Vascular Plants Without Seeds

Characteristics of Vascular Plants Without Seeds

- Eukaryotic
- Multi-celled (with cell walls composed of cellulose)
- Autotrophic
- Do have xylem and phloem
- Do not produce seeds
- Do not produce flowers or fruits

The Groups of Vascular Plants Without Seeds

- Fern allies
  - Whisk Ferns – Psilotum
  - Club Mosses/Ground Pines – Lycopodium
  - Spike Mosses - Sellaginella
  - Horsetails/Scouring Rushes – Equisetum
  - Quillworts - Isoetes
- Ferns

What it Means to be Vascular

- There are two types of vascular tissue
  - Xylem, which is involved with the transport of water and dissolved minerals
  - Phloem, which is involved with the transport of organic food molecules, usually in the form of sucrose
- Vascular plants are capable of living in dryer areas because they can absorb water from the soil via the root system and transport it throughout the plant via the xylem
- Vascular plants can grow larger than nonvascular plants because water, minerals, and organic food molecules can be transported throughout the plant via xylem and phloem, and wastes can be transported away from cells

Typical Fern Life Cycle

Haploid (n) spores germinate and divide by mitosis to produce haploid (n) multicellular bisexual gametophytes

Haploid (n) cells of mature gametophytes in antheridia and archegonia develop into haploid (n) male gametes (sperm) and female gametes (eggs), respectively

Haploid (n) male gametes are transferred via water from antheridia to archegonia where a haploid (n) sperm cell fuses with a haploid (n) egg cell (fertilization) within an archegonium to form a diploid ($2n$) zygote

The zygote ($2n$) divides by mitosis within the archegonium to produce a diploid ($2n$) multicellular sporophyte that begins its existence attached to the gametophyte

As the sporophyte matures, it overgrows the gametophyte and the gametophyte dies

Diploid ($2n$) cells of the mature sporophyte in structures called sporangia divide by meiosis to produce haploid (n) spores

Haploid (n) spores are released from the sporangia and fall to the ground where they germinate and divide by mitosis ……

Typical Fern Gametophytes

Fern gametophytes are small heart-shaped or ribbon-shaped structures that usually have both archegonia and antheridia

Fern gametophytes are green because they contain photosynthetic cells; therefore, fern gametophytes are autotrophic and make their own organic food molecules

Fern gametophytes absorb water (which contains dissolved minerals) directly from the moist environment, and the water moves from cell to cell by diffusion (like moss gametophytes, fern gametophytes are nonvascular – they do not contain xylem and phloem)

Fern gametophytes do not have roots, but they do have structures called rhizoids, which anchor them to the substrate on which they are growing

Typical Fern Sporophytes

After fertilization, the diploid ($2n$) zygote (which is inside an archegonium on the gametophyte) divides by mitosis to form a multicellular diploid ($2n$) sporophyte

The fern sporophyte soon exceeds the gametophyte in size; the gametophyte withers and dies

A mature sporophyte is composed of three parts

Roots

Stems (often rhizomes – horizontal underground stems)

Leaves (fronds)

Young leaves are usually coiled into what is commonly known as a fiddlehead

Mature leaves of fern sporophytes are green because they contain photosynthetic cells; therefore, fern sporophytes are autotrophic and make their own organic food molecules

Some fern leaves, known as sporophylls, have clusters of sporangia attached to them

The most obvious fern structures that we see growing in nature or in cultivation are sporophyte leaves

Why Many Ferns Grow in Moist Environments and Why Some Grow in Dry Environments

Fern gametophytes are nonvascular and do not have roots; therefore, they must be in contact with a moist environment from which water can be absorbed directly into the cells of the gametophyte

Ferns gametophytes produce motile sperm in antheridia, and the sperm cells must get from there to egg cells located in archegonia; therefore, a moist environment is required for the transfer

Fern sporophytes can reproduce asexually by fragmentation of the rhizomes; therefore, some ferns are capable of growing in dry areas because there is no sexual reproduction requiring water for the movement of motile sperm from antheridia to archegonia

Fern sporophytes can grow in dry areas because they have vascular tissues in their roots, stems, and leaves; therefore, water and minerals can be absorbed from the soil by the root system and transported throughout the sporophyte via the xylem

This lecture outline was prepared partly from *Biology*, by Campbell and Reece, 2002 (6th edition), and from *Botany – An Introduction to Plant Biology*, by Mauseth, 1998 (2nd edition), and may contain phrases or entire sentences taken verbatim from those sources.