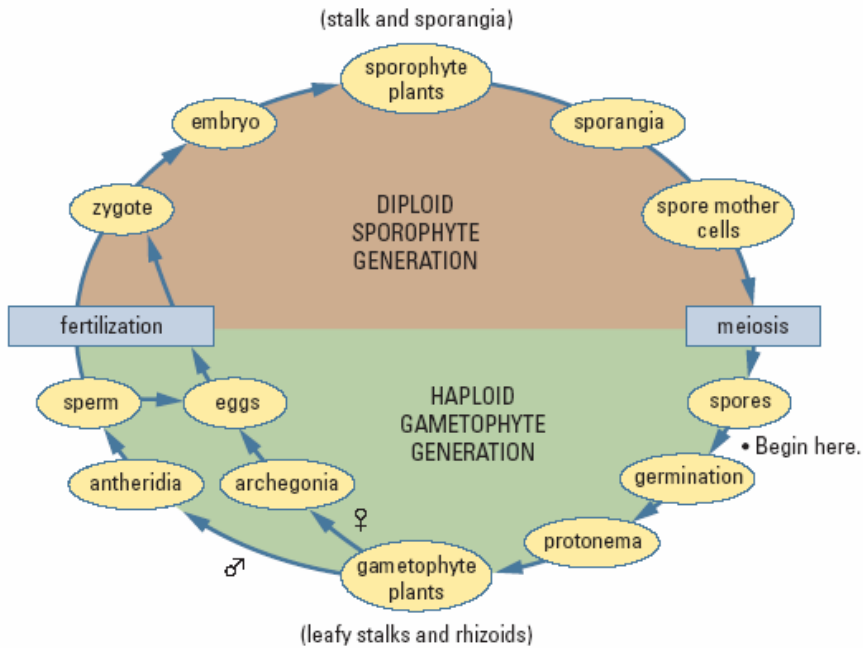


genotypes than the parent plants. This genetic diversity increases the ability of plants to adapt to changes in environmental conditions. Look closely at **Figure 2** again and identify where sexual reproduction occurs in the plant life cycle.

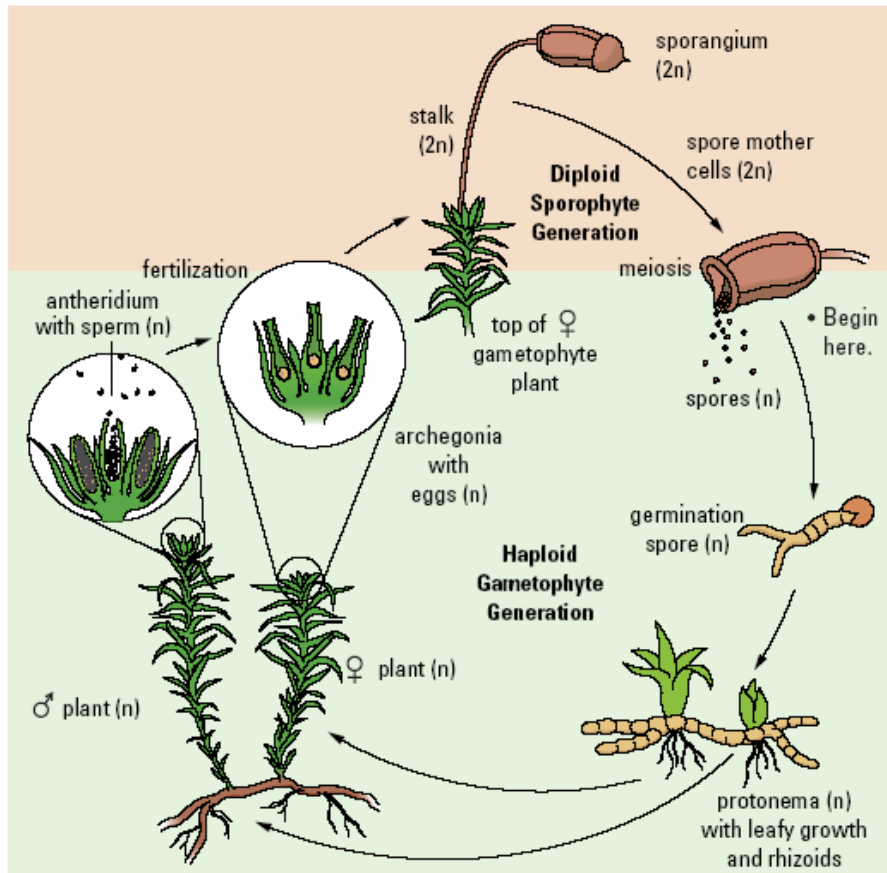
### Life Cycle of Mosses

The full life cycles of mosses and other bryophytes involve an alternation of generations as shown in **Figure 3**. Follow **Figures 3** and **4** carefully as you read about the life cycle.



**Figure 3**

Alternation of generations of a moss. Starting with the spores at the right side of the diagram, follow the cycle clockwise and note the labels carefully as you read the detailed description.



**Figure 4**

Alternation of generations of a moss. Starting with the spores at the right side of the diagram, follow the cycle clockwise and note the labels carefully. Compare these details with the text and with the simpler diagram, **Figure 3**.

The tiny haploid spores that have been produced by meiosis are the first cells of the gametophyte generation. As they are released, they are usually carried by the wind or sometimes by water. If a spore lands in an environment suitable for its growth, the protective covering splits and the spore germinates. The single cell divides rapidly by mitosis. The resulting haploid plant is called a protonema and resembles a filamentous green alga. This tiny gametophyte plant continues to grow. Rhizoids are produced from its lower surface to help anchor it. In time, the protonema produces little buds that grow into larger gametophyte plants, which may grow upright or along the surface of the soil or rock. As these plants mature, sex organs are formed. In the case of upright plants, these structures are surrounded by the leaflets at the top of the stalks.

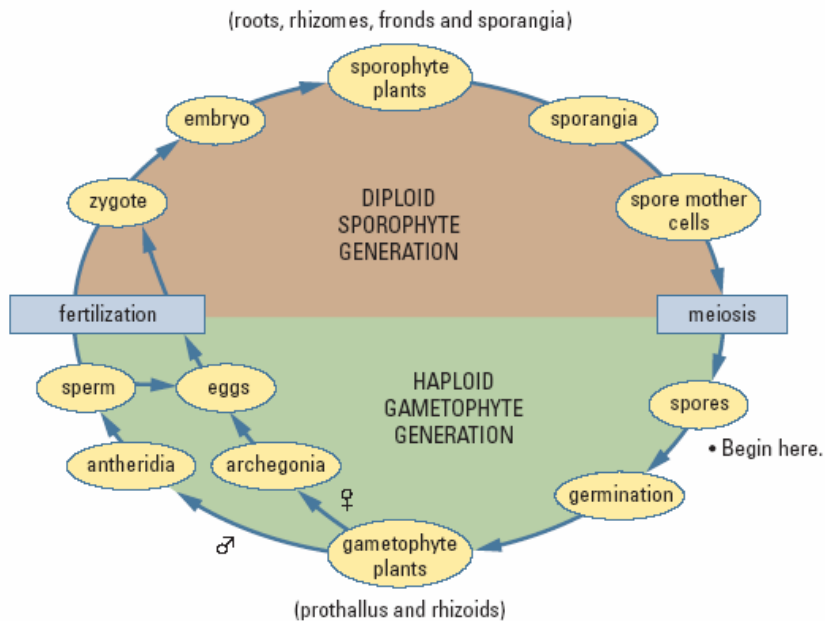
The male sex organ, called an antheridium (plural: antheridia) is tiny and shaped somewhat like an elongated balloon. Several of these organs are clustered at the top of one plant. Inside these organs, male gametes (sperm cells) are produced by mitosis. The female sex organ, called an archegonium (plural: archegonia), is also tiny and shaped like a bowling pin. Inside each of these organs, a female gamete (egg) is produced by mitosis. These sex cells are haploid, as are all the cells of this gametophyte generation.

When the sperm are mature, they are released from the antheridia. The mature eggs remain in the archegonia, which now produce a very sticky material. Transfer of the sperm from the male plants to the female plants can only occur if there is water. However, the plants are usually very close together and the water required can be as little as dew drops. Once in the vicinity of the archegonia, the sperm cells are attracted to the sticky material and swim down the neck of the archegonia. Only one sperm fuses with the waiting egg. This fertilization marks the beginning of the new sporophyte generation.

The first cell of this new sporophyte generation is the diploid zygote that grows rapidly by mitosis to form the diploid embryo—still in the archegonium. The embryo continues to grow into the new sporophyte plant, remaining embedded in the archegonium, which supplies nearly all the nutrients for the growing sporophyte plant. As the embryo grows, it becomes visible as a thin, brown stalk rising out of the top of the female gametophyte plant. Sometimes the brown stalk seems to be wearing a “hat.” This “hat” is the top of the old archegonium, which was torn off and rides up as the stalk grows. The stalk’s total height is often equal to the height of the gametophyte plant supporting it. Gradually the top of the stalk, under the “hat,” enlarges into a sporangium, inside of which are many diploid spore mother cells. Each spore mother cell undergoes meiosis to form four haploid spores, which are the first cells of the next gametophyte generation. The sporangia open and eject the spores, which are carried away by air currents. The stalk height increases the efficiency of spore dispersal.

### Life Cycle of Ferns

The full life cycle of ferns involves an alternation of generations. Follow **Figures 6** and **7** carefully as you read the details that follow.



**Figure 6**

Alternation of generations of a fern. Starting with the spores at the right side of the diagram, follow the cycle clockwise and note the labels carefully as you read the detailed description in the main text.