prothallium matures it produces male and female reproductive organs

=antheridia & archegonia

archegonia located in central region near notch each contains a single egg

antheridia scattered among rhizoids sperm cells shaped like cork screws

ferns require water for fertilization

as young sporophyte develops the prothallium withers and dies.

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Ecological Importance of Ferns & Allies

help soil formation and prevent erosion

many species of *Azolla* (water fern) harbor nitrogen fixing bacteria

→ help in cycling this important nutrient through aquatic ecosystems

Human Impacts of Ferns & Allies

1. early uses

eg. ferns: in late 1800's 1000's of tons of silky leaf hairs from certain Hawaiian species were used to stuff pillows, mattresses and furniture

eg. horsetails have a hollow jointed stems impregnated with silica

→ gritty texture (=scouring rushes) first "brillo pads"

native Americans and pioneers used them to clean pots

pioneers also used them to polish brass, furniture and flooring

eg. lycopodium spores used as flash powder in early days of photography

2. are widely **cultivated** for horticultural value

ferns are a favorite houseplant for many

make good house plants because they are adapted to low light

most common fern in the world is bracken fern (= *Pteridium aquilinum*)

grows well in poor soil – uncommon fern trait

eg. hanging plants, around homes, etc

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3. a few species of ferns and allies are eaten

eg. the **fiddlehead** of some species are harvested in early spring esp in New England and Canada, boiled or steamed and eaten

eg. bracken fern, cinnamon ostrich fern

eg. ancient Romans & native Americans peeled and ate stems and rhizomes and sporangia of horsetails

4. some fern species are used in basketry and weaving and as novelty items

eg. club mosses often used in wreaths

eg. one species of spike moss (a club moss) is called "resurrection plant" or "resurrection fern" and is sold in hobby stores

5. probably most significant contribution to human culture is as **coal deposits**

→ carboniferous forests (~325MY ago)

these forests consisted of treelike **ferns, club mosses, whisk ferns** and **seed ferns**

clubmosses were once large, treelike plants with trunks 3' dia, 100' tall that dominated these forests

also large tropical 'seed ferns' existed for ~100 M years

as they died there were no organisms that could decompose the lignin in their wood

→ didn't completely decompose

→ converted to coal deposits

Coal

coals is the most abundant fossil fuel in the world

largest reserves are in US, Russia, China

in US coal represents 90% of all fossil fuel deposits

today coal is used mainly to produce steam for electric power plants

some is also used to produce coke for steel and iron production

humans use energy equivalent of 3.6 tonnes of coal/person/year

most coal beds developed in swamps:

trees fall, becomes water logged and sinks to the bottom

in stagnant water, no O₂, possibly no fungi that could digest cellulose or lignin

→it stops decaying

plant material becomes peat

peat is compacted to become different grades of coal

peat → lignite → bituminous coal → anthracite

original peat may become compressed to 1/25th of its original thickness

most coal formed 500 - 350 MY ago

average depth below surface is 300'

average thickness of seams 2-8'

most of the coal from deep mines has been exhausted most of the rest will have to be strip mined

eg. some seams in western US are 100' thick

→ but much if it is at or near surface

creates numerous environmental problems:

1. will require massive destruction of land to mine
2. causes stream and groundwater pollution as water mixes with sulfur residue to produce sulfuric acid

acid mine drainage has polluted 1000's km of streams

3. burns dirty with toxic emissions, carcinogens, radioactive elements