Chapter 12

Strengthening Biology Teaching by Working with the Local School System

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Introduction

Strengthening the interface between universities, colleges, and high schools is an important means of promoting and advancing science education. We as educators can enhance the quality of biology education by sharing our expertise and discussing current advances with others. We will all benefit by gaining a better understanding of what is being taught and the limitations within each type of school system. To this end the exchange of information between levels (elementary, secondary, and post-secondary) is critical. The result should have a positive effect on the students: more students will be excited about biology and they will be better prepared at the completion of each stage of education!

This workshop specifically addressed how we at universities and colleges can effectively host sessions for high school biology teachers. The format of the workshop was discussion oriented; we divided the participants into small groups for part of the time and ended with each group reporting back to the whole group. The discussions emphasized exchanging information on what we are doing, problems we have encountered, and strategies to improve the effectiveness of collaboration.

In addition, the three presenters provided some practical "how to" suggestions in the areas of organizing workshops, developing summer credit courses for high school teachers, and applying for external funds to support these initiatives. Participants were provided with sample laboratory exercises appropriate for high school students, sample course outlines and promotional information used for summer credit courses for teachers, and an information guideline on how to develop a grant proposal.

This chapter summarizes the workshop discussions by organizing the information into the following categories: Summary of Small Group Discussions, One-day Workshops, Credit Courses for High School Teachers, and Funding Sources for Educational Development. Material on organizing seminars and workshops is provided in Appendix A. Promotional material used by Floyd College to advertise summer courses is provided in Appendix B.

Summary of Small Group Discussions

Why is collaboration necessary and/or useful?

The reasons proposed for collaboration fell into two categories. The first category was basic self-interest. Joint programs make one's school known and place it in a favorable light both to the secondary

school teachers and to the students. This can result in recruiting students to one's school and department. The second category deals with improving the skills and science background of the teachers and thus, ultimately, of the students. Working with the teachers can also result in attracting more students into science majors and raising the understanding of science by the general population. To reach these goals it was proposed to (1) work with teachers to demystify science and to increase their confidence in their ability to teach science (particularly elementary teachers), and (2) increase the teachers knowledge base and laboratory skills so that they can offer more insight and laboratory experience to their students (particularly secondary school teachers).

It is critical to demystify science for elementary teachers since they will not include it in their curriculum if they are not comfortable with it and can, in fact, turn students off science very easily. At the higher grades the payback for collaboration is better prepared students entering our programs. Interestingly, better student preparation was described in terms of writing and mathematical skills, rather than science knowledge. Though not defined within these discussions, presumably science knowledge includes laboratory and critical thinking skills.

What are effective collaborative projects?

A variety of strategies were suggested for effective collaboration. The key strategy suggested is to involve the intended audience in the planning of the project. Planning could involve teachers, department heads, coordinators, and school administrators. These groups should be contacted at the start to give input on activities—you won't attract teachers if they are not interested in what you are planning. In addition, even if the topic is appropriate the event may fail if other components are not given serious consideration. Often the teachers are overworked and may view any attempt from the universities as just one more thing to attend. The plans must reflect the needs and priorities of the teachers. The following issues require carfeul consideration when planning collaborative projects:

(1) The proposed *date(s)* for the event. Survey the intended audience to determine the best time of year, days of the week, and time to host an event to avoid conflicts and to maximize participation.

(2) Establish what types of school *support* is most meaningful to the teachers and what will be available for participation in your project. Support may be release time, course credit, expense money, additional stipends, etc.

(3) *Relevance* of the information and technical experience for direct application in the teacher's classroom.

Another suggestion was to take the event to the teachers rather than asking the teachers to come to the university. This could take the form of workshops at a school or at least demonstrations of what is available in these projects to help attract the teachers to the university. In some locations teleconferencing might be a possible outreach strategy.

Finally, it is critical to provide follow-up support to the teachers. One-time only programs are generally not sufficient and can lead to a sense of frustration in the teachers. One simple possibility would be a resource directory of people and sites to be distributed to the teachers. Providing kits, supplies, and/or equipment at either the school or available through the university would be another follow-up. Establishing an ongoing dialogue with at least one teacher in the school would also be vary valuable. This contact teacher could act as the liaison for other teachers and the university department.

What is the motivation for either the secondary school or university participants to collaborate?

Secondary school teachers may benefit by receiving credit, either graduate or continuing education. Teachers often need credit for salary increases or because continuing education is required in their contract. Teachers may also receive stipends for attending. Other motivation may be in the form of supplies or other support for their teaching. Many teachers wish to take part because of personal motivation, their sense of responsibility and pride in doing as good a job as possible. For those who say, "But those are the teachers who need help the least because they tend to be the innovators already," let us suggest: a very important purpose of these sessions is to rejuvenate the "good" teachers and link them with other dedicated educators.

Be forewarned that a lack of participation by teachers for a project may be no reflection on the quality of the session. Teachers are inundated with meetings and administrative responsibilities and are often overworked, underpaid, and sometimes undervalued as professionals. Universities attempting to collaborate for in the professional development of teachers may be viewed as just one more thing to do without any compensatory relief in time off, work load, or money. Sometimes the impediment for participation is easily remedied: *know your audience and their needs*. For example, if your course has a pass/fail credit but the teachers need a mark to affect pay increments, perhaps the marking system is negotiable.

There is, unfortunately, even less motivation for many college faculty to take part in these collaborations. The deterrents to being involved in such teaching projects include slowing/stalling career advancement in institutions with a strong research component for advancement. However, there are a growing number of post-secondary institutions that recognize the significance of collaboration to improve teaching and public awareness. Not only is it possible to attract more and better students to ones particular college/university but also donations from alumnae may be increased with a heightened public profile. Other external sources of funding are available for particular collaborative efforts.

One-day Workshops

The one-day workshop can serve an important function providing intense coverage of a specific topic or a general introduction which may lead to further study. These workshops may be single isolated events or one in a series. The advantages of a single-day commitment for a workshop are quite obvious: the time committed by participants and faculty is concentrated and confined, unlike courses that run over several weeks and it is easier to share limited resources including space, equipment, and support staff for a single event than over time. The danger with such a session is that after an initial burst of enthusiasm during the workshop there is a subsequent letdown when it is over. To counteract some of this letdown, it is highly advisable to have a follow-up of some type for participants. The follow-up may be a newsletter or it may actually be another gathering. The goal of the follow-up is to sustain the positive effect of the workshop and to establish a network of support within the system for the teachers. Additional advice includes:

1. Be sure the workshop is relevant with material that can be used directly in their teaching; that is, the material should be **adoptable**. Some teachers may have the time and interest to adapt the material later, but many do not and need material that is ready to use directly in their classes.

2. Incorporate opportunities for **hands-on activities**; do not just lecture at the participants but rather structure the sessions with opportunities to *try things*, such as laboratory exercises; *discuss things* in small group seminars; and *see things* by providing demonstrations. The demonstrations may show how to use or maintain common laboratory equipment or may illustrate some commercially available packages including computer software, videos, as well as models, laboratory exercises, and reading materials, etc.

3. Create a **congenial atmosphere**. Provide unstructured times for informal discussion, have a comfortable meeting area, and tasty food to encourage casual dialogues and networking. See Appendix A for specific suggestions on how to organize workshops/seminars.

Credit Courses for High School Teachers

Case Study at the University of Nevada, Las Vegas

Persistence and a sensitivity to the critical comments of participating teachers have resulted in the development of a highly successful outreach program in the sciences at the University of Nevada, Las Vegas (UNLV). Four years of experimentation and modification have yielded a formula that has received high praise from participating teachers and strong support from both university and school district administrators. This effort was supported in part by grant money from Title II of the Education for Economic Security Act (EESA), which has as its specific goal the upgrading of education for the teaching of science and mathematics.

The grant money enabled UNLV to assemble a Professional Development Academy comprised of faculty from a variety of disciplines. These faculty conferred with the Deans of the Education College and of the College of Science, Mathematics, and Engineering, as well as representatives from the school district involved in teacher development. The results of this dialogue were 10 specially-designed courses offered for credit to teachers in the summer by faculty from the College of Science, Mathematics, and Engineering. Counselling was available for teachers by faculty at the College of Education. We include a partial list of the courses offered at UNLV to illustrate the breadth of possibilities and the types of courses that met a need in that area. The courses include:

Laboratory Experiences for Life Science Teachers was a hands-on class that dealt with laboratory exercises for all the topics usually covered in high school life sciences and biology curricula.

Chemical Demonstrations for Science Teachers stressed practical hands-on activities for reviewing fundamental chemical principles.

Computing Concepts for Teachers introduced teachers to algorithms, introductory programming, and BASIC programming language as well as word processing, and the use of data bases, spreadsheets, and other recent integrated packages.

A Survey of Physical Science for Elementary Teachers offered a non-mathematical approach with demonstrations and experiments designed for kindergarten through eighth grade students.

Survey of Physical Science for Secondary Teachers included mechanics, energy, electricity, and magnetism.

Quantitative Thinking in Science was a course designed specifically to de-mystify mathematics by relating math concepts to simple and straight-forward examples taken from the various disciplines.

The total course enrolment was about 100 teachers: 32 in the life science course, 23 in earth science, and 22 in the physical science classes.

The culmination of the 5-week summer session is a 1-week long, *multi-disciplinary field trip* with credit earned in Biology, Geology, or Physical Science. The 24 teachers attending the field trip found this course a particularly worthwhile experience. This course illustrated many practical applications of what they had learned in the classroom and provided the opportunity to discuss their observations and questions with experts from several different disciplines. The camaraderie and development of networks for future collaboration has also been a significant benefit.

Enthusiasm and innovation can pay off in the academic world. The development of special-purpose, goal-oriented courses for a particular group of individuals has worked well for UNLV and the school districts of southern Nevada. A combination of classroom, seminar, field trip, and other teaching formats has drawn together parts of a community that should never have drifted apart. The key ingredients have been the faculty dedication and the concept of the Professional Development Academy.

See Appendix B for examples of promotional material advertising summer courses developed at Floyd College, Rome, Georgia.

Funding Sources for Educational Development

United States

The following sources provide a comprehensive profile and analysis of the major private foundations, corporate foundations, and corporate charitable-giving programs. These sources contain information about funding of all research-related programs, including education research. They also provide information as to type of grant awarded, geographical location, selection criterion, recipient type, recent grants, officers and directors, application and review procedures, and contact people.

Sources of Funding Through the Federal Government

1. National Science Foundation (NSF) Science Education Directories
   (a) Materials development, research, and informal science education.
      i) Instructional materials development.
      ii) Research in teaching and learning.
   (b) Teacher preparation and enhancement private sector partnerships.
      i) Science and mathematics education networks.
      ii) Teacher enhancement.
      iii) Teacher preparation.
2. Department of Education
   (a) Secretary's discretionary fund.
   (b) Various collaborative opportunities.

Directories of Funding Institutions

1. Directory of Research Grants
   The Oryx Press, 2214 North Central Ave., Phoenix, AZ 85004-1990
2. Taft Foundation Reporter
   Susan E. Elnicki, Senior Editor
   The Taft Group, 12300 Twinbrook Parkway, Suite 450, Rockville, MD 20852
3. Taft Corporate Giving Directorate
   Katherine E. Jankowski, Editor
   12300 Twinbrook Parkway, Suite 450, Rockville, MD 20852
4. Corporate 500: The Directory of Corporate Philanthropy
   Kenneth Gilman, Editor
   Public Management Institute, 358 Brannan St., San Francisco, CA 94107
5. On-line data bases
   (a) Foundation Directory (The Foundation Center, NY)
   (b) Foundation Grants Index (The Foundation Center, NY)
   (c) Grants (Oryx Press, Phoenix, AZ)

Canada

In Canada there are significantly fewer funds and funding agencies for educational development than in the United States, but there are some. In addition, the political climate both federally and provincially (at least in Ontario) is quite favourable for funding projects aimed at encouraging students to enrol in the sciences and to strengthen teaching in that area.

Federal Sources

1. Social Sciences and Humanities Research Council (SSHRC)
   255 Albert St., P.O. Box 1610, Ottawa, Ontario K1P 6G4, (613) 995-5455.
   Research officers at both the Faculty of Education, University of Toronto, and Ontario Institute for Secondary Education (OISE) indicated the Council is particularly receptive to proposals indicating collaboration between disciplines and involving different sectors (e.g., academia and industry; secondary and post secondary educators collaborating to enhance science education, etc.).
2. National Research Council (NRC)
   200 Kent Street, Ottawa, Ontario K1A 1H5, (613) 995-5966.
   Theoretically, the NRC funds research in education, however, as funds are very limited for all types of scientific research the likelihood of being funded is extremely low.

Sources in Ontario

1. Provincial ministries
   (a) Ministry of Education: approach the division responsible for research as well as specific subject areas (e.g., biology) Ontario is supporting several initiatives at the moment targeting the teaching of science at the elementary and senior levels.
   (b) Ministry of Natural Resources
   (c) Depending on the nature of the initiative, contact other related ministries because they may have funded specialized teaching packages (e.g., environmental issues).
2. Individual or collective Boards of Education have funds to support developmental projects.
3. Provincial associations: there are various associations of teachers and coordinators of science at the Boards of Education that fund specific initiatives. Also associations interested in environmental issues such as the World Wildlife Fund (Canada).

Private Industry

The private sector is a good and as yet under-utilized source for funds and collaboration. For example, the Toronto Board of Education has successfully worked with companies such as Lever Brothers (manufacturers of soap; to produce a video about environmental issues that has been distributed to all high schools in the province) and P. J. Spratt & Associates (an educational consulting firm that produced material about hydro electric power).

Examples of Funded Projects

Resource Partnerships in the Life Sciences at Simmons College (Boston, Massachusetts)

This project was funded by NSF from June 1, 1985, through May 31, 1988, and was jointly sponsored by Simmons College and Boston's Museum of Science. The goals of the project were (1) to improve the abilities of pre-college life science teachers' to guide student reasoning based on observation; (2) to expand an existing network of teachers with “leadership-training” in the school districts of New England; (3) to foster supportive relationships among teachers, school districts, and institutions in order to maximize benefits from resource sharing; and (4) to further refine this model program so that it can be an effective prototype for resource sharing partnerships.

These goals were accomplished by accepting 48 high school and middle school teachers (24 pairs) from through New England into a 2-year program entitled “Patterns in Life.” The program involved participation in a 4-week residential workshop at Simmons College during July, 1986. The workshop included biological, pedagogical, and computer-related activities. In each area, activities and topics were selected which would broaden the teachers' scientific backgrounds, and would also provide them with activities which could be readily adapted for use in their classrooms. Scientists, science education specialists, and the participants themselves shared their knowledge and experiences during the workshop. Emphasis was placed on small cooperative-learning groups, computers, and hands-on activities. In addition, 6 days were devoted to visits to the Museum of Science, Massachusetts Audubon Society sanctuaries, and the New England Aquarium to learn of their usefulness as educational resources. During the workshop, each teacher developed a Science Leadership Plan which was implemented during the 1986–87 academic year. The Plan described how the teacher would incorporate the knowledge gained during the workshop into their own

classroom teaching and how they would serve as local resources, sharing his/her knowledge through in-service workshops and informal partnerships with other science teachers. The Plan also included general and specific professional goals, with a time-line for implementation. During the year of implementation, the workshop staff provided support through site visits, 9 newsletters, 2 day-long meetings held at Simmons College, and a variety of workshops for the teachers and their colleagues. Formal and informal evaluations indicate that "Patterns in Life" has very effectively met the specific goals outlined in the proposal, as well as the general goals of the Directorate for Pre-college Science and Engineering Education. The contact person is Dr. Richard Nickerson at (617) 738-2196.

The Chemical-Biology Education Enhancement (C-BEE) Program at Stevens Institute of Technology

Stevens Institute of Technology (Hoboken, New Jersey) was awarded a Howard Hughes Medical Institute (HHMI) grant of $1,000,000 for a period of 5 years from June 1989 through May 1994 for its C-BEE Program. One the major goals of C-BEE is to develop programs with middle and high school science teachers to attract talented students—with emphasis on women and minorities—into biology and related sciences.

In its first year the C-BEE Program established ties with two school districts near Stevens in densely populated industrial areas with a majority of the student population of ethnic minorities and a large proportion being economically disadvantaged. Some of the projects in progress include: (1) providing support for two science teachers and a Stevens professor to design and implement the first Advanced Placement Biology course ever offered in the district using both school and Institute facilities; (2) encouraging talented high school juniors to come to Stevens after school and on Saturdays to learn laboratory techniques and conduct research projects—about 25% of these students have won awards at science fairs and other competitions; and (3) providing a special graduate course for high school teachers interested in incorporating high-technology information and laboratory techniques in chemistry into their curricula.

Another project, held in the summer of 1990 and called the "Bio-Sciences Safari," involved collaborating with both schools and governmental agencies. A group of 12 science teachers, classroom teachers, and science supervisors spent 8 days at Stevens and in Washington, DC, learning what is being done in biology, medical research, and education at federal agencies, national museums, and government research laboratories. In addition, at each visit to an institution, the group focused on career opportunities at all levels in that institution. The results of this "Bio-Sciences Safari" were presented at the New Jersey Science Convention in the fall of 1990.

APPENDIX A
Organizing Seminars and Workshops

Topic

1. Working in *collaboration* with the target audience, define a *need*.
2. Discuss proposal with the appropriate administrators (for teaching sessions approach school superintendents and principals) to establish support for the venture and possibly release-time for participants.

Location

1. On the university/college campus, preferably in the sponsoring department.
2. At a school in the target area.

Format Planning

1. Establish a working committee including representatives of the target audience.
2. Decide what type of session will be the most effective to meet the needs of the group to maximize participation: lectures, small group discussions, demonstrations, or hands-on laboratory exercises.

Date

Decide when the session(s) should take place. The most important point is to *know your audience*.

1. Establish what time of year is best to avoid busy times at your institution and for the intended audience.
2. Decide whether the event should be during the week or on a weekend.
3. Decide the time: all day or only morning or afternoon or evening.
4. Decide whether the event will be a one-time occurrence or a series.

Facilities

1. Purpose of the session: Do you need laboratory space, computers, small conference rooms, large lectures or a combination of these?
2. Number of participants: minimum and maximum for available space.
3. Traffic flow of participants within context of normal usage: Are students and faculty going to be crowding the area also, are the rooms situated close together and/or easy to find?
4. If you are serving refreshments, consider availability of electrical outlets, water supply, sinks, refrigerators, and stoves.
5. In this time of conservation and environmental awareness, consider whether to serve refreshments on re-usable cups, plates, and cutlery which require more kitchen support.
6. Types of facilities you are likely to need: registration area near entrance, coat room, washrooms, refreshment and/or general meeting area, room large enough for introductions and other full-group sessions, and appropriate seminar and/or laboratory rooms.
7. Check the availability of parking and public transportation.
8. Avoid potential problems:
   (a) Check out all rooms and equipment personally.
   (b) Confirm arrangements in *writing*.
   (c) Confirm the event with campus security especially if the event is outside normal hours to be sure the outside doors are unlocked!
   (d) On the day of the event have extra light bulbs for slide projectors and overhead projectors, extension cords, markers, chalk, erasers.
   (e) Run through all slides on the projector in advance to avoid errors.

Speakers

1. To make the initial contact, meet or telephone each prospective speaker.
2. Explain date, time, and topic with a clear definition of the target audience and the purpose of the session.
3. Discuss honorarium or fees to avoid misunderstandings.
4. Ask the speaker to provide a title and a short description of the talk for promotional information.
5. Ask what equipment the speaker needs such as chalk boards, flip charts, slide projectors, or sinks and any other requests regarding room lay-out such as movable tables and chairs.
6. Establish a timetable of reasonable deadlines for such things as the short description, any printed material to be distributed at the session.
7. *Confirm everything in writing!*

Accommodation

1. Budget for accommodations for out-of-town speakers. Make reservations and forward the specifics of the arrangements to the speaker. Arrange for transportation from the airport/train station.
2. If you are likely to have out-of-town participants attending the workshop, include information on accommodation, covering a range of prices, including university housing in dormitories and residences, bed and breakfast establishments, motels, and hotels.
3. If the workshop extends more than 1 day, provide a short list of restaurants in the vicinity.

Marketing the Event

1. Sources of contact
   (a) Approach relevant associations, such as Science Teachers Associations, that might promote the event to their members.
   (b) Include articles in regular newsletters that go to the target group from your institution or from the school district/boards.
   (c) Write the department heads of science/biology at the specific schools.
   (d) Write individual teachers. *The more personalized the invitation, the better the response rate tends to be*.
   (e) Press releases to the news media or interviews on radio and television are also possible ways of announcing the event if appropriate in your area.
2. Timetable for announcements
   (a) Preliminary announcements should be sent at least 6 months in advance of the event.
   (b) Specific information should be available about 3 months in advance.

Participant Registration

1. Send registration forms about 3 months before the event. Have participants register IN ADVANCE for the event. Some fee, included *with* the application insures greater commitment! (You might offer discount for early registration.)
2. Clearly state the method of payment: “checks payable to...”, whether credit cards are possible, etc.
3. Clearly indicate whether course credit can be earned with participation and whether it is pass/fail or a mark, graduate level or continuing education.
4. Send confirmation with map, parking and public transportation instructions, and information about accommodation.
5. Allow for cancellation with refund of all or part of the fee.
6. Allow for some last-minute registrants.

The Actual Event

1. Personnel: registration, refreshment, program (including greeting and assisting the speakers), and clean-up committees.

2. Registration table
   (a) For the participants: pre-printed nametags and folder containing schedule, map, printed handouts, and evaluation forms.
   (b) Supplies for late registrants.
   (c) General supplies to handle the unexpected: marking pens, tape, paper.
   (d) Bulletin board for messages to individual participants or last-minute announcements.
3. Signs and/or maps posted to direct participants.
4. A room designated for speakers, especially if from outside your department.
5. Evaluations/comments box: in refreshment area or at registration desk
6. Lost and Found (perhaps at registration desk).

APPENDIX B
Promotional Material Used by Floyd College[1]

Public Service Course Offerings for the Classroom Teacher

Take advantage of Floyd College's commitment to science education at all levels. The faculty members within the division of Natural Science and Mathematics are willing to share their experiences in education as well as demonstrate the equipment and facilities at Floyd College which are available to educators in our area. Fulfil state requirements for staff development while gaining confidence with new concepts and state-of-the-art technology.

Laboratory Exercises that Work
50 classroom hours • July 16–20, 1990
M–F • 7:30 a.m.–12:30 p.m.; 1:00 p.m.–6:00 p.m.
Program #345-567-1

Registration Deadline, June 21, 1990

There is currently a national upsurge of interest in rekindling emphasis on laboratory science at all levels of education. Very often, science teachers feel intimidated by a lack of equipment or unpredictability of results in a classroom setting. As a result these teachers limit their methods to lecture/demonstration techniques. The Floyd College science faculty would like to offer an opportunity for "hands-on" experience with laboratory exercises and equipment. We will share "tried-and-true" experiments, give you a chance to perform these experiments yourself, discuss lab safety, evaluate available equipment for its application to your classroom, and discuss current NSF funding options. Disciplines of emphasis will depend upon the interests of the class participants: human biology, general biology (including cytology, botany, ecology, microbiology, and ecology), chemistry, and physics are available. Level of application will also be determined by the interests of the registrants.

$350 per person, minimum of 12 participants, maximum of 20

Staff development credit is available. Contact your school's administration for funding possibilities.

Fielding Your Team for Science Olympiad

20 classroom hours • August 6–10, 1990
M–F • 9:00 a.m.–1:00 p.m.
Program #123-456-9

Registration Deadline, June 28, 1990

The Science Olympiad is an academic interscholastic competition that the sponsors feel will stimulate student interest in science, increase science education visibility, and improve community perception of science education. Last fall, this workshop was offered for area teachers in order to familiarize them with the responsibilities of coaching a Science Olympiad team. Of the several area schools who participated in Science Olympiad for the first time this spring, two of them placed high enough to go to the State tournament. We are very proud of them and expect more success next year. All participants came away winners! The students demonstrated performance skills in science techniques as well as knowledge of science facts and concepts. We would like to see you join the renaissance in science education by participating in the 1990–1991 Science Olympiad.

$50 per person, minimum of 15, maximum or 30 participants

1. These course descriptions were provided at the workshop by Donna Daugherty, an ABLE member from Floyd College, Rome, Georgia.