

# Growing Fern Gametophytes in the Classroom

Christopher R. Matlack

Until recently, I had found it very difficult to teach the concept of alternation of generations in the primitive vascular plants in a way that allowed high school students to connect living organisms with the concept of alternating haploid and diploid growth forms. However, several years ago, I discovered a way to grow fern gametophytes in the classroom so that my introductory biology students could have specimens in front of them as we discussed this topic.

Seniors taking my term-long ecology elective did a variation of Darwin's seed bank investigation, as described in Weiner's (1994) book *The Beak of the Finch*. They collected some topsoil from a small patch of woods behind one of the buildings on campus and put it in empty clear plastic sandwich containers near a source of light in the classroom. The students then identified and removed all plants as they sprouted, much as Darwin had done while observing that over a period of six months, 537 plants grew out of three tablespoons of mud that he had collected from the bank of a nearby pond.

Grasses and other pioneer plants came up during the first month, but then, soon after, heart-shaped fern gametophytes appeared. I have all of my introductory students perform this same exercise in April, so that by May I can teach this unit to them with the living structures in hand.

## Methods

1. Have your students collect 2" of top soil, using a shovel and a pail, from a mixed deciduous forest in early spring.

**Christopher R. Matlack** is chair of the Science Department at Phillips Exeter Academy, Exeter, NH 03833.

2. Back in the lab, put the soil in a clear plastic sandwich container (23 cm × 23 cm × 8 cm) that has a hinged cover (Figure 1). [I obtained these containers from a catered luncheon that I had attended and cleaned them in an autoclave before using.]
3. Keep the container at room temperature and thoroughly wet the surface of the soil every day using a spray bottle.
4. Illuminate the container with fluorescent grow-light bulbs on a 12/12 hour day/night cycle.
5. Check every day and discard mosses, angiosperms and gymnosperms that germinate.
6. In about a month, the spores of ferns should germinate and grow into small (1–2 mm) heart-shaped gametophytes.
7. A few weeks later, young sporophytes will grow out of the base of the notch on the gametophytes.

## Classroom Application

The alternation of generations in plants continues to be a topic that some students find very difficult to grasp, particularly if the teacher has already covered gamete production in diploid organisms, like humans. Being

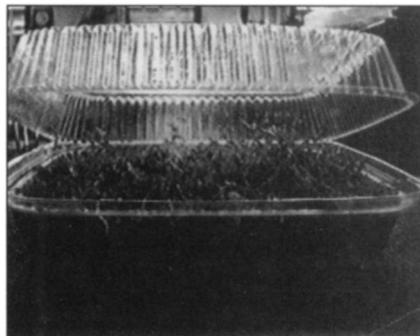


Figure 1. Ferns germinating in a clear plastic sandwich container.

able to grow and see the fern gametophyte growth form (Figure 2) has been a big help to my students in facilitating their understanding of alternation of generations in the primitive vascular plants.

Using stereo microscopes, I have each student find a fern gametophyte when I am discussing the fern life cycle (Figure 3) in class. Also, I use a flex camera and project the image of one onto a TV monitor. The heart-shaped fern gametophyte (N) will have archegonia (N) producing eggs (N) in the notch of the structure (Figure 4), while the antheridia (N) will produce sperm (N) down near the tip. Provided cultures are kept moist, within a few weeks, antheridia will mature and release sperm. The sperm will swim to a neighboring archegonium and fertilize an egg that will result in a zygote (2N) in the archegonium of that gametophyte.

The result of that fertilization will then grow into a developing fern frond, the sporophyte (2N) generation. My students also collect developed fern fronds from the woods, so that we have them on hand as well for observation of larger specimens. Later in the season, the sporophytes produce spores (N) by meiosis. On many types

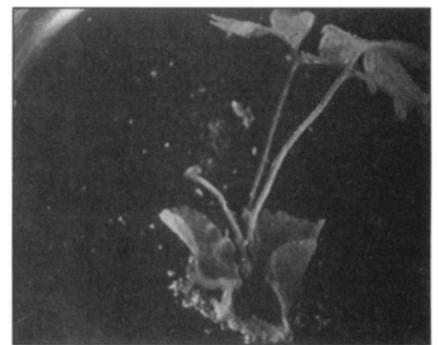


Figure 2. Fern gametophyte (N) with young sporophytes (2N) growing out of the archegonia.

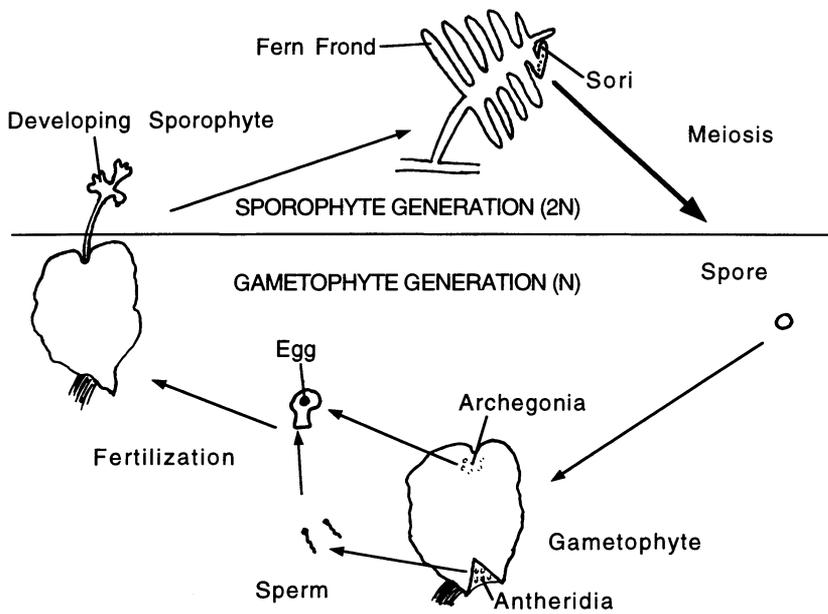


Figure 3. Alternation of generations in the fern life cycle.

of ferns, the spores are found on the underside of the fronds in circular, orange structures called "sori." These spores are released into the soil every summer and should be in your woodland soil sample.

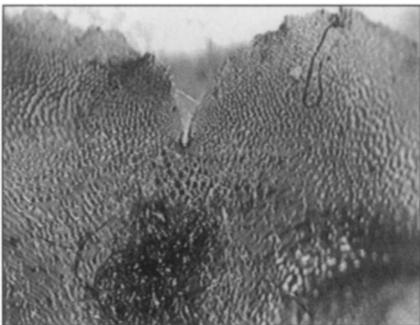


Figure 4. Archegonia in the notch of the fern gametophyte.

### Acknowledgments

I thank Frances Ekstrom for editing the manuscript, Jim Ekstrom for helping to produce the photographs of the developing ferns, and Jim Loats for assisting in making the fern life cycle diagram.

### References

Weiner, J. (1994). *The Beak of the Finch. A Story of Evolution in our Time*. New York: Alfred A. Knopf.

**TEACHERS.....**  
 Looking for pure eggs  
 for live biological  
 studies in your  
 classroom?  
 Guaranteed  
 To Hatch  
 & Grow!  
 Just  
 Add  
 Water!

**Triops**

**Fairy Shrimp**

**Killifish**

**Daphnia**

Complete  
 Aquatic  
 Ecosystems  
 Available

Call, fax or write  
 Triops Inc. today:

P.O. Box 10852  
 Pensacola, FL 32524  
 1-800-200-3466  
 Fax 1-850-479-3315

Downloaded from <http://online.ucpress.edu/ab/article-pdf/60/8/594/48698/4450556.pdf> by guest on 04 March 2021

MEXICO  
 GUATEMALA  
 BARRIERS

- REEFS & ATOLLS
- CORAL ISLANDS
- SEA KAYAKING
- SNORKELING
- CAMPING
- MAYAN RUINS
- TROPICAL ECOLOGY
- RAINFOREST RIVERS

**BELIZE**

**BELIZE**  
**EDUCATIONAL EXPEDITIONS**

Specializing in educational, sea & river expeditions in Belize, Central America. Qualified Instructors, top-notch equipment and 12 years of experience.  
 Call for information or visit us on the Web: <http://islandexpeditions.com>

1-800-667-1630

Island EXPEDITIONS.COM