PLANT KINGDOM

INTRODUCTION

Members of the Plant Kingdom are characterized by the following:

- They are multicellular, having various specialized tissues.
- They photosynthesize, using a cell organelle called a chloroplast.
- They have adaptations to living on land and have evolved as terrestrial organisms.
- Their leaves and other above-ground parts have a **cuticle** of wax that protects them from drying out in the terrestrial environment.
- Their cells have a cell wall made of cellulose; cell walls are often reinforced with lignin.
- They have an embryo that is protected and nourished by the parent's body.

In addition to these characteristics, there are two distinct generations in the life cycle of a plant. One generation, the **sporophyte,** produces **sporangia** that produce **spores** (by meiosis). The second generation, called the **gametophyte,** grows from a **spore**. The gametophyte plant produces **egg** and **sperm**. Sexual reproduction results when sperm **fertilize** the egg. The resulting zygote then matures into the spore producing generation (sporophyte). Refer to the page 3 of this section for a diagram of a plant life cycle (e.g., ferns).

These characteristics distinguish plants from all other organisms including the algae. Remember, the algae are members of the Protist Kingdom, and may have some, *but not all,* of the characteristics of plants.

Here is a review of the basic classification system used for all living organisms:

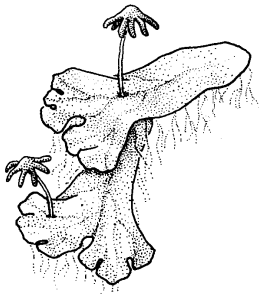
Type of Cell	Domain	Kingdom	Example
Prokaryotic	Archaea	***Not Used***	Prokaryotic organisms found in extreme environments
Prokaryotic	Bacteria	***Not Used***	common bacteria, cyanobacteria
Eukaryotic	Eukarya	Protists	algae, *Paramecium*, *Amoeba*, *Euglena*
Eukaryotic	Eukarya	Fungi	mushrooms, mold, *Penicillium*
Eukaryotic	Eukarya	Animals	vertebrates, insects, nematodes, sponges
Eukaryotic	Eukarya	Plants	moss, ferns, redwoods, flowering plants

GOALS AND OBJECTIVES

1. Know the characteristics of the Plant Kingdom.
2. Identify the different **phyla** of the Plant Kingdom.
3. For each Phylum, understand how they reproduce, if they have vascular tissue and/or wood.
4. Recognize the different plant organs and their functions: **shoot**, **root**, **embryo**, **leaves**, **lateral roots**, **root hairs**, **vascular tissue**, **xylem** and **phloem**.
5. Know the different parts of the flower and their functions.
6. Understand the reproduction of flowering plants.
7. Understand adaptations to terrestrial life seen in the four different phyla.

KINGDOM PLANTS

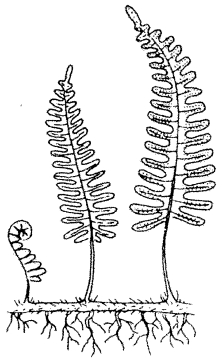
PHYLUM LIVERWORTS AND PHYLUM MOSSES – liverworts and mosses



characteristics: small terrestrial plants dependent on moist environments for growth and reproduction. They are **nonvascular,** relying on diffusion for transport of water and nutrients. They lack roots, stems and true leaves. The plant body grows from a **spore** produced by the **sporangium**. Spores enable the dispersal of mosses and liverworts to new locations. Sexual reproduction results when sperm (produced by the gametophyte) swim in a film of water and **fertilize** the **egg**. Most land plants have a waxy cuticle to protect them from drying out.

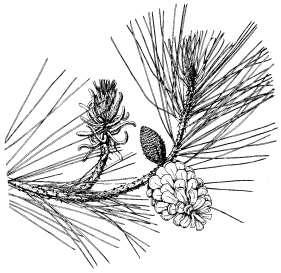
Liverwort **Moss**

PHYLUM FERNS – sword fern.



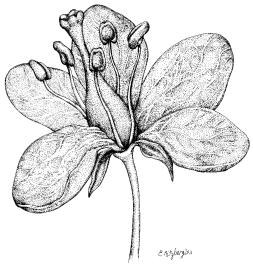
characteristics: **seedless** vascular plants producing vascular tissue enabling them to transport water and nutrients. **Vascular** tissue facilitated the development of below ground roots, and above ground stems and leaves (fronds); these structures allow ferns to grow taller and to be less dependent on water. The sporophyte generation produces spores in **sporangia** located in clusters called **sori** (singular: sorus) on the back of the fronds. The spores disperse ferns to new locations. The germinated spore becomes the gamete forming generation (gametophyte). Sexual reproduction is dependent on water and results when **sperm** swim in a film of water and **fertilize** the **egg**. The resulting zygote develops into the spore producing generation (sporophyte).

PHYLUM CONIFERS – pines, redwood.

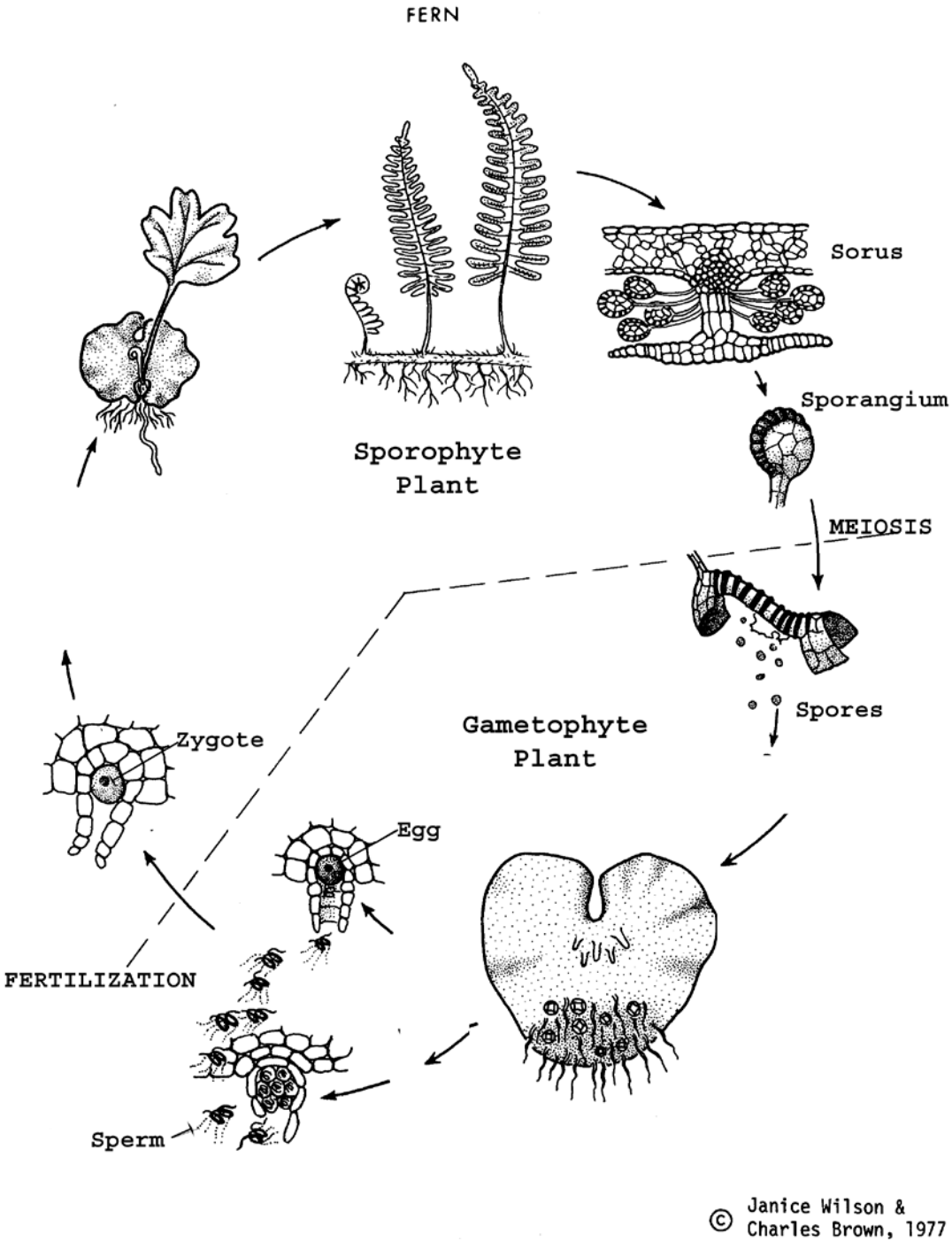


characteristics: vascular plants that produce seeds in woody female cones. **Pollination** occurs when **pollen** (containing sperm) from small **male cones** is transferred by wind to the **egg** producing **female cone**. **Fertilization** results when the sperm is released from the pollen and fertilizes the egg in the **ovule** and forms a zygote; the ovule then develops into a **seed** which protects the **embryo**. Seeds disperse conifers to new locations. Secondary growth from the **vascular cambium** allows the production of **wood** and the ability to grow to great heights.

PHYLUM FLOWERING PLANTS – poppies, lilies, grasses, oaks.



characteristics: vascular plants that produce seeds in fruits. Sexual reproduction involves the **flower**. **Pollination** results when **pollen** (produced by the **stamen**) is transferred by wind or animals to the **pistil** of the flower. **Fertilization** results when the sperm are released into the **ovules** in the flower's **ovary** to fertilize the enclosed egg. The ovule then develops into a **seed** containing an embryo and the ovary develops into a **fruit**. Having a seed enclosed in a fruit provides protection and enables the seeds to be dispersed by a variety of means over long distances. Some members have wood as a result of secondary growth from the vascular cambium. Two structures that distinguish a flowering plant from all the others are the flower and the fruit.

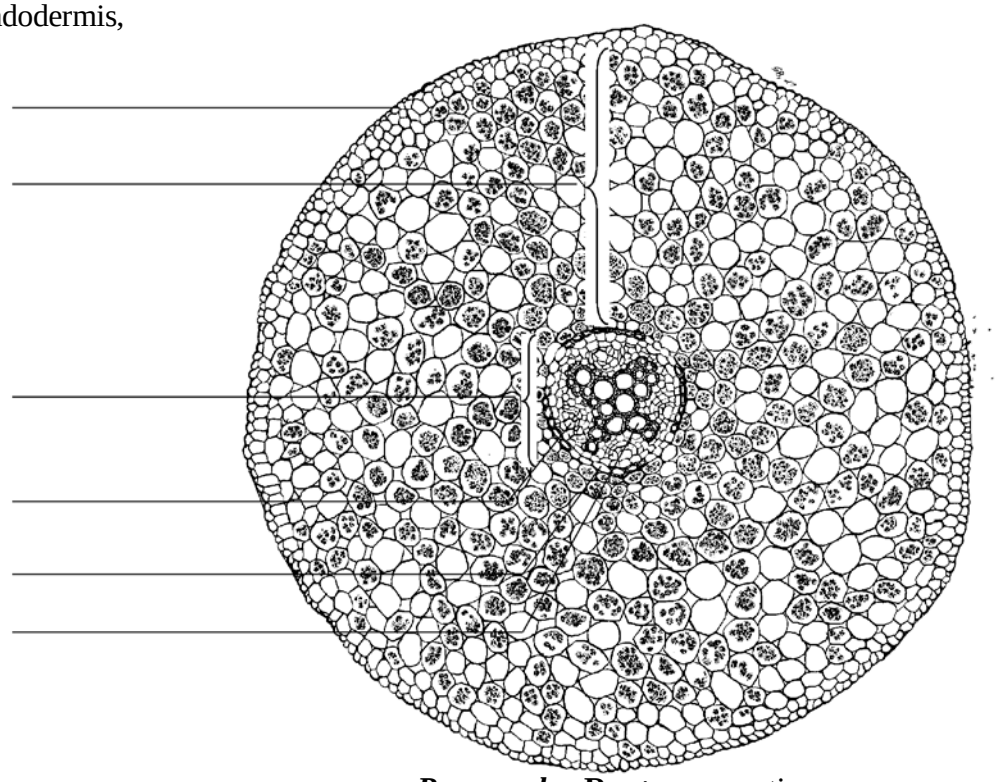


Example Plant Life Cycle
Fern

Root cross section (*Ranunculus)*

A. Examine a prepared slide of a root cross-section (*Ranunculus*) under the microscope using low, medium, and high power.

B. Label the regions of the root (epidermis, cortex, vascular cylinder, endodermis, xylem and phloem).



***Ranunculus* Root** cross-section

1. Give three functions of the root.
   1.
   2.
   3.
2. Give a function of the cortex.

3. Give the function of the vascular tissue:
   a. xylem

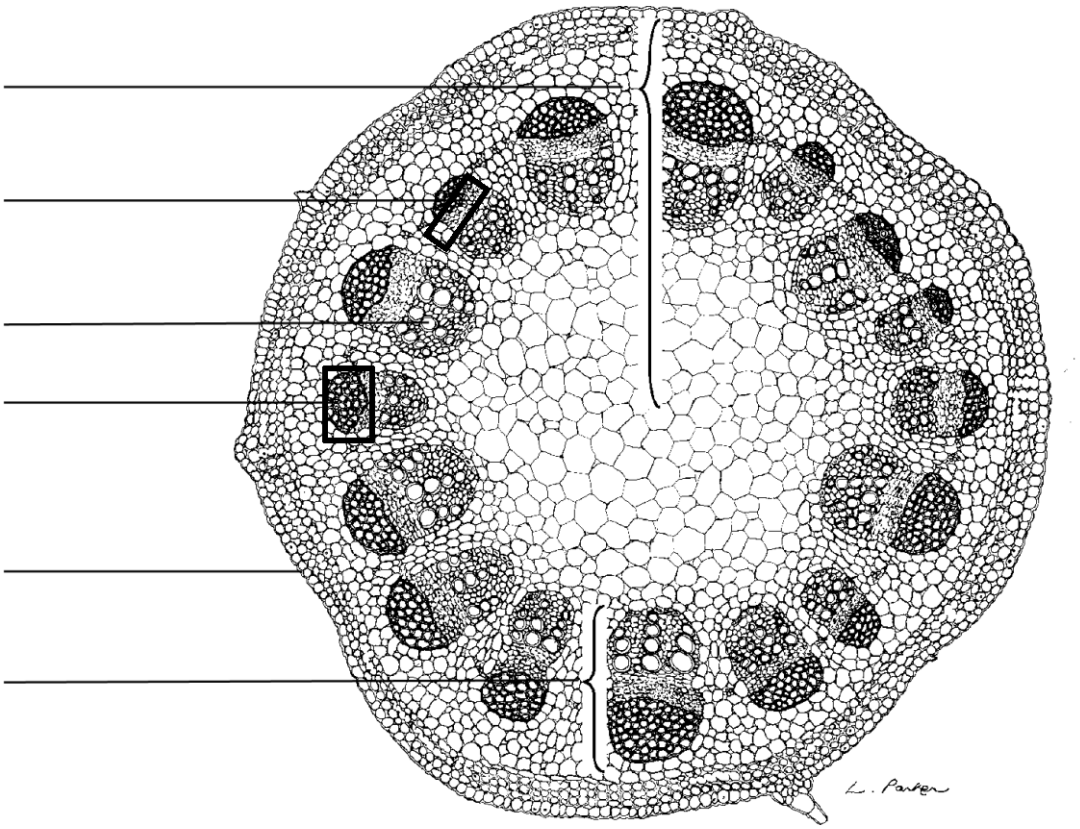
   b. phloem.

Sunflower: Stem cross section *(Helianthus)*

A. Examine a prepared slide of a stem cross-section (*Helianthus*) under the microscope using low, medium, and high power.

B. Label the regions of the stem: epidermis, ground tissue (pith and cortex), vascular bundles, xylem, phloem fibers, and phloem (companion cells, sieve tube members).

C. Coloring the different tissues as seen may help you remember which is which.



***Helianthus* Stem** cross section

1. If you looked at a longitudinal section of the stem, what would you expect the xylem and phloem to look like?

2. Which part of the stem of a plant is able to make new cells and allow the stem to elongate?

3. Which part of a stem of a plant is able to increase in width or girth (this secondary growth adds wood)?

Monocots and Dicots

A. Examine a prepared cross section slides of dicot and monocot stems;

1. How is the arrangement of vascular bundles different in each?

2. What are examples of monocots and dicots?

D. ♣**Stomata – Leaf Epidermis**

1. Examine the prepared slides with a compound microscope at 4X, 10X, and then 40X.
2. Make a drawing of the **epidermal cells**, **guard cells** and **stomata**.

E. **QUESTIONS:**

1. What is the function of the stomata?

2. What is the function of the guard cells?

3. Name one molecule needed for photosynthesis that enters the leaf through the stomata.

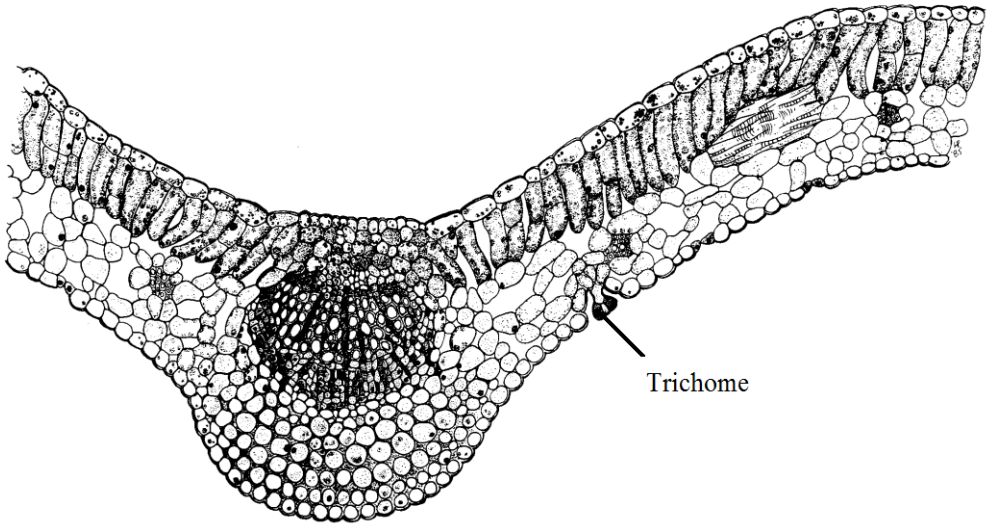
4. Name two molecules that exit the leaf through the stomata during the day.

5. What substance on the surface of the epidermis protects a leaf from drying out?

Leaf cross-section

Examine a prepared slide of a leaf cross-section at high power (40X). Identify and label the **epidermis**, **vascular tissue**, **palisade mesophyll**, and **spongy mesophyll**.

1. What is the name of the main photosynthetic tissue in the leaf?



2. Describe how each of the above cell types contributes to the principle function of the leaf (i.e. gas exchange and light absorption).
    a. epidermal cells

    b. guard cells

    c. palisade mesophyll

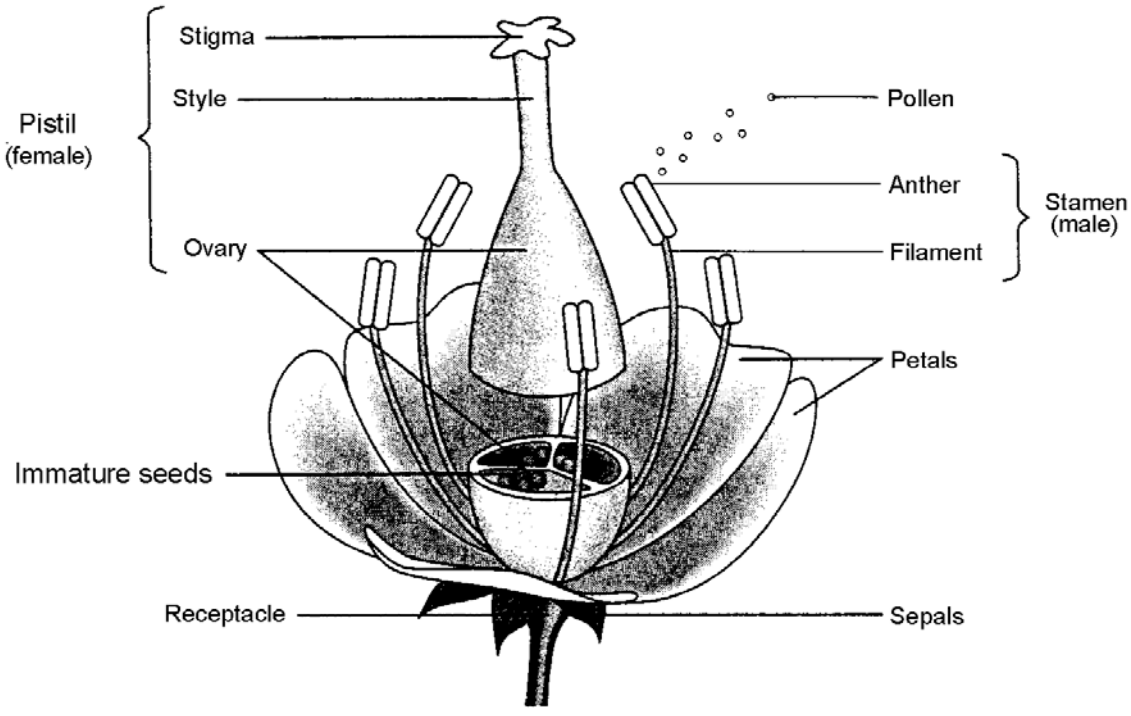
    d. spongy mesophyll

    e. vascular tissue (veins)

FLOWERING PLANT REPRODUCTION

In flowering plants the main reproductive structures include the male **stamen** and female **pistil**. Flowers also have two whorls of modified leaves: the **sepals** (the outer whorl) and the **petals** (the inner whorl). Not all flowers have both stamens and pistils, sometimes the male stamens are in a different flower than the female pistil. Nor do all flowers have the **sepals** (outer whorl of modified leaves) or **petals** (the inner whorl of modified leaves).

The stamens produce **pollen**. Pollen contains a cell that can grow into a long tube, this tube delivers sperm cells to the female reproductive parts. The pistil includes a place for pollen to land (**stigma**). The pollen grows a tube down through the style to the lower part of the pistil, until it reaches the section called the **ovary** that contains the immature seeds (ovules). The pollen tube delivers the sperm, which fertilize the egg encased in the immature seed. The fusion of egg and sperm lead to a **zygote** (a single cell produced from the fusion of the egg and sperm) which grows into the **embryo**. As the seeds develop inside the ovary the ovary matures into a **fruit**. The fruit may be a fleshy or a dry covering around the seed. When the seed is mature and has been dispersed, the embryo will break through the seed coat (**germinate**) and grow into the seedling.



Flower Example (Lily)

Flower Example (Lily)

1. How many pistils, stamens, petals and sepals does the flower have?

2. What are the functions of:
   a. sepals?

   b. petals?

   c. stamens?

   d. pistil?

Pollination and seed dispersal

1. Give at least two examples of flower adaptations that ensure pollination.
   a.

   b.

2. Name three different examples of adaptations that ensure that seeds (fruit) are dispersed from the parent plant.
   a.

   b.

   c.

3. Name a way that the parent plant helps the embryo once it has germinated. (Where do the nutrients come from that the embryo uses until it starts photosynthesizing?)

Review Questions

As with any Kingdom, the Plant Kingdom includes a tremendous diversity of organisms. The Plant Kingdom is divided into categories called Phyla At the side bench are examples of several Phyla. Be able to answer the following questions for each specimen:

Mosses and Liverworts:

1. How does fertilization occur? (How does the sperm reach the egg?)

2. Do they disperse by spores or seeds? Where are these structures produced?

3. What advance found in mosses and liverworts (and <u>all</u> other plants) represents the first step in becoming a terrestrial organism? (stops them from drying out)

4. Give two characteristics of the Mosses and Liverworts that limit them to moister environments?
   1.

   2.

5. Do they have secondary growth (wood)?

Ferns:

6. How does fertilization occur? (How does the sperm reach the egg?)

7. Do they disperse by spores or seeds? Where are these structures produced?

8. What specialized tissues found in ferns (compared to mosses and liverworts) represent increasing independence from an aquatic habitat?

9. Do they have secondary growth (wood)?

Conifers:

10. How does pollination occur?

11. Do they disperse by spores or seeds? Where are these structures produced?

12. What specialized tissues, also found in ferns and flowering plants, allow them to live in a terrestrial habitat?

13. Do they have secondary (woody) growth? What is the name of the cells responsible for secondary growth? What is the adaptive advantage of woody growth?

14. What reproductive characteristic found in conifers (compared to ferns) represents increasing independence from an aquatic habitat? What is the adaptive advantage of pollen and seeds?

Flowering Plants:

15. How does pollination occur?

16. Do they disperse by spores or seeds? Where are these structures produced?

17. What specialized tissues, also found in ferns and conifers, allow them to live in a terrestrial habitat?

18. Do members of this phylum have secondary growth?

19. What two structures/organs differentiate flowering plants from all other plant phyla?
    1. 2.

20. How do these structures increase the reproductive success of flowering plants over conifers?
    1. 2.

Review Questions:

21. What adaptation prevents the shoot (above-ground) from drying out in terrestrial plants?

22. What allows ferns to grow taller than mosses and liverworts?

23. What characteristic is found in conifers and flowering plants that frees them from water during sexual reproduction?

24. Give two ways animals function to increase reproductive success in flowering plants.

    1.

    2.

25. Distinguish between pollination and fertilization