

# Outdoor Biology Instructional Strategies: Development and Evaluation

JOHN FALK  
LARRY MALONE  
MARCIA C. LINN

**O**UTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES (OBIS) is an experiential, outdoor-based, group-oriented program established in the summer of 1972. OBIS, located at the Lawrence Hall of Science, University of California, Berkeley, is supported by a grant from the National Science Foundation. The project's goal is to develop activities which encourage middle-school-aged youngsters to explore biological phenomena outdoors in order to observe and understand how the ecosystem functions. OBIS is not primarily a school classroom curriculum; it is a community-oriented project directed toward YMCA camps, junior museum groups, after-school ecology clubs, scouts, church youth groups, nature centers, and other organizations of 10-15-year-olds. Because OBIS is attempting to bring program materials to a diverse group of users whose leaders are assumed to have no training in natural history or biology, the activities must be clear and concise, interesting to the participat-

John Falk (*pictured*) is education coordinator for the Chesapeake Bay Center for Environmental Studies, Smithsonian Institution, Route 4, Box 622, Edgewater, Md. 21037. He received a Ph.D. in biology and science education from the University of California, Berkeley, in 1974. Falk was director of the University of California's Summer Program in Outdoor Biology from 1970 to 1972, a research associate for OBIS from 1972 to 1974, and he is presently a field director for OBIS. He has published several articles on outdoor education and ecology and is currently involved in promoting adult outdoor environmental education. Malone and Linn are research biologist and research psychologist, respectively, at Lawrence Hall of Science, University of California, Berkeley. Malone, a 1965 graduate in general biology from the University of California, is involved in the development of ideas, trial testing of activities, and implementation and dissemination of OBIS materials. Linn received a Ph.D. in educational psychology from Stanford University in 1970. She is the author of numerous articles on educational psychology and science education and is a consultant for the Adapting Science Materials for the Blind Project at American University.



ing youngsters, and independent of the background and training of the leader. In order to achieve these goals, evaluation must be an essential part of OBIS activity development.

In this paper we will describe how OBIS develops an activity, discuss the OBIS evaluation of some OBIS lawn activities, and discuss the role of evaluation in development of the format presently used by OBIS.

## *OBIS Lawn Unit*

One ubiquitous American community available to thousands of potential student investigators is the lawn community. In this paper, specific results will refer to the development of lawn activities, even though OBIS was preparing activities for use with ponds, vacant lots, seashores, and woods at the same time. When the lawn was originally considered as an OBIS study site, the plan called for a unit of ten activities focused on the lawn community. Evaluation of the lawn and other units influenced the decision to change the OBIS format to a variety of individual activities that could stand alone or be sequenced in a number of ways to form more flexible units.

## *Development of OBIS Activities*

Activities are tried and evaluated at least three times before they are prepared for general dissemination. During the first phase of development, an OBIS staff member, calling on his past experience and intuition, organizes an idea into an activity. Activities are designed to meet several basic qualifications: (i) increase the understanding of the ecosystem; (ii) be appropriate for 10-15-year-olds; (iii) be designed for an accessible and readily available outdoor site; (iv) be appropriate for an untrained leader; (v) last about one hour; and (vii) involve simple, inexpensive equipment that could be made or purchased by a community group leader.

The OBIS staff member then tries out the activity with a small group of students while another staff member observes. Both staff people prepare a written report noting which aspects of the activity succeeded and which failed and recommending that the activity be dropped, revised and retested at Phase I, or moved to Phase II. Because the leader at this point is the originator of the idea, success or failure of the activity is determined by the activity content and the effectiveness of the equipment rather than the ability of the leader to understand and present the activity.

**Table 1. Lawn unit development.**

	Development Phase		
	Phase I	Phase II	Phase III
Groups	5	8	35
Student	43	82	784
Outside leaders		7	11
Observer reports	42	58	37
Leader feedback		12	92
Student feedback Forms		67	539

One activity in the lawn unit is quadrat censusing. During Phase I, the OBIS leader tried quadrat censusing of dandelions on a lawn. This activity failed because there was no way to verify the accuracy of the census. In the revised activity, "Bean Bugs," the leader evenly spreads a specific number of dried beans over a specific area. This method allows the group to confirm its estimate. The activity then went to Phase II.

In Phase II of development, the staff writes the activities and prepares equipment for use by local group leaders. Staff members observe activities used by local groups, write reports, and discuss the activity with the leader, specifically requesting suggestions on the written instructions. In this phase of development, the OBIS staff concentrates on evaluating and revising the instructions for the leader. As in Phase I, evaluation at Phase II is based primarily on observation, although pilot testing of written feedback forms for students and leaders is initiated. Successful activities enter Phase III; others are retested at Phase II or dropped.

Phase II trials of the quadrat census activity "Bean Bugs" resulted in two changes: (i) trials revealed that leaders needed complete instructions in order to do the mathematics involved in censusing; and (ii) trials showed that averaging of all the students' independent results yielded quite an accurate estimate of the total bean bug "population." These changes were incorporated into Phase III.

In Phase III of development and evaluation, the activities are disseminated to dozens of leaders and hundreds of youngsters in the Greater San Francisco Bay Area. At this point, although materials are provided, instructions for making equipment are included with each activity. The OBIS staff cannot observe all these leaders firsthand, so written reactions by leaders and participants are used. A photographic technique was also used for certain activities in Phase III to determine student involvement. The purpose of evaluation in Phase III was (i) to determine the educational value of the program (whether or not participants learned concepts and processes of ecology from the OBIS materials); (ii) to assess the attitude of the leaders and participants toward the OBIS materials; (iii) to determine the effectiveness of OBIS equipment; and (iv) to determine whether students became actively involved in observing the ecosystem.

## OBIS Evaluation Philosophy

In OBIS, evaluation instruments have the same format and design as regular OBIS activities. Student evaluation instruments include objects that can be manipulated, pictures to identify, and other experiential components. For example, the evaluation activity for quadrat censusing is to census the number of loops of yarn in a square of shag carpeting. Similarly, feedback forms include specific questions along with the opportunity to express comments or questions that may arise. Whenever possible, the staff arranges for leaders to communicate their feelings and write down their comments about each activity they use.

In addition, OBIS evaluation instruments are adapted to each phase of activity development. During Phase I the OBIS staff evaluates the activity idea, during Phase II outside leaders and OBIS staff evaluate the leaders' instructions, and during Phase III the staff determines whether the activity is interesting and informative to both leaders and participants.

### Lawn Unit Evaluation

A variety of community and school groups participated in the first year of development of the lawn activities. Table 2 summarizes the numbers of leaders and students involved at each phase, and the numbers

**Table 2. Comparison of trial and control classes on two feedback questions.**

<i>Quadrat Censusing</i>												
Control classes						Trial classes						
						T	T					
						T	T	T				
						T	T	T	T			
						T	T	T	T			
0	1	2	3			0	1	2	3			
Mean score of class on posttest						Mean score of class on posttest						
<i>Role of Man in the Lawn Community</i>												
Control Classes						Trial Classes						
						T						
						T						
						T	T					
						T	T	T				
						T	T	T	T			
6	7	8	9			6	7	8	9			
Mean score of class on posttest						Mean score of class on posttest						

**Table 3. Lawn attitude survey: results for representative questions.**

Question	Student Response (Percent responding)		
	Yes	Somewhat	No
I liked being outdoors.	88	9	3
I learned some things I wanted to know.	40	33	27
I would like to take another course like this.	44	36	20
The course was too long.	9	18	73

and types of written feedback forms received. Excerpts from each type of feedback are given below.

*Staff observer reports.* During all three phases of lawn activity development, staff members relied on the information recorded in the staff observer reports. The focus of these reports varied from one phase to the next, as mentioned above, but the purpose remained to gather firsthand information and record staff impressions at each phase of development. Reports frequently centered on specific problems; for example, Were the students involved in the activity? Was a discussion necessary to clarify the concept involved? Were instructions clear and easily followed by leader and participants? These reports often include suggestions to the developers concerning changes in equipment, ideas for related activities. The following are excerpts from some staff observer reports on the bean bug activity and another lawn activity that calls for a gardener to speak on the role of man in the lawn community.

"Bean Bugs" were chosen to develop the censusing technique for two main reasons: the results are verifiable, and the beans are easily identified units (unlike grass and other lawn plants) which don't move around (like ants, sowbugs, etc.). This turned out to be a valid choice as the kids had little trouble locating and counting the population.

... good using peas for bugs—perhaps better to follow up with census of a couple of "real bugs." Discuss with kids when quadrat-type census can be used."

Speaker dragged on. Information was slow in coming and not well organized. Lecture was too "textbook" rather than an informal talk about how to maintain a lawn and the problems one can expect to encounter.

*Leader feedback forms.* Of extreme importance to the evaluation of OBIS lawn activities at Phase II and III was information, both written and oral, from the outside leaders. As frequently as possible, develop-

ment staff people met with OBIS leaders to discuss successes and failures. From these discussions came many concrete suggestions on extending or modifying activities. Written feedback in the form of a questionnaire asking leaders to note positive and negative features of units and make suggestions for revision was pilot-tested with a handful of groups during Phase II. This questionnaire was relied upon heavily during Phase III when direct observations and discussions were less frequent. Leader feedback from the questionnaire was exemplified by the following:

This activity [Bean Bugs] involved two math concepts that my kids were very weak on [averaging and area]. This activity should work better with older kids, say 13-15 years. They had fun counting and finding bean bugs, but some seemed lost trying to determine the population.

We did this one in two sessions [distribution of animals in a grassland] since the activity was too long for one activity session. A distribution map was made in three colors: red for animals caught by hand, green for animals caught in nets, and blue for animals caught in baited vials.

I didn't do this activity [guest speaker] because I couldn't get a good speaker.

*Student feedback forms.* As mentioned above, student feedback activities were designed to resemble other OBIS activities. For example, the quadrat census technique was tested by the following question:

On the back of your packet is a make-believe THICKET (a square piece of shag carpet). Each piece of yarn represents a single berry plant. Use the one-inch square piece of wire to find out how many berry plants there are in the thicket.

*Hint:* The thicket is 10 inches by 10 inches. Please show all your work.

During Phase III the lawn unit was tried by 35 different groups. Leaders for 13 of the groups were able to identify similar groups of students not doing OBIS who could serve as controls. Histograms of scores for these groups on the quadrat question and on the role of man in the lawn community question are given in table 2. As can be seen, students of OBIS performed better than controls on the quadrat question but showed no appreciable difference in performance on the role-of-man question.

Questionnaires were used to determine the childrens' attitude toward the lawn unit. The children were able to indicate their opinions of various aspects of the unit. Statements like "The activities were fun," "I liked being outdoors," and "I learned something I wanted to know," were included on the questionnaire. Table 3 indicates some general results.

Student involvement in the activities was also measured. The photographic technique was used to

(Concluded on p. 173)

their own ideas and in themselves as individuals. They were able to go into greater depths in areas of their own interest and they were not forced to study material that was already familiar to them.

The system allowed students to master each gradual sequenced step before proceeding to the next. As a result, there were fewer failures.

Such a system can also be of benefit to a departmental budget. Ours is inexpensive compared to the sophisticated media approaches presently being developed, and its low cost and simplicity would allow it to be adapted to a wide range of teaching situations. The time involved in the preparation of instructional objectives, tapes and other materials was great, but more time is involved in minicourse development involving the preparation of student study guides.

I feel this individualized system will cost less, can teach more students per instructor using less building space, and is more efficient in teaching students than the traditional approach. I am excited with the great potential impact individualization has on student achievement. Student evaluations of the course also indicated that this was one of the most rewarding they had ever taken.

## REFERENCES

- BURNS, G. W. 1972. *The science of genetics*. Macmillan Co., New York.
- COOMBS, A. F. 1964. We thought you would like to know about modular scheduling. Roy Martin Junior High School Information Services Department, Las Vegas, Nev.
- \_\_\_\_\_, R. F. MADGIC, R. V. OAKFORD, T. SATA, and R. TALBERT. 1971. *Variable modular scheduling*. Benziger Inc., New York.
- CREAGER, J. G., and D. L. MURRAY. 1971. *The use of modules in college biology teaching*. CUEBS Publication No. 31, American Institute of Biological Sciences, Washington, D.C.
- KEMP, J. E. 1971. *Instructional design*. Fearon Publishers, Belmont, Calif.
- MAGER, R. F. 1962. *Preparing instructional objectives*. Fearon Publishers, Inc., Palo Alto, Calif.

## OBIS . . .

from p. 164

record student involvement during 5 of the 9 lawn activities for 4 of the leaders. This technique, utilizing still photographs taken at predetermined intervals with a wide-angle lens, allowed for the quantitative determination of in-field behaviors. For each picture, the percentage of students actively engaged in the activity was determined. An average of 90% of the students were actively involved in lawn investigations when the pictures were taken.

## Conclusions

The OBIS development and evaluation resulted in significant changes in the lawn activities. The activities developed to investigate the role of man in the lawn community were not successful or particularly

motivating when used with youngsters, so these activities were dropped. This is not to say that an OBIS activity cannot or will not center on the role of man in the lawn community but only that this specific activity failed. On the other hand, the idea of population census using a quadrat census technique (Bean Bugs) was both educational and fun.

General comments from the evaluation of the lawn unit follow:

1. Many community groups have difficulty arranging ten weekly visits to the lawn.
2. Groups would prefer to visit a variety of sites.
3. Groups desire the flexibility to select activities that are consistent with group size, weather conditions, and availability of transportation.

These are some of the reasons that the OBIS format was changed from a unit approach to a single activity approach.

An effective curriculum development project requires three main components: ideas, trials, and evaluation. Ideas can come from any place at any time and do not require the structure of a project for their origin. However, for an idea to be made available to a broad audience, the idea must be formulated into an activity and tried repeatedly with youngsters. During each trial the effectiveness of the activity must be evaluated on the basis of certain questions. Is the activity idea clear to the instructor? Does the instructor have all of the necessary materials and knowledge to convey the idea to the youngsters? Is the idea actually conveyed to the youngsters? In the case of OBIS, activities are designed to be both educational and fun. Unlike typical school programs, OBIS activities must compete for time with sports, crafts, recreation, and social events. Therefore, OBIS materials are evaluated for enjoyment, usability, and educational soundness.

Evaluation, from a curriculum project's point of view, is a vital tool which must be a dynamic part of staff activities to be of maximum use. The evaluation described here is not a meter-stick by which we measure how superior our approach and materials are to the products of another project but rather an internal set of checks and balances by which we screen and scrutinize our products to insure that they are the best we can produce. We hope that any individual or group of researchers undertaking the challenge of turning ideas into curricula will find our methods useful as a model or at least a point of departure for designing development evaluation schemes.

## Information for Contributors

ABT's "Writer's Handbook" lists information for contributors on criteria for selecting manuscripts, directions for adhering to style and format, editorial procedures for handling manuscripts, and a few writing "hints." Copies are available on request from the editor.