A Treasure Hunt through Pond Scum

Marshall Darley

Department of Plant Biology
The University of Georgia
Athens, GA 30602
Phone: 706-542-1797
darley@dogwood.botany.uga.edu

Marshall Darley earned his doctorate in marine biology from Scripps Institution of Oceanography, University of California, San Diego. He is an associate professor of biology at The University of Georgia where he teaches introductory organismal biology to nonmajors and majors. He also co-teaches biology of protists and leads a teaching seminar for graduate students.

Reprinted From: Darley, M. 2003. A treasure hunt through pond scum. Pages 273-276, in Tested studies for laboratory teaching, Volume 24 (M. A. O'Donnell, Editor). Proceedings of the 24th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 334 pages.

Introduction

The protists are a remarkably diverse, polyphyletic group of organisms that includes many interesting, beautiful, scientifically useful and even pathogenic species. Although traditionally grouped together in the kingdom Protista in Whittaker's five-kingdom system, monophyletic protist lineages are being identified and elevated to kingdom status within the domain Eukarya in the three-domain system. Examples of new kingdoms include Euglenozoa (euglenids, kinetoplastids), Alveolata (ciliates, dinoflagellates, apicomplexans), and Straminopila (a very diverse lineage including oomycetes, diatoms, chrysophytes, and brown algae). How can we hope to cover this diversity given the time constraints in introductory biology laboratories?

Most of us were introduced to protist diversity by examining wet mounts of cultures or prepared slides of representative species. In the protist lab of our introductory biology labs for non-science majors at The University of Georgia, we cover algal diversity with an inquiry-based approach we feel is more interesting and fun while still introducing students to the wonders of algal diversity. Instead of having students examine a row of cultures or a series of prepared slides, they find and identify algae in a sample of pond water enriched with cultured algae. The activity below is the

principal activity of seven activities in the two-hour protist lab. By the way, *algae* is plural, *alga* is singular.

The focus in our protist lab is on algae rather than protozoa because pigmentation makes algae easier for introductory students to find under the microscope. Distinctive, readily observed features also make it easy to identify genera. In four of our introductory labs (protists, fungi, seedless plants, invertebrates) students are required to collect and bring in a sample they have collected from nature, and examine it in lab. In addition to making the organisms more real and relevant, this activity gives students some ownership of the material. I also co-teach an upper level Biology of Protists course in which most of the labs focus on samples students have collected. Freshly collected material is usually in better shape than cultured material and students soon discover that protists are not a big mystery because many of the same genera keep turning up again and again. And we invariably find one or more genera the instructors have not seen before.

Student Activity

Challenge: Explore the sample of pond water provided, finding and identifying 10 or more of the algae present using the following dichotomous taxonomic key and the illustrations provided. Add your discoveries to the class list being compiled on the board.

To make your exploration of the wonderful world of algae (a.k.a. pond scum) more interesting, we have "synthesized" some pond water for you to examine. We started with phytoplankton collected from local ponds, added some "scuzzy water" (obtained by shaking and/or squeezing water weeds and other submerged items to liberate loosely attached organisms) and finally added a number of common, cultured algae. This pond water therefore contains an amazing variety of algae and other protists. Enjoy!!

Some suggestions: Start by examining some of the pond water in a small petri dish under the dissecting microscope to get an overall sense of the organisms present and perhaps identify material you would like to examine more closely with the compound microscope. Make several wet mounts during your examination (and swap slides with your neighbors), realizing that some algae will be concentrated near the surface whereas others will be found on the bottom. To avoid crushing larger specimens such as *Volvox*, add a bead of petroleum jelly to the edges of a cover slip (smear a small amount of petroleum jelly on the palm of your hand and then wipe each edge of the cover slip across the smear). Make a brief sketch of each organism to help you remember it.

Although it is easy to simply look at the pictures to identify many of the algae present, it is important that you understand how a dichotomous identification key works and how to use it (one may be on your quiz next week). A useful approach is to use the key to identify the genus and <u>then</u> look at the picture to see if it matches; in other words, does it pass the "common sense test?" Other algae will undoubtedly be present. You may use the more elaborate keys available in the lab to identify other algae that may be present.

A Dichotomous Key to Some Common Freshwater Algae

1. Alga is a filament (a linear series of cells) – 2
1. Alga is a unicell or a colony (flat or spherical) – 6

    2. Filament is unbranched -- 3
    2. Filament is branched – ***Chaetophora*** (Chlorophyceae)

3. Chloroplast fills cell; filaments often end in "H" piece – ***Microspora*** (Chlorophyceae)
3. Chloroplast has a distinctive shape – 4

    4. Chloroplast is in the form of a spiral – ***Spirogyra*** (Charophyceae)
    4. Chloroplast is not in the form of a spiral – 5

5. Two "star-shaped" chloroplasts in each cell – ***Zygnema*** (Charophyceae)
5. Two thin, "plate-like" chloroplasts in each cell – ***Mougeotia*** (Charophyceae)

    6. Alga is a unicell – 7
    6. Alga is a colony – 13

7. Algal cell does not contain flagella – 8
7. Algal cell is motile with flagella – 11

    8. Algal cell is green – 9
    8. Algal cell is golden brown and elongated (pennate diatom) -- ***Nitzschia*** (Straminopila)

9. Cell is round, not divided into two halves – ***Chlorococcum*** (Chlorophyceae)
9. Algal cell is not round, often appears to be divided into two halves with nucleus in the middle of the cell, dark green (desmids, Charophyceae) – 10

    10. Cell is elongated without a constriction in the middle; cell may be slightly curved (like a banana) – ***Closterium***
    10. Cell has an obvious constriction in the middle; cell highly ornate with several lobes and secondary lobes – ***Micrasterias***

11. Cell is green – 12
11. Cell is not green, with two sub-apically inserted flagella; may be blue-green, brown, reddish brown – **cryptomonads** (genus unknown)

    12. Cell elongated with one long flagellum – ***Euglena*** (euglenid, Euglenozoa)
    12. Cell is oval with two flagella – ***Chlamydomonas*** (Chlorophyceae)

13. Colony is spherical and motile – 14
13. Colony is non-motile – 15

    14. Colony is green – ***Volvox*** (Chlorophyceae)
    14. Colony is yellow-brown – ***Synura*** (Chrysophyta)

15. Colony is spherical – ***Coelastrum*** (Chlorophyceae)
15. Colony is not spherical – 16

    16. Colony is a round, flat plate – ***Pediastrum*** (Chlorophyceae)
    16. Colony has 2 or 4 cells with spines on the corners – ***Scenedesmus*** (Chlorophyceae)

Notes for the Instructor

As noted in the Student Activity above, a collection of labeled line drawings is provided with this activity. Useful line drawings may be found in the following listed books. It would also be possible to provide one or more of these detailed published keys and have students look up the genera identified in the simple key above. Starter cultures of many of the cultured algae in the key, along with printed instructions for collecting, isolating and cultivating algae are available to ABLE members upon request to the author.

Canter-Lund, H., and J. W. G. Lund. 1995. Freshwater algae: their microscopic world explored. Biopress Limited, Bristol, United Kingdom, 360 pages. This book, beautifully illustrated with many exquisite color micrographs, is bound to stimulate students' interest in algae. The accompanying text describes the algae illustrated. Included are sections on symbiosis, animals that feed on algae and fungi living on and in algae.

Dillard, G. E. 1999. Common freshwater algae of the United States: an illustrated key to the genera (excluding the diatoms). J. Cramer, Stuttgart, Germany, 173 pages. This spiral-bound book is a newer and shorter key to genera of freshwater algae.

Graham, L. E., and L. W. Wilcox. 2000. Algae. Prentice Hall, Upper Saddle River, New Jersey, 700 pages. This is the text I would recommend for an introduction to the algae.

Prescott, G. W. 1978. How to know the freshwater algae. Third edition. McGraw-Hill Higher Education, Dubuque, Iowa, 293 pages. This is a long-time standard key for identifying freshwater algae.

Rainis, K. G., and B. J. Russell. 1996. Guide to microlife. Franklin Watts, a division of Grolier Publishing, Danbury, Connecticut, 287 pages. This is the book we place in our introductory labs because it includes bacteria, microfungi, protists and invertebrates. It is not a key, but is well illustrated with "Where to Look", "What to Look For" and "Did you Know..." sections on each genus.

Whitford, L. A., and G. J. Schumacher. 1984. A Manual of Fresh-Water Algae. Sparks Press, Raleigh, North Carolina, 318 pages. This book is a useful, well-illustrated key to species of algae found in North Carolina and the southeastern United States.