

# National Science Foundation Support Of Teacher Education in Biology

By WILLIAM H. ADAMS

The National Science Foundation (NSF) was established by an act of Congress in 1950 and charged with developing a national policy for the promotion of basic research and education in the sciences. This report deals with the science-education aspects of this mandate, especially as it pertains to teacher education in biology.

## Recognition of Need for Change

Historically, teacher education in biology at NSF had its formal inception in 1954 during a 10-day Southeastern Conference on Biology Teaching conducted by the National Association of Biology Teachers (NABT) in Gainesville, Fla., from Aug. 28 through Sept. 6. This conference was financed by a \$15,000 NSF grant and preceded the annual meeting of the American Institute of Biological Sciences (AIBS) convened at the University of Florida. The codirectors of the planning committee for this conference were Samuel L. Meyer and Richard L. Weaver, and they were assisted by Ned Bingham, George Jeffers, and W. Hugh Stickler, who served as committee members.

Clearly, this conference was exploratory in nature and not designed specifically for the training of teachers. This was evidenced by the four broad conference objectives, which consisted of establishing the proper role and major contributions of six basic disciplines to teacher training, identifying and selecting major problems inherent in the actual teaching of biology, developing recommended procedures

for the improvement of biology instruction, and devising means for implementing the recommendations of the conference.

Participants in the conference consisted of teams of high school and college teachers and administrators from 10 southeastern states. Altogether, 94 staff, committee, and team members participated in the conference. Keith R. Kelson served as NSF representative to the conference. In his closing remarks to the conference, Kelson underscored the urgent need for providing help to the high school science classroom.

Owing in large part to the success of the southeastern conference, a second grant of \$15,000 was awarded to NABT for the North Central Conference on Biology Teaching, which was conducted from Aug. 19 through 30, 1955, at Cheboygan, Mich. This conference followed the original format by preceding the annual meeting of the AIBS convened at the University of Michigan Biological Station. Richard L. Weaver served as chairman of the planning committee for this conference and Richard R. Armacost, John Breukelman, Paul Klinge, and Alfred H. Stockard served as committee members. The objectives of this conference were essentially those of its predecessor, with the exception of the five basic disciplines selected, which had more practical applications, especially in relation to man. The participants were again organized as teams and consisted of high school and college teachers and administrators from 10 north-central states. A total of 90 staff, committee, and team members participated in the conference.

Keith R. Kelson again served as NSF representative and, in the course of his remarks before the conference, greatly expanded his thesis regarding

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the plight of science education originally presented to the southeastern conference. Prominent among the major tenets presented were the following: the singular importance of the high school teacher's subject-matter problem and the feasibility of NSF's establishing programs designed to alleviate this problem by providing funds and courses for in-service and former teachers to pursue courses of study in science designed to improve their competence as effective, knowledgeable instructors. Institute-type summer projects were unveiled during this conference, and the first summer institute supported by NSF exclusively for high school teachers of biology was conducted by Indiana University in cooperation with NABT in 1956. This initial summer institute was soon followed by academic-year and in-service institutes. Since that time, institutes have provided over 49,800 full-time and 21,200 part-time training opportunities in biology for secondary-school teachers.

### **A Period of Transition**

But what has happened to the high school teacher of biology during these 15 years? And what role does today's teacher play in the flow of continuing education from early childhood through college? To answer the first question: comparing the "typical" secondary-school teacher of biology of the mid-1950s with the professional biology teacher of today is like looking at a classical "before" and "after" advertisement for one of the new enzyme detergents. Difficulties encountered in assigning specific disciplines to early institute participants clearly indicates that they were typically general-science teachers with a heavy concentration of academic preparation in secondary-education methodology and, quite frequently, physical education. As a consequence of this type of training, human and descriptive biology was prevalent throughout their classroom instruction, with little if any direct student involvement. Today's teacher of high school biology, by virtue of recent undergraduate preparation, graduate or institute-type training, or some other form of professional rehabilitation, is typically a single-discipline instructor of biology, with high professional standards. Classroom instruction, bolstered by major curriculum improvements, has shifted to modern biology, with its quantitative and molecular emphases and considerable student involvement requiring independent thought, coupled with the excitement of discovery. To answer the second question: today's biology taught at various levels of organization in high schools provides a smooth transition between the "living things" presentation by general classroom teachers in elementary schools and the serial presentation of subdisciplines by specialty biologists in colleges.

Although NSF has played an important role in this transformation, it is difficult to state with any precision the magnitude of this influence except that

it has obviously served as the catalyst for accelerating the growth and development of the professionally trained biology teacher of today. Stated another way: what would be the present status of our teachers of biology without this massive and continuous support in all aspects—curriculum and training—of instruction?

In order to better understand the role NSF has played in this respect, let's consider the various teacher-training programs that have contributed to this development. In the broadest sense, the majority of these programs, including all institutes, are designed primarily for individual teachers, with a single program structured for training within school systems. Activities within these programs may be conducted either on a unitary, "single-shot" basis or on a sequential, continuing basis and, in some cases, in combination with the activities of other programs.

### **Formal Institutes for Teacher Training**

Full-time institutes are conducted either during the summer or academic year or in various combinations of time periods. In-service institutes are conducted during the school year while teachers continue with their regular employment. Many of the early institutes and research projects were conducted for combinations of high school and college teacher participants.

Academic year institutes for secondary-school teachers are usually characterized by pre- or post-summer sessions, depending upon the academic requirements of the specific institute, and they frequently result in the awarding of a degree at the master's level. 21 teachers of biology participated in the first of these institutes, at Oklahoma A&M College and at the University of Wisconsin in 1956-57. During the 16 years since their inception, approximately 4,100 teachers of biology have participated in these full-time institutes.

Since the first summer institutes for teachers of biology in 1956, the opportunities for continuing education and the awarding of degrees have increased with the progressive emergence of sequential programs of graduate-level instruction. Summer institutes afford teachers an opportunity to participate without absence from their regular academic-year employment—a distinct advantage in some school systems and with many teachers. Through fiscal year 1971, summer institutes have provided over 45,600 training opportunities for teachers of biology.

Beginning with 107 participants in biology courses in 1957-58, in-service institutes have provided many training opportunities for teachers within commuting distance of their individual schools throughout the academic year. Over 21,200 part-time training opportunities have been afforded teachers of biology through fiscal year 1970.

### **Other Approaches to Teacher Training**

Supplementary projects for improving the quality

**National Science Foundation support of selected teacher-education activities.**

Programs	Total amount	FUNDS		TRAINING OPPORTUNITIES			Fiscal-year term
		Biologic sciences Amount	Share	Total amount	Biologic sciences Number	Share	
Institutes							
Academic-year	\$127,570,000	\$25,313,000	19.8%	20,800	4,100	19.7%	1956-71
Summer	296,274,000	53,100,000	17.8	260,300	45,600	17.5	1956-71
In-service	38,400,000	5,319,000	13.9	157,600	21,200	13.5	1957-70
Comprehensive	1,700,000	300,000	17.6	910	125	14.3	1971
Research participation	7,370,000	2,800,000	37.6	3,800	1,500	38.0	1959-68
Special projects	1,595,000	514,000	32.2	25,600	6,100	23.8	1965-70
Summer conferences	1,417,000	229,000	16.2	3,500	590	16.9	1965-71
Total	\$474,326,000	\$87,575,000	18.5%	472,510	79,220	16.8%	

of instruction in biology include conferences and special activities outside the purview of the established programs. Conferences are usually conducted during the summer months and are shorter in duration and usually more specialized than summer institutes. Approximately 590 teachers of biology have participated in conference activities in the eight-year period since fiscal year 1964. Special projects permit exploration of ideas and new approaches to teaching long before they are widely accepted or implemented and frequently serve as prototypes for future programs. Nearly 6,100 teachers and administrators at all academic levels have participated in special projects in the seven-year period since fiscal year 1965. Notable among these have been national projects to facilitate introduction of Biological Sciences Curriculum Study (BSCS) special materials (*Biological Science: Patterns and Processes*) and the development of better approaches to the preparation of high school biology teachers (BSCS Special Publication 6). The highly successful NABT lecture series was also initiated as a special project in teacher education.

Complementing instructional institutes, conferences, and special projects, research-participation projects permit high school teachers to conduct scientific investigations with a college counterpart on a full-time basis during the summer months. In exceptional cases, these studies could be continued during the academic year in the teachers' individual schools with considerable involvement of their own students. Approximately 1,450 teachers of biology participated in this research program through fiscal year 1968, when it was suspended.

Beginning in fiscal year 1961, projects involving cooperation between participating colleges and secondary schools have provided for the training of both teachers and students within school systems. Among its accomplishments, this program has been successful in introducing the BSCS curriculum to entire school systems, with subsequent adoption or revision of existing curricula.

A recent development has been the emergence of comprehensive grants for teacher training. This ap-

proach will provide year-round teacher-training activities by combining elements of academic-year, in-service, and summer institutes and other programs that traditionally have been funded separately by NSF. Initial grants will provide both in-service and pre-service training opportunities for 125 teachers of biology.

**Response to a Need**

Although difficult to evaluate precisely as previously stated, the accompanying table provides some indication of the order of magnitude, expressed in dollars and training opportunities, of selected NSF support for education in biology. Of the \$474 million expended for all the various teacher-education activities listed, nearly a fifth (18.5%), or over \$87 million, has been for education in biology. These funds have provided over 472,500 training opportunities of all types, with over 79,200 (16.8%) in biology. The highest percentage of training opportunities for biology teachers has been in research participation (37.6%) and special projects (32.2%), with the lowest percentage in in-service institutes (13.9%). It should be pointed out that this listing does not represent total effort in support of science education: estimates were used for many activities prior to 1964, training opportunities do not equal total number of individual teachers since many individuals have participated in more than one project, and all figures have been rounded for easy comparison.

As many experienced teachers increased their proficiency and capability through participation in these various activities, attention in many projects shifted to the science training of administrative personnel in education. These activities have ranged from the introduction of new science curricula to the broadening of general-science backgrounds of school principals and other administrators with limited training in and exposure to the sciences.

In summary: NSF formally recognized the urgent need for providing help to the high school teacher of biology with the initiation of institutes for pre-

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college teachers in 1956. This action and subsequent institutes and related training activities led to a transition from multiple or general-science teachers in the secondary schools to the professionally recognized, single-discipline teacher of today. Commensurate with this emergence of the professional biology teacher, the high school curriculum underwent a similar transition from a teacher-directed presentation of conventional and often dated subject matter with limited student response to a presentation of basic principles and current topics in biology with considerable student involvement. During this period of transformation, NSF provided financial support and direction in an advisory capacity without resorting to predetermined standards or otherwise unduly restricting the course of action once initiated.

The reforms brought about by these changes at the pre-college level have focused attention on the crux of the problem: adequate preparation of pre-service teachers. It is at this level that a catalyst for change similar to the one just described must be applied—and applied now. This must be done in order to move from the previous policy of remedial training for experienced but inadequately trained teachers to one of updating and strengthening expertise in subdisciplines for the professionally trained teacher of biology on a continuing basis.

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#### MATH MATERIALS READY

A new set of instructional materials to help low-achieving fifth through eighth graders learn mathematics has been developed by the National Council of Teachers of Mathematics (NCTM). Called *Experiences in Mathematical Ideas*, the two-volume textbook for teachers includes 13 prototype units, ranging from "Experiences with Base and Place Value" to "Experiences with Geometry." A teaching package accompanying each volume contains materials needed for classroom use, printed on 8½-by-11-inch sheets, which can be easily reproduced for overhead-projector transparencies, game materials, and copies of worksheets for students.

"EMI does not comprise a complete mathematics program for low achievers in grades five through eight," the National Council explains. "Neither is it intended to be used solely for supplementary or enrichment purposes. Rather, the units offer a model for teaching the representative segments of mathematics that are usually taught to and needed by all students. Most of the units are independent of the others and need not be taught in any specified order nor at certain grade levels."

The cost is \$20 a volume, which includes text and teaching package. For further information contact National Council of Teachers of Mathematics, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.

#### CHARACTER POLLUTION?

Pollution may have unsuspected, subtle effects responsible for some of the uglier traits of character in modern man, an Indiana University physiologist believes.

"Chronic high irritability, possibly affecting our whole society, is an example of what I'm talking about," says Alfred Strickholm, whose research is on the hard-to-detect but real effects of chemicals on individual nerve cells. "Society may be suffering from subtle sicknesses to which pesticides and other pollutants are contributing.

"People can be sick all the time and not know it. They can feel rundown, chronically bad, and think it's normal."

More research is needed on such problems, Strickholm feels, and he deplors the fact that one of the reasons it's not being done is the recent cutback in government support of research.

"There should be more, not less, public support of basic research. Putting tax money into research is sound investment," he says.

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#### *Individualized* . . . from p. 279

by the students for these laboratory and discussion groups appeared to be independent of ability.

The overall result was that the class was conducted without too many problems. There was a period of adjustment for the students and teacher, but it was achieved with relative ease. The teacher and the students became more of an integral part of the learning process.

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