PLANT CELLS: A LABORATORY EXPLORATION

an abbreviated lab handout based on materials from:
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According to the cell theory first elaborated by Schleiden and Schwann, cells are the fundamental units of life. As a result, common plant materials should be made of cell types that vary, depending on the shape and/or qualities of the structures.

Please predict cell shape, cell texture, cell status (alive vs. dead), and cell function before your examination of each plant sample.

Surface or epidermal cells
These are derived from small sections of thin leaves (e.g., coleus or impatiens), cut in half, with the surface side up. Add a drop of water and a cover slip.

What do you see? (NB: possibility of stomata, trichomes, and adaxial vs. abaxial cellular differences. One may want to follow up with a section and/or maceration of a geranium or other leave to emphasize internal leaf structures)

Tobacco leaves
Pull a small piece or two out of a cigarette and put onto a slide. Add a water drop and a cover slip.

What do you see? What part of the plant is being used? (NB: multiple aspects of leaves noticeable, e.g., mesophyll cells, stomata, etc.)

Nut "meat"
Mince small amounts of walnut (or other nut) onto a slide, add a water drop and a cover slip.

What do you see? How does it differ from previous samples? (NB: noticeable lipid globules)

Toothpick
Take a small splinter or shavings from a toothpick. Put on a slide, adding a drop of water and a cover slip.

What do you see? Toothpicks are typically made of pine, vs. a hardwood such as maple. Does that make a difference in what you see? (NB: many tracheids visible)

BIODIVERSITY

an abbreviated lab handout based on materials from:
Assistant Professors Dan Capuano and George Preston, and Instructor Susan Stiner
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Our planet is full of life forms, with over 1.5 million species described or catalogued. Of these, approximately 50% are insects, 20% are plants, and only 3% vertebrates. Biodiversity can be seen around the campus, not just exotic tropical rainforests! We will use a plot survey and inventory of the species of plants and animals found within given study areas around the HVCC campus.

Questions:
What organisms make up the other 25% of recognized species?
What is meant by the term species?
What is meant by the term biodiversity?

Materials:
- wire hoop
- data table with pen/pencil
- field guide supplied by instructor.

Procedure:
We will sample three areas:
- the mowed lawn of the main HVCC campus
- the well-maintained turf of the HVCC football field
- another area that might be considered "wild/undisturbed" compared to the above two locations

Work in pairs and for each area:
- Randomly toss the ring to determine your study plot.
- Determine the number of different species within your hoop. Record the number of different plants and animals.
- Repeat this process two more times. Calculate the average number of plant and animal species from your three samples before moving to another area.
- Calculate and graph class averages of plant and animal species from each area.

Questions:
Why is each group conducting three plot inventories for each area?
How does your group's data compare to others in the class? Why might there be differences?
What generalizations can you draw from the data collected? What forces might be at work in each area?
Develop a hypothesis (testable statement) from your observations and current data. Design an experiment that would test your hypothesis. What is the format of the proposed experiment(s)?

SEED DISPERSAL

an abbreviated lab handout based on materials from:
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Today, we're going to simulate patterns of seed dispersal with milkweed seeds (or others that are similarly "feathery"). Preferably, this lab is done outdoors in a day with a gentle breeze, but can be adapted for other settings.

Materials:

- 10 milkweed seeds
- meter stick
- graph paper for scatter plot

Procedure:

One at a time, hold the seed from its "feathery" structure and release the seed in a consistent manner from a height of:

- 10 cm
- 1 m

Record the distance in cm or m that each seed travels, as well as its location with a scatter diagram:

Questions:

How do plants reproduce?
What are other possible mechanisms for seed dispersal, giving an example that you know?
What advantages/disadvantages might there be to a tall plant? To a short plant?

LOCAL ETHNOBOTANY

an abbreviated lab handout based on materials from a workshop at the Society for Economic Botany meetings, University of South Carolina, June 22, 2000:

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Ethnobotany is a wide-ranging subject that can cover a spectrum from anthropology to systematics. A lab (or a course project) where students work in groups to explore different aspects of a local, familiar phenomenon can be readily derived. The workshop at Columbia focused on sweet grass baskets of the Lowcountry (Charleston area). For my example from the Capital Region of upstate New York, I will present handicrafts of the Shakers.

Materials:
(reproductions) of Shaker basket, box, candies
Books:
Buchanan, R. 1996. The Shaker Herb and Garden Book. Boston: Houghton Mifflin.
Jonas, G. 1993. The Living Earth Book of North American Trees. Pleasantville, NY: Reader's Digest Association.
Kennedy, G., Beale, G., and Johnson, J. 1992. Shaker Baskets and Poplarware. Stockbridge, MA: Berkshire House.
Levetin, E., and McMahon, K. 1999. Plants and Society, 2nd ed. Boston: WCB McGraw-Hill.
Sprigg, J. 1990. By Shaker Hands. Hanover, NH: University Press of New England.
Sprigg, J. and Johnson, J. 1991. Shaker Woodenware: A Field Guide. Great Barrington, MA: Berkshire House.
Web sites:
http://www.hancockshakervillage.org/ (major Shaker museum in Pittsfield, MA and source for Shaker links)
http://www.nysm.nysed.gov/history/shaker/index.html (upcoming exhibit at NY State Museum, Albany)
http://www.rbgkew.org.uk/peopleplants/board/project.htm#basketry (Elaine Joyal's Basket Ecology project overview)

Questions to be asked: Each cluster of questions will require a different group to use the available resources and report back to others for a final overall report.

Cultural background:
Who were the Shakers?
Why the "plain" appearance of the basket and box?

Materials background:
What woods were used for the basket (NB: ash) and for the box (NB: maple)?
What is the genus and family for these woods?
Why were these woods chosen? Are there substitutions?
How would Shakers grow and produce herbal products?
Of what use(s) is/was the lemon/mint combination?

Sustainability issues:
Is/was the basket/object making **economically** sustainable (did it make money)?
Is/was the basket/object making **socially** sustainable (were subsequent generations interested in continuing the process)?
Is/was the basket/object making **ecologically** sustainable (were raw materials available without depletion from overharvesting, habitat destruction, etc.)?

ABSTRACT

Plants in Community Colleges: Wilson Crone, Hudson Valley Community College
Many students take general biology at community colleges, and so discussions to improve botanical coverage should include these courses. Community college students arrive with a wide variety of academic interests and preparations, which do not allow for easy characterization of their needs. Community college faculty members are often generalists without extensive botanical background. Furthermore, community colleges are typically commuter-oriented, short of space, and contain labs that serve a variety of different courses each day (i.e., no dedicated labs to the plant sciences). A pragmatic conclusion from these factors is to look for botanical offerings that require little space and maintenance between uses.

At Hudson Valley Community College (Troy, NY), faculty members use plants in several ways (field trips and exercises, basic photosynthesis and morphology laboratories, and application experiments), but only as small parts of general biology or environmental science classes. If biology faculty members are to lead a shift of undergraduate laboratory emphasis from observation to experimentation, then the rapid growth and easy manipulation of plants are features plant scientists need to publicize. While students (and even faculty) may think that plants are "boring," hands-on lab techniques that lead to demonstrable results of biological principles can lead to a renewed appreciation of green organisms.

ADDITIONAL REFERENCES

Some supplemental botany materials:

http://www.life.umd.edu/classroom/BSCI124/main.html *A non-major's class in botany offered through the University of Maryland*.

http://www.life.uiuc.edu/plantbio/102/ *A "plants and people" course at the University of Illinois*.

http://web1.manhattan.edu/fcardill/plants/intro/ *An online survey of the plant kingdom from Manhattan College.*

http://scitec.uwichill.edu.bb/bcs/bl14apl/bl14apl.htm *An introductory course on the plant kingdom from the University of the West Indies.*

Edick, G.F., and McDaniel, C.N. 1998. Doing Biology; an Introduction to the Experimental Process, 5th ed. (Lab Manual for BIOL-1020, Introduction to Biology Laboratory, Rensselaer Polytechnic Institute). *A one-semester introductory biology laboratory that consists of plant experimentation.*

Educational materials, particularly those that apply to community colleges:

http://www.hhmi.org/BeyondBio101/comcol.htm *A short reminder that community colleges are an integral part of higher education.*

http://members.home.net/mshapiro2/comments-4-7-00.htm *A thought-provoking caveat on the "rush" to distance learning, especially in those institutions, such as community colleges, with a primarily teaching focus.*

Cohen, A.M., and Brawer, F.B. 1996. The American Community College, 3rd ed. San Francisco: Jossey-Bass. *A readable overview of, and the history behind, the various goals of the community college system.*

Gagné, R.M., Briggs, L.J., and Wager, W.W. 1992. Principles of Instructional Design, 4th ed. Wadsworth, 1992. *An updated classic about different learning styles and how to address them*.

Grubb, W.N. et al. 1999. Honored But Invisible--An Inside Look at Teaching in Community Colleges. New York: Routledge. *Multiple examples of the teaching that goes on at this level.*

Sacks, P. 1996. Generation X Goes to College. Chicago: Open Court (Carus Publishing). *At times a tirade, but otherwise an engaging presentation of current college students and suggestions on how to teach in an information (but not knowledge)-filled world*.

ECOLOGICAL FOOTPRINT

Project Kaleidoscope Summer Institute, "The Future of Plant Biology," July 2000
material to accompany "The Future of Biology 101" by Paul Williams, UW-Madison

prepared by Assistant Professor Wilson Crone
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Resources:

Wackernagel, M., and Rees, W. 1996. Our Ecological Footprint: Reducing Human Impact on the Earth. Gabriola Island, BC: New Society Publishers. *The overall summary of the ecological footprint concept.*

Ryan, J.C., and Durning, A.T. 1997. Stuff: the Secret Lives of Everyday Things. Seattle: Northwest Environment Watch. *The (extensive) environmental ramifications of commonplace objects*.

http://www.rprogress.org/progsum/nip/ef/ef_main.html *Several presentations and calculations of ecological footprints*

http://www.ire.ubc.ca/ecoresearch/ecoftpr.html *A short web site overview of the ecological footprint concept*.

http://www.esb.utexas.edu/drnrm/EcoFtPrnt/Calculate.htm *Another online calculator to estimate a "personal" footprint*.

Overview:

The "Ecological Footprint" is a means of measuring the impact of human activities on supporting ecosystems. It measures the land area necessary to sustain current levels of resource use and waste generation by a selected population, e.g., person, campus, city, country (taken from Wackernagel and Rees, 1996). This is an attempt to demonstrate the "support systems" that human beings take for granted when pursuing different socioeconomic lifestyles. How much productive land is needed to supply materials and absorb waste?

Some guidelines to calculating your campus and/or personal ecological footprint:

A useful conversion factor is one hectare for each 100 gigajoules per year as a land-for-energy ratio for fossil fuel (NB: a Calorie (kilocalorie) corresponds to 4.2 kilojoules). North Americans use approximately 5 hectares/person, as vs. 1.5 hectares/person of ecologically productive land available for the world's population (from Wackernagel and Rees, 1996).

What are types of categories for consumption?

- Food (what are energy inputs, e.g., fertilizers, to grow it)
- Housing (heating, cooling, as well as the materials involved in the house and the land that the construction covers)
- Transportation (car vs. public transportation vs. bicycle, commuting distance)
- Other goods and services (clothing, recreation, appliances, government services)

What are types of categories for waste?

- Sewage (think of a campus's wastes going into one large "septic tank")
- Carbon sink (given the prevalence of fossil fuel use in western societies)