Investigations

RESEARCH IN ENVIRONMENTAL EDUCATION

The ERIC Center for Science, Mathematics, and Environmental Education, at Ohio State University, Columbus, has available a number of publications of interest to biology teachers:

1. *A Directory of Projects and Programs in Environmental Education for Elementary and Secondary Schools,* compiled by John F. Disinger and Beverly Lee in 1973, lists representative current environmental projects and programs in the United States. Information in the directory was gathered through a generalized questionnaire mailed to all environmental education projects known to the ERIC Center. When available to the compilers, the following information is included for each of 297 projects: title, director's name, address, and telephone number; project headquarters; principal staff; project history; objectives; materials prepared in the project; materials implementation list; teacher preparation, if any; summary; and future plans. Projects are indexed according to state and location within the state. The directory allows the reader to determine which projects are of special interest to him, and project directors may then be contacted for additional information.

2. *Affective Instruments in Environmental Education,* by John H. Wheatley, is a 27-page mimeographed publication describing several affective instruments currently available and some of the test data these instruments have produced. This publication would be useful to researchers in environmental education because the instruments have been screened. One of the very real problems in research studies is the preparation of an instrument. If an affective instrument is needed, Wheatley lists several, with appropriate descriptive material, from which a researcher may choose.

3. *Environmental Education Information Report,* is a three-volume set. In volume 1, *A Review of Environmental Education for Elementary and Secondary Teachers,* of greatest interest to the researcher is the summary statement concerning programs and materials. For example, there are many environmental education programs in schools in the U.S.; yet, if one compares the number of programs to the number of school districts (some 38,000 in the nation), it is clear that few schools have functional programs for environmental education. Considering the small number of K-12 units, the proportion of programs in these situations is very small indeed. The report points out that environmental education programs survive, in general, only as long as outside funding is available. Too frequently, successful school programs have been dependent on the leadership of one dedicated person and, as a consequence, have survived only as long as that person remains an active leader in the school district. Few programs have employed organized evaluation procedures. Volume 1 also includes descriptions of programs in environmental education.

Volume 2, *A Review of Environmental Education for Teachers of Urban Disadvantaged,* indicates that relatively few urban schools have developed environmental education programs with emphasis on the urban area or have included community involvement as a technique. The portion of volume 2 of interest to researchers who are attempting to locate examples of urban environmental education programs is the description of active programs. Where available, descriptions of urban programs include the name of the director, the program address, grade level, subject area, overview, rationale and general objectives, evaluative data, locations of sites, and materials prepared by the program and their cost.

Volume 3, *A Review of Environmental Education for School Administrators,* includes, in abbreviated form, much of the material in the other two volumes.

4. *100 Teaching Activities in Environmental Education* is for the searcher rather than researcher, that person who wants a ready description of activities for teaching environmental education. Each activity has been classified according to grade level, subject matter, environmental concept involved, and environmental problem area. For each there is a statement on how the activity may be used and a reference to a source for more details on the activity and variations.

For the researcher who is beginning to compile information about environmental education in the U.S., these publications are good beginning sources of data.

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WHAT ARE FACTS?

Too often students unquestionably accept things they read or hear as facts. It is an accepted fact that the center of the earth is composed of molten lava—or is it? It is an accepted fact that the planet Pluto is extremely cold—or is it? Has anyone ever been to the center of the earth or to Pluto?

At the beginning of the school year, I do an exercise that deals with so-called facts. I place a piece of chalk in an empty box and bring it into the classroom, giving the students the impression that the box is very heavy. Then I ask the class to hypothesize about what is in the box and I write their suggestions on the blackboard. I suggest

the students tell me things to do to the box (such as shake it) to give them some clues to its contents. Once that is done, we go over the items written on the board and cross out those we feel are not possibilities. A unanimous decision must be made before any item is eliminated.

Next the students are encouraged to ask me about any property of the item in the box (for example, does it float, write, burn?). After many questions, we again look at the board. By this time, the majority of the students are sure that they know what the item is. To them, they have established a "fact." With everyone in agreement about the box's contents, I lay it down and go about other business. But wait—the students want me to open the box to see if their "fact" was correct!

The point is emphasized that scientists often cannot get first-hand information about a phenomenon. Many scientific facts are gotten from hypotheses, observations, and experimentation: such are the workings of science.

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AMITOSIS IN *NITELLA AXILLARIS*

Most biology textbooks and courses give extensive details of mitosis and meiosis but amitosis, a relatively uncommon type of nuclear division, is rarely discussed. Amitosis is a type of vegetative nuclear division that does not involve a typical mitosis. Shen (1967) has indicated that amitosis is probably a means of increasing the DNA content and nuclear surface area. In this study amitosis was observed in the vegetative cells of *Nitella axillaris*.

Nitella plants (which can be obtained from most biological supply companies) were grown in the laboratory under continuous illumination in soil extract medium made from garden soil (Green 1958). Small vegetative cells were removed and permanent slides prepared by a modification of the aceto-orcein squash method suggested by Darlington and La Cour (1970):

1. Remove the vegetative cells and fix for 24 hours in Carnoy's fluid (3 parts absolute alcohol and 1 part glacial acetic acid).

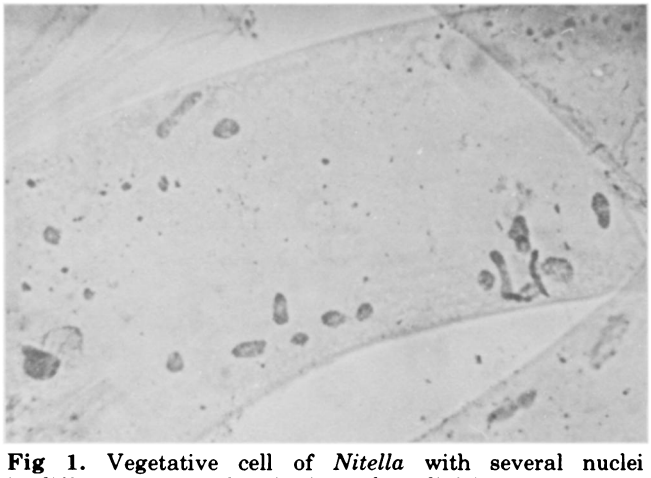

Fig 1. Vegetative cell of *Nitella* with several nuclei in different stages of amitotic nuclear division.

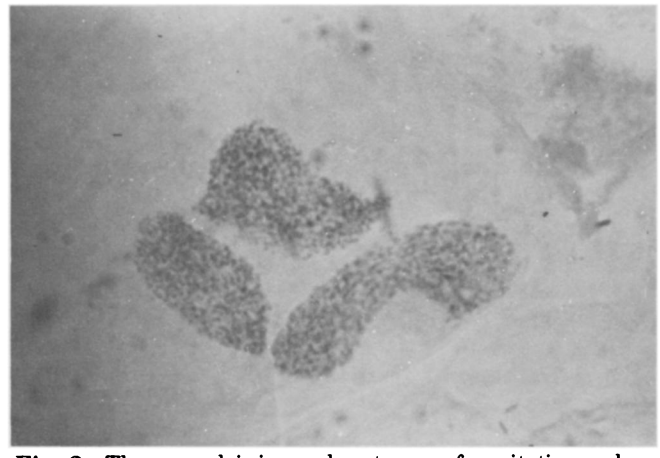

Fig 2. Three nuclei in early stages of amitotic nuclear division.

2. Wash in 40% acetic acid.
3. Transfer to a slide and immerse in 2% aceto-orcein stain (available from Turtox Co., Chicago).
4. Position a coverslip and carefully pass over an alcohol flame.
5. Place between sheets of bibulous paper and squash carefully.
6. Place the slide on the surface of dry ice. The slide and cover slip readily separate on contact with the dry ice for a few minutes.
7. Dehydrate through an alcohol series 50%, 70%, 90% and two rinses in absolute alcohol with the slide and cover slip separated.
8. Clear in xylene.
9. Mount with a drop of Canada balsam.
10. Dry at room temperature for a few days. The slides are now ready for study.

When the slides are studied under the microscope several nuclei at various stages of amitotic nuclear division can be observed (fig. 1). Several particulate structures that are DNA positive can be seen when the stained cells are examined (fig. 2). However there is no evidence of organized chromosomes. Wilson (1928) suggests two types of nuclear division: one where the two parts of the nucleus draw apart, and the other by

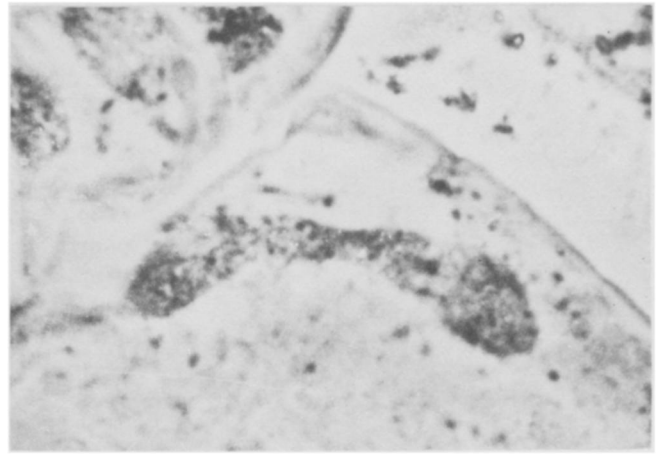

Fig 3. A single nucleus in a late stage of amitotic nuclear division.