

An Experimental Workshop in Biology for Elementary Teachers

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That elementary teachers are searching for suitable in-service programs in science is well established. In this article, the authors describe a two and a half weeks workshop to take care of this need. The emphasis of the program was on modern advances in science and technical procedures used which have classroom applications.

A rather unique experiment took place at the State Teachers College in Millersville, Pennsylvania, from August 10 through 28 of 1959. A crash program in biology was conducted for in-service elementary teachers.

Although Millersville for many years has been a leader in the requiring of science for elementary teachers, many of the older grade school teachers have no training in biological science whatsoever. That this science paucity is not only local nor restricted to the primary-intermediate grade teachers has been shown in several studies.¹

With the recent pressures exerted upon the elementary school to incorporate science in the curriculum, many schools have begun "science teaching" with, apparently, little thought given to the scientific background of the teacher. This constant threat to the equanimity of the teacher, plus his concern that elementary science will become a state requirement, have driven many good elementary teachers in a frantic search for some "science courses." It is highly improbable that he can, or will, be required to return to college to study such courses as advanced algebra, calculus, advanced chemistry, anatomy, microbiology, or physiology, but he needs something more demanding than "teaching of science," regardless of its necessity and value.

The problem is one for the biology department, rather than the education department.

¹Pella, M. O., "The Nature of the Academic Preparation in Science of Wisconsin High School Teachers of Physics, Chemistry, Biology, and General Science," *Science Education* 42:106-139, March, 1958. Koelsche, C. L., "The Academic and Teaching Backgrounds of Secondary Science Teachers in the State of Ohio," *Science Education* 43:139, March, 1959.

ment. It is up to us to provide a rich, rigorous, but interesting and valuable study of life science.

On first observation, a rational, objective biologist would tend to discredit any idea that very much biology could be learned in a three-week workshop. The idea of "workshop" alone would alienate many science teachers because of the not uncommon experience of participating in workshops where the "work" part of the word was neglected or completely forgotten.

The biology department at Millersville was convinced that something had to be tried but that this something must be challenging, rigorous, and interesting.

With apologies to those purists who are jealous of the term "experiment" we present the following in the format of a classical experiment:

The Problem

Many in-service elementary teachers are inadequately prepared to teach science. When they were pursuing their undergraduate work, there was no great demand for science in the elementary grades, and so, their college curriculum was not strong in the area of science. Today, however, the demand is keen, and these ill-prepared teachers are suffering because of their deficiencies. Since most of them cannot return to college during the regular semesters, a way must be found for them to inaugurate their science training.

Hypotheses

The Biology Department of Millersville State College feels that it can provide some introduction to an understanding of pure

and applied science "to wide-awake elementary teachers" in the period of a three week summer workshop if those teachers are willing to devote themselves to the program and be willing to spend long hours in the library. It also feels that the program can be a rigorous one that taxes the resourcefulness and diligence of the most inquiring in-service teacher. It suggests that much of the traditional lecture material can be learned from duplicated notes or assignments without using instructional time.

The Plan

Preliminary planning involved the following considerations:

1. Is there a desire, on the part of elementary teachers, for such a program? Should other interested persons be allowed to attend?
2. What is the basic material that all elementary teachers should know about biology? How much of this could be learned on the students' own time without help from the instructor?
3. What talent is available for a rigorous program? Are there agencies, other than the college, willing to sponsor the program?
4. What should be the specific, primary objectives of the program? How can these best be accomplished in the allotted time?

Intensive investigation revealed the answers to most of these questions. It was discovered that there is a need for such a program and it was too pressing to ignore. Although the program would be designed principally for elementary teachers, it was decided that a limited number of science majors be permitted to attend, in the hope that their basic scientific knowledge would be of benefit to the group and that the practical and modern aspects of the program would be of considerable value to them. The planners decided that studies related to the following areas would be of the most value:

1. Classical biology—basic principles and applications.
2. Radiation biology—modern concepts of the benefits and dangers of radiation to life.

3. Agronomy—applications of recent biological investigations to agriculture.
4. Conservation—the application of scientific principles to conservation of wild life.
5. Sanitation—basic microbiology and its relation to public health.
6. Miscellaneous—introduction to anatomy, physiology, taxonomy, and laboratory procedure.

That there was available talent and sponsoring agencies to insure a rigorous program will become evident.

The following list is a condensation of the objectives upon which the workshop was based:

1. To give the elementary teacher a fund of information, i.e., facts and principles of science.
2. To show the teacher how to help himself by providing source material.
3. To emphasize the importance and practicability of science in everyday life.
4. To establish the scope of scientific work and expose the teacher to extremely recent scientific developments.

The Experiment

On August 10, 1959, twenty anxious "workshoppers" filed into the meeting room. There were venerable teachers of long experience, young teachers with obvious youthful exuberance, and prospective biology teachers who were just a bit skeptical about the abilities of the elementary teachers, with whom



Dr. Seymour Shapiro, coordinator of radiation mutations at Brookhaven, spent two days with the elementary teachers building enthusiasm for science and bringing them abreast of recent developments in the field of radiation biology.



In-service teachers learn about plant breeding and improvement from one of Pennsylvania's tobacco authorities.

they would work in the next three weeks. All attention was focused on the front of the room as the director entered and began the orientation lecture.

Months of careful planning was now being put to the test. The student evaluator began his note-taking, being especially watchful that the course content was rigorous and representative of the field of biology.

The orientation lecture was designed to acquaint the participants with the scope of scientific work and how they would investigate it. Instructions were given on course requirements, careful and thorough completion of assignments, answering of questions pertinent to the following day's activities, participation in all discussions and field activities. In addition, science majors in the class were notified that they would be required to submit special projects for the benefit of all. Information sheets, with all requirements, course objectives, assignments, references, and schedule of activities were distributed. The afternoon session centered around a discussion of the scientific method.

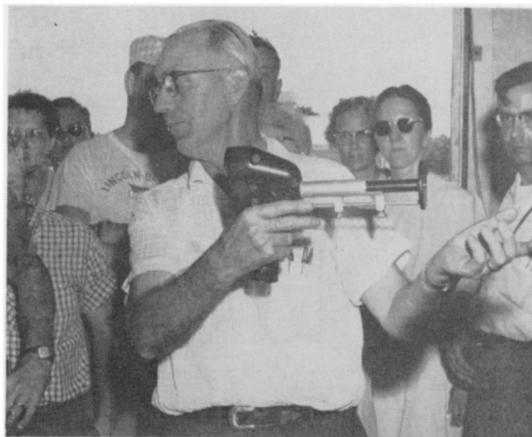
The second day was spent in preliminary studies of agricultural research. The activities were under the direction of Mr. Maxwell Smith of the Pennsylvania Agricultural Extension Service. The scope of the extension service was discussed and in the afternoon, a trip was taken to a Research Farm of the Pennsylvania Agricultural Extension Service where scientific investigations of plant diseases and plant breeding are conducted.

The third day was spent on basic studies of radiation biology under the direction of

Dr. Andrew Koch, radiologist at a nearby hospital. Centering chiefly around the effects of radiation on living cells, the lecture anticipated further study with a radiation geneticist from Brookhaven National Laboratories. The afternoon was spent with Dr. John Sharf of the Armstrong Cork Company in focusing attention on the dangers of atomic weapons and the possibilities of food preservation via radiation.

The fourth and fifth days were spent in detailed discussion of radiation biology with Dr. Seymour Shapiro, Coordinator of Radiation Mutations at Brookhaven National Laboratories on Long Island. Dr. Shapiro was the keynote speaker for the workshop and he presented his rather difficult material in such a way that the previously-fearful elementary teachers were enthralled and visibly encouraged to do further study in this area. Dr. Shapiro was sponsored by the AIBS. The exchange between the cooperator and the participants was stimulating. The elementary teachers came to feel that scientists can be warm, humorous, and approachable whereas the scientist developed a new appreciation for the abilities and problems of in-service teachers. Dr. Shapiro introduced the fundamentals of genetics and then discussed the effects of radiation on the DNA molecule and consequent hereditary change.

The sixth day from 6 a.m. until 7:30 p.m. was spent on a trip to Beltsville, Maryland, where the group witnessed experiments on plant growth, breeding, and nutrition; entomological research; human nutrition research, animal breeding, and animal nutrition.



A U.S.D.A. agricultural expert demonstrates to elementary teachers how backfat of Beltsville hogs is determined electrically.



Students learn fish counting techniques by actually working with the regional fishery manager.

The seventh day was spent in the field with Mr. Earl Geesaman of the Pennsylvania Game Commission observing conservation practices with respect to game protection, breeding, and feeding.

The eighth day was spent in the laboratory studying microbiological technique, use of the microscope and other optical devices, and preparation of culture media. The director reviewed mitosis and meiosis, and there were microscopic observations of prepared materials demonstrating these processes.

The ninth day was spent in surveying one of the local streams with an ichthyologist of the Pennsylvania Fish Commission, Mr. Robert Bielo. The pH, CO₂, turbidity and rate of flow of the stream were measured by the participants, and a fish census was taken with the aid of electric shockers. Taxonomic methods were also a part of this experience.

The tenth day was spent in the laboratory. The participants examined the bacterial cultures previously prepared and determined the spore count and growth rate of the colonies. Later, the anatomy of birds was discussed and identification of many species was accomplished with the aid of study skins. The afternoon was spent in further microscopic examinations of typical plant and animal cells.

The eleventh and twelfth days were spent with an agent of the Pennsylvania Health Commission, Mr. Frank Lisella. The lecture hour consisted of a familiarization with water-borne pathogenic organisms and methods of control. Field activities consisted of visits to the campus swimming pool and kitchen

and the county sanitary land-fill operation which illustrated sanitation measures essential to the health of the citizenry.

The next to last day was spent in the meeting room. A comprehensive final examination was administered to all participants, and final recommendations concerning future individual study were given to the participants. The afternoon was spent in constructing and using keys.

The last day, spent at the home and garden of the director, was a lesson in outdoor education. Because of the pressure on teachers and administrators by many recreational groups it was felt that perhaps an investigation of objectives and procedures of this area of education should be conducted. A picnic lunch was served and final discussions of the workshop and its value were heard.

Evaluation

On special forms prepared by the student evaluator, the participants were able to give their individual evaluations of the program in a standardized way that could be statistically analyzed. In addition to compiling this data, the student evaluator wrote a detailed report² of the proceedings and evaluated the workshop strictly from the viewpoint of its rigorous scientific nature. It is noteworthy that the evaluations of the participants and the student evaluator were both indicative of a highly successful program. Some of the important results are summarized in the following:

1. A challenging program in science education for elementary teachers can be conducted successfully in a three week summer workshop.
2. Careful selections of available talent in the areas of pure and applied science can make an interesting, informative program. That there is available talent of a high order was demonstrated.
3. The scores on the final examination indicated that the elementary teachers had discovered as much or more than the science majors.

²This report and evaluation covered over one hundred typewritten pages. It is unfortunate that we cannot include the many interesting details of the experiment in this article, but the reason is self-evident.

4. The assignments encouraged (or demanded) the proper use of reference materials, and prepared the participants for the ensuing topics.³
5. According to the participants' own evaluation the workshop did prepare them for the task of teaching science in the elementary grades. Certainly, the extent of factual knowledge was

limited, but they now had the ability and the desire to study on their own.

Theory

The original hypothesis apparently verified, we might be able to develop a "theory" to embody the findings. But, rather than do this, we will invite other interested college teachers to attempt the same program in their own localities. We are encouraged with the results of the experiment, but, since it was the first trial, we will reserve the right to draw weighty conclusions until after many more trials. It is our qualified opinion, however, that the experiment was successful and that through even more careful investigation and planning, next year's workshop will be bigger and better.

³Each day the students had to answer 10-20 questions pertaining to the topic to be discussed. These questions and answers plus careful assignment of reading in textbooks, reference books, and particularly periodicals were carefully and regularly examined and evaluated by the director with appropriate comments. Much basic material, to which class time is usually given, was covered in this way.

Alpine Tundra Ecology

The National Park Service at the Rocky Mountain National Park, Estes Park, Colorado, will have its first annual summer seminar on Alpine Tundra Ecology, June 25-30, 1962. The fee for the program will be \$10.00, and inquiries concerning the program should be addressed to Mr. Merlin K. Potts, Chief Park Naturalist, P.O. Box 1080, Estes Park, Colorado.

Conservation Education

The Ninth Annual Conference of the Conservation Education Association will be held August 19-23, 1962, at Wisconsin State College, Stevens Point. The theme will be: "How Can Conservation Education Meet the Challenge of Urbanization?" Drs. Paul Yambert and Bernard Weivel of Wisconsin State College are in charge of local arrangements.

Attention: All Members

Please note that this issue of ABT is the last one until the October number. The Journal is *not* published in the months of June, July, August, and September. Temporary summer changes of address, such as Institute, summer school, and vacation addresses, should *not* be sent in to the Secretary-Treasurer. Permanent changes of address should be sent in promptly at any time.

Students' Warburg Apparatus

The Midwest Research Institute, 425 Volker Boulevard, Kansas City 10, Missouri, has just published a complete listing of directions, diagrams, and pictures, as well as research possibilities for the construction of a Warburg Apparatus and a Fenn Volumeter. This is one of the superb reports issued by the Institute, and it should prove of great value to students and teachers of advanced biology. College undergraduates as well as their teachers will also be interested in this publication.

The Scholar

President A. W. Griswold of Harvard University makes this statement on academic freedom: "The public does not yet adequately grasp the principle of academic freedom: The doctor cannot help the patient who insists on making his own diagnosis; the philosopher cannot communicate his wisdom to the kibitzer who keeps telling him what to think."

He goes on to say that a thin well-read line of scholars is not enough to defend the proposition that "in education, the customer isn't always right."

Project Booklet

The pamphlet entitled, "Dental Projects for High School Science Students" is available from the Science Service, 1719 N. Street, N. W., Washington 6, D. C.