Biology for the Elementary Teacher

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The efforts of a university to provide an in-service program in biology for elementary teachers are described here. It took the form of week-end programs in a field station environment. The care which the directors took in presenting a really useful program for elementary teachers had its rewards in reports of its effectiveness given here.

There has long been a feeling on the part of the science education personnel in the Department of Teacher Education at Michigan State University that there should be a course designed to meet the needs of elementary teachers for content in the science areas, since it is only after these needs have been met that effective methodology can be discussed. Consequently, a workshop was designed, entitled "Biological Science for Elementary Teacher," which was offered at Michigan State University's Gull Lake Biological Station during the spring term of 1959. It was taught as a three credit course giving work at both the graduate and undergraduate levels.

The description of the purpose of the course, as listed in the university catalog was:

> A workshop designed to aid elementary school teachers in providing science experiences for their classes by stressing not only facts, concepts, and principles of biology, but also methods and materials that may be used in the elementary classroom. The workshop will include life processes of plants and animals, adaptations to the biological environment, and the development and interdependence of life, with a special emphasis on field and laboratory work. Stress was always placed upon the principle that all living things depend upon all other living things and that an understanding of the balance of nature and the interrelationships of life are more important in human experience than making collections or memorizing birds names.

Personnel

The twenty-four students in the workshop ranged in age from twenty to sixty years of age and from one to thirty-five years of experience in the classroom. Most of them were working toward a master's degree in elementary education, although there were two principals and one curriculum consultant pursuing postmaster's degrees. With the exception of two persons with degrees who desired to work toward teaching certification and three school camp counselors, the remainder of the class consisted of elementary classroom teachers.

The backgrounds of the teachers varied from no experience in biology to those who had bachelor's degrees in the subject, from those who had worked on farms and in plant nurseries, to those who had had no experience in vocational biology. There were eleven men and thirteen women enrolled, approximately half of whom had to travel for at least an hour to get to the Biological Station, some of them from as far away as seventy-five miles.

Setting

The Gull Lake Biological Station, owned and operated by Michigan State University, provided an ideal location for the course. The lodge, which served originally as a private mansion for W. K. Kellogg, and later as a rehabilitation annex for Percy Jones Army Hospital, served as an indoor classroom with facilities for laboratory work, meals, and overnight quarters. Surrounding the lodge are some thirty-two acres of lawn, trees, shrubs, gardens, and water front, plus an additional seventy acres maintained in a natural state. Kellogg had imported many varied plant species to the extent that over fifty species of trees can be found in the immediate vicinity of the lodge. A greenhouse is maintained at the station to supply

the gardens with their annual needs and also to serve as a research laboratory and tropical display.

The country surrounding the station included many diversified forms of terrain, soil, drainage conditions and bodies of water, *e.g.*, small lakes, streams, bogs, and swamps. One of these streams, Augusta Creek, flows through a five hundred fifteen acre tract of land known as The Kellogg Forest. This forest and the bird sanctuary were also donated to Michigan State University by W. K. Kellogg. The forest was established for the purpose of illustrating the rehabilitation and use of eroded soil by proper conservation practices. Hence, much of the area is not a natural setting but is planted in a multiple forest program to produce archery bolts, Christmas trees and boughs, edible nuts and berries, firewood, posts, pulpwood, and sawlogs, game animals, fish and game, and songbirds. The forest is even more replete with diversified tree species than the Biological Station. There is, however, sufficient area in its natural state to provide evidence of many ecological interplays.

The Bird Sanctuary mentioned previously surrounds Wintergreen Lake, and has the primary function of a migratory bird refuge. The resident waterfowl consists of some twenty species of ducks, geese, and swan. Pens in the area house specimens of many of Michigan's game birds (pheasant, grouse, quail, partridge, etc.), as well as other birds and mammals that might normally be found in or near the natural habitats of these birds. Peafowl roam the area at will; other pens house exotic species of birds; a lakeside museum contains a large assortment of mounted and study skins of birds and mammals. The land itself has a park-like atmosphere with winding trails and hilly terrain and a vast assortment of native and introduced flora.

This, then, was the setting for a biology class designed to teach biology to elementary teachers and principals and to stimulate them to introduce biological concepts in their classes. The lodge provided an atmosphere of relaxation and ease for both students and instructors and was used for all lecture and discussion sessions. The grounds surrounding the lodge, with the addition of the forest and the sanctuary, supplied specimens of tropical and subtropical vegetation, lawns with trees and shrubs arranged by man, eroded hillsides and watersheds, open grassland, farmland, deciduous and evergreen forests with and without forest-edge conditions, cutover areas that were being left to follow a natural sequence of change, and natural, although usually not climatic, upland woods. Aquatic conditions ranged from a large freshwater lake (Gull Lake is approximately five miles long and one mile wide) to a small lake with much evidence of filling-in, to a small trout-stream, and to a marsh. Certainly, not all of any of these areas were used, but those specific areas which illustrated the principles under discussion were selected for study.

Procedure

Classes met on alternate weekends, beginning in March and extending into May. Each weekend consisted of a three hour block of instruction on Friday evening, approximately three hours of field work on Saturday morning, and another two hours on Saturday afternoon, involving a wide range of activities.

The first meeting, conducted by Richard Newsome, head of the science department of Battle Creek High School, was devoted to a study of plant adaptations, the emphasis being on gross adaptations related to food production and use, reproduction, and defense. An effort was made to include the physical and biotic factors that result in adaptations as they might be found in tropical, temperate, alpine, and arctic conditions, as well as those peculiar to xerophytic and hydrophytic habitats. Specific adaptations were illustrated and analyzed to teach the principles of adaptation. The aim was not a memorization of specifics, but an appreciation of the concept of adaptation as a dominant force in nature. The field trip for this session consisted of close observation of plant forms around the lodge and in the greenhouse in order to find adaptations and to consider their cause and function.

James Good, science teacher at Battle Creek Southwestern Junior High School, presented the topic of "Animal Adaptations" for the second weekend. The theme, essentially, was that animals survive because they have successfully adapted when confronted

with adverse conditions. He analyzed the characteristic differences between phyla and illustrated specific structural and functional differences which determine the degree of success that an organism will have in protecting itself, obtaining food, and reproducing. Animal adaptations were observed Saturday morning among birds and mammals at the Kellogg Bird Sanctuary. While these two groups include only a small segment of animal types, they do illustrate the kinds of adaptations that most animals might exhibit. Since many of the mammals seen here occur in the natural habitat of the birds, the usefulness of the adaptation needs no explanation. The birds themselves are illustrative of carnivore and herbivore and demonstrate a wide range of beak and feet designs.

The next two weekend meetings were devoted to a study of life functions: as carried on in plants, and then as carried on in animals. Sidney DeBoer, of the biology department of the Battle Creek Community College was guest lecturer on "Life Processes in Plants," while Walter Marofsky, director of the Gull Lake Biological Station presented "Life Processes in Animals." DeBoer and Marofsky slanted their topics to emphasize that the relative success, the rate, and the continuance of these processes is contingent upon favorable environmental conditions. It was also illustrated that no organism functions independently; that each affects, and in turn is affected by, a host of physical and biotic influences. The field trips for these sessions consisted of two types of ecological surveys. The first was the study of a line transect which ran for some one hundred fifty yards beginning in a marsh and then passing through brush, across a trout stream, through a natural stand of hardwood trees with rather dense underbrush, across an open trail, and into a plantation of red pine. Each participant was apportioned a section along the transect for study. The object of this study was not taxonomical, hence identification was limited to general types, such as grass, moss, pine tree, insect, crayfish, etc. Each person was asked to consider: "What is this organism doing here?" and "How is it equipped to live here?" Soil samples were taken, temperature readings were taken of the air, ground, and water, and at various heights and depths, the relative humidity at regular intervals along the transect was calculated, the rate of flow of the stream was determined, and various other data was recorded. While in the field, the data collected in each distinct habitat area was pooled, and later one person from each area illustrated and analyzed a graphical representation of a vertical view of their observations.

Compiling notes on a vegetation profile of a grassland area.

Three weeks elapsed from this experience until the next session, so before beginning a new exericse, a glance was taken at the transect area to observe the changes that had taken place. The warm weather and lack of rain had allowed a transformation that sharply altered the conditions studied. The area was almost new to those who had observed it.

Five areas, situated at various points on the circumference of the forest had been selected for a quadrat analysis. Included were an open upland field with some brush, a forest edge, a black oak tree within a natural section of the forest, the edge of a pine plantation on a steep hillside, and a small island in the trout stream. The size of the quadrat varied with the plant density of the area, and five or six people were assigned to each quadrat with the task of counting the number of plant species and the number of plants present within each species, and then making topographical and vertical representations of their sections. Again, temperature and humidity readings were taken, soil samples were collected, and unknowns were collected for later observation. The graphs and data prepared in the field

were again placed on the chalkboard at the lodge and each quadrat compared with the others. The analysis and comparison was directed toward adaptations, basic needs, and interrelationships of living things.

In the culminating lecture of the course, Thomas Aylesworth, assistant professor of teacher education at Michigan State University, and the workshop director, presented a summation of the previous lectures in terms of ecology. Here, the role of the physiological, morphological, and physical sciences were shown to be of importance in establishing the principles of ecology. Some attempt had been made previously to introduce the biotic and physical factors which influence life, but here they were pinpointed and examined. These included food chains, energy transfers, diseases, soil conditions, land formations, and natural barriers, to mention only a few. The ideas of cycles, communities, and succession were also introduced, with particular emphasis on plant succession and the climax species of southern lower Michigan.

The last field exercise involved a small wooded area adjacent to an elementary school on the outskirts of Battle Creek. The problem on this trip was to recognize applications of the principles that had been covered in the workshop, and to make a preliminary survey of the woods for the supposed purpose of establishing a nature trail through it. The participants were divided into five groups and each group was assigned one part of the problem. For example, one group surveyed the area, examining the soil in terms of its formation, composition, and depth. When each group had completed its preliminary survey, the entire class toured the area while representatives from each group pointed out the items which they had observed and made recommendations as to how they thought the area should be used.

The activities described thus far occupied the Friday evening and Saturday morning sessions for the duration of the course and also involved part of two Saturday afternoons. The activities of the other Saturday afternoons ranged from the examination of biological supply catalogs and a discussion on materials and equipment to an introduction to professional organizations. Special emphasis was given to the methods of teaching by an interpretation of Edgar Dale's "Cone of Experience" as it applies to science education. A series of three one-hour sessions was devoted to an introduction to radiation biology. The first of these, given by the workshop director, was on the principles of heredity, the second, on radiation, was given by George Moore of the United States Public Health Service, a medical officer of the Office of Civil and Defense Mobilization. The third was concerned with the biological effects of radiation and was directed by the assistant director. Time was also provided for previewing biological films and for instruction and practice on the use of the microscope. These topics were considered as an enrichment activity for the workshop.

Aside from the facilities used during this workshop, very little in the way of equipment was required. An effort was made to present ideas and demonstrations which involved only pieces of equipment which might be readily available in an elementary school. Also, the use of the term "lecture" does not accurately describe the method with which the sessions were conducted. To the contrary, great care was exercised in selecting examples which could be demonstrated, preferably with living materials or, at least, with charts, films, or flat pictures. These sessions might more accurately be described as discussion-demonstrations.

In addition to the reading which was done between sessions in a biology textbook, one large assignment was given. Each member of the workshop was required to survey his community for materials and facilities available to them for use in their classroom. This survey was to include books on subject matter, methods, and materials, equipment, places for field trips, resource persons, and displays. It was intended also that films, film-strips, and other audio-visual materials and equipment would be included. This information was compiled in a file which was returned to the participant for his own use in teaching biological concepts in his school.

Results

The questionnaire that was distributed to the students at the end of the course was divided into five general areas:

I. As you now see it, what is the most

important purpose of this course other than receiving credit? How well was this purpose met?

II. What course activity (lecture, laboratory, demonstration, etc.) contributed most toward the accomplishment of the above purpose? How well was this activity carried out?

III. What method of study did you find most necessary to meet the grading requirement of this course? How do you rate this method in terms of its general value?

IV. What important plan, decision, or course of action are you considering as a partial result of taking this course? To what extent did the work in this course influence this consideration?

V. What is the most important action the instructor should take to improve the course? In order to keep student interest and effort at a high level, how important is it that the above action should be taken?

In addition, there was a request that the student make any additional comments that he might have on the back of the form.

The first category, that of the purpose of the course, was answered by all of the students as being to help them gain background and insights concerning the biological world, and all but one indicated that this purpose was met either "excellently" or "very well."

A coffee break during a quadrat study in an open wooded area.

This one person indicated "fairly well," and no one marked "poorly" or "very poorly." The second category, concerning the most beneficial course activity, was evenly divided. Twelve indicated the lecture sessions, and twelve indicated the field trips. Again, all but one of the students marked either "excellently" or "very well," and the one person marked "fairly well."

When asked about the method of study that was most important in achieving the objectives of the course, six indicated that observation was the most effective, and eighteen mentioned the term project. Again, all but one of the students marked this as "excellently" or "very well."

With regard to the course of action that they would follow as a result of taking this course, all of the teachers responded that they would attempt to improve their classroom work in the area of biology, and all but three marked this workshop as being an influence in this decision either "almost entirely" or "to a great extent." When answering the last question, that of improvements that might be made in the workshop, three indicated that they would like more demonstrations, and the other twenty-one suggested no change. It should be pointed out that these students had twenty-four hours to complete the form, so the lack of response on the last item was not attributable to their lack of time to consider their suggestions.

In conclusion, the students expressed their approval of the workshop both verbally and on paper, urged the instructors to schedule it again, and indicated that they would do their best to publicize the course the next time it was to be offered. The favorable response was so overwhelming that the workshop, which was to be offered on an experimental basis only, was given next spring. The conclusions drawn by the instructors were that teachers are willing to read much, listen attentively, and walk far in order to acquire knowledge that will help them improve their classroom work. All of the reactions of the students might seem to be superficial; however the reactions themselves indicated that the objectives of the course, as stated earlier, had been achieved.