6. Recruitment

This evaluation explored the way students and teachers were recruited for the program because of its implications for who ultimately attends the program and the outcomes that can be expected. Questions about recruitment were included on both the student and teacher interviews. The analysis also considered the counties from which participants were drawn.

According to recruitment materials, ARC-ORNL mandatory criteria for selection are as follows:

- Student participants must be at least 16 years of age by the date the program begins.
- All participants must be U.S. citizens.
- Student participants must attend public school in a designated Appalachian county and plan to enroll in an eligible public school for the following school year.
- Student participants must have a letter of reference from a teacher, school counselor, or administrator.
- Teacher participants must plan to teach math, science and/or technology (e.g. Web design, computer programming) the following year in the ninth grade or higher in a public school in a designated Appalachian county.

Other considerations for selection include the following:

- Location in a distressed county or a distressed area in other Appalachian counties.
- Teachers and students do not have to be from the same school.
- Students and teachers who have not had an opportunity to participate in previous Oak Ridge or similar math and science programs are given priority.
- ARC has not established income levels for participation. However, ARC requests that recruitment focus on those students from families without the financial means to send their children to such a program.
- ARC has not established academic criteria requirements for participation. ARC requests that recruitment focus on “middle tier” students who show potential in math and/or science and who, with some encouragement, may improve their academic standing and consider college.
- ARC would like those who recruit applicants to target “middle tier” students who have potential for success in math and science and who may be encouraged to take higher-level courses and/or to improve their academic standing by participating in the program.

On the basis of the ARC designations of counties’ economic status 1997-2004, we determined that 31% of students and 47% of teachers were from schools in distressed counties. According to teachers, schools were selected either by the state department of education, the school district,

and, in one case, a Local Development District in the Appalachian region.[31] Within a school, teachers themselves choose whether to attend. In our small, and possibly unrepresentative sample, it appears that about one-third of teachers filled in when another teacher, either in their school or another, was unable to attend; 60% of teachers reported attending the Summer Institute with students from their schools.

6.1 Teacher Recruitment

The interviews with teachers revealed a range of ways of learning about the institute. Although all teachers completed applications, teachers who were invited or filled vacancies were sure they would be accepted, while the others assumed the process was competitive. The specific ways that teachers were recruited bulleted below account for 19 recruitment events for the 13 interviewed teachers because four of the interviewed teachers had attended more than one year.

- In five cases, staff at the state department of education invited the school to send a teacher and students.
- In four cases, the teacher said the school had been contacted directly by the school district.
- In another four, the principal contacted the teacher.
- In one case each, the invitation came directly to the school from a Local Development District office to the school; a student-teacher pair applied and learned that the school could send another teacher; and one teacher was contacted by a friend who had heard there was an opening.
- One respondent recalled that he filled an unexpected vacancy prior to 1997 and was invited back the following year.

The interview with teachers explored obstacles to recruitment and strategies for overcoming them. A few teachers who were involved with other summer teacher development programs confirmed that teacher recruitment was a common problem. Those who were interviewed posited numerous reasons that more teachers did not apply to the Summer Institute. Lack of information was by far the most common reason and mentioned by all interviewed teachers. One teacher who had received a program announcement felt that the projects to which teachers would be assigned were not clearly described. Other reasons included:

- scheduling conflicts and competition from other professional development options
- necessity for summer employment
- desire to spend the summer with family or pursue other interests
- pessimism—students and teachers do not believe a competitive program would select anyone from a “school like theirs”
- disinterest in professional development, particularly for teachers at the end of their careers.

[31] Local Development Districts are multicounty planning and development organizations.

Teachers recommended a variety of actions that could be taken.

- Chief among these was more personalized outreach by past participants—for example, through conference presentations at meetings of the National Council of Teachers of Math and of the National Science Teachers Association.

- Other teachers thought it would help if teachers considering applying could contact a past participant.

- Other teachers suggested sending program announcements directly to teachers through listservs and mailings as well as to others (e.g., district personnel, principals, guidance counselors). They underscored the importance of timeliness of this outreach.

Seeking insights about the things that promotional materials might highlight, we asked teachers why they decided to attend the Summer Institute. Some attended to accompany promising students whom they were anxious to expose to this experience. Others mentioned that they enjoyed professional development because of the growth opportunity and because summer programs "rejuvenate" and "revitalize" them. Three of the teachers mentioned specifically being interested in working at ORNL. One suggested that flyers should emphasize that the institute is "fun," that teachers will have something to bring back to their classrooms and that there is a stipend.

6.2 Student Recruitment

The ways in which students were made aware of the Summer Institute varied:

- Of the nine students interviewed, seven were personally approached by a teacher or school staff member and asked to attend the institute.

- One student learned of the opportunity after a guidance counselor spoke to her sophomore class.

- One student received no information from his school but heard about the institute from his grandfather, a physics teacher, who had attended the Summer Institute a few times before.

Although this is a small sample of students, it appears that information regarding the institute is not made widely available to students but is targeted to a few students on the "radar" of teachers or guidance counselors.

Students' recollections of the application process confirm their impressions of the recruitment process. One student attending the 1999 Summer Institute reported that she did not have to apply because her science teacher was able to select two students. Five of the students didn't recall much about the application process but did not remember it as stressful. Another student, however, recalled that this was the first competitive program to which she had ever applied and recalled being anxious about whether she would be accepted. Another student stated that some students at the institute "were kind of wondering how they got there." In other words, for some students this process was competitive, whereas for others it was unclear to them how they were chosen to attend.

7. Review of Selected Pre-College STEM Programs

AED staff reviewed a wide range of pre-college STEM programs in the United States in an effort to identify attributes of successful pre-college programs and to provide descriptions that might benefit the continuing improvement of ARC-ORNL Math/Science/Technology Summer Institute. The programs described here do not comprise an exhaustive review, but rather a representative sample of programs that are compelling to participants, attractive to funders, and sustainable for the organizations that develop and deliver them.

The review revealed a veritable smorgasbord of approaches, goals, resources, academic scope, target population, and program duration. Because evaluations of these programs have either not been undertaken or are unpublished, it is difficult to make claims about "what works" across all such programs. Nonetheless, this review offers an opportunity to compare approaches used by the Summer Institute with those of similar programs. The programs described below were chosen because they demonstrate the following criteria:

- They have garnered funding through multiple sources over time, perhaps indicating favorable reviews by participants and past funders, though such data are unpublished.
- They have strong program leadership, as indicated by the growth, longevity or general reception of the program.
- They represent a range of geographic locations across the United States.

Programs are grouped according to similar theories of action or modes of operation that strive to meet goals similar to ORNL goals. Within the groupings, programs are discussed in alphabetical order. The grouping titles may indicate a specific target population.

College Bridge Programs for At-Risk Youth Who Show Promise

College and universities that offer scholarships for minority students in the sciences often provide summer programs that bridge high school and undergraduate STEM experiences, in an effort to decrease attrition rates in college STEM majors among this target population. Such programs are often successful because they target students who show promise, because these same students often matriculate to the institution, and because program goals align with the goals of the parent institution/department. The AMP/Pre-College Summer Program at Fisk University was a three-week summer program targeted minority students with GPAs of 2.5 or higher, competitive ACT/SAT scores, and teacher recommendation. In other words, this is an example of a program that seeks to increase the success of minority students who already show academic motivation and promise. Academic instruction in science and mathematics, laboratory work, communications classes, field trips, and seminars on learning strategies were offered. Students enrolling in Fisk University who successfully completed this program were eligible for future stipends and undergraduate research posts. The program's evaluation included an assessment of students' academic progress via pre- and post-program written and oral exams. Participants also completed surveys to offer feedback on each aspect of the program. No results were available.[32]

[32] http://www.fisk.edu/index.asp?cat=49&parent=384&pid=385

Another program targeting minority youth for a two-week summer program is the Build a Human Project at the Creighton University School of Medicine in Nebraska.[33] The University of Cincinnati offers competitive summer programs for local high school students interested in health careers and the biomedical sciences.[34]

Programs in Informal Science Institutions

The Arizona Bioengineering Collaboration (ABC) is run by the Arizona Science Center and offers middle school science teachers the opportunity to enroll in each of four six-hour courses on various topics and applications in biotechnology over the course of the school year. Teachers also receive curriculum materials.[35] The Center provides similar opportunities in biotechnology targeting students and parents in the form of afterschool and weekend programs. This approach is used at several other informal science institutions around the country, mainly because it is easiest to bring teachers to the institution where resources are readily available and because teachers and students appreciate experiencing something new at a prestigious or cutting-edge science institution. Receiving curriculum materials is often appealing to teachers in schools where curricular resources are limited or not well-coordinated throughout the county or school district. No evaluative data was available for this program. The California Academy of Sciences in San Francisco has run BioForum, a similar series.[36] Other sites of similar programs include the Chicago Botanic Garden,[37] the Boston Museum of Science,[38] and the Fairchild Tropical Botanic Garden.[39]

Institution-School Partnerships

Many current grant programs require partnerships between organizations and school districts. This direct link with schools provides assistance with participant recruitment and follow-up communications, and allows program staff to gain insight into the immediate and long-term needs of local teachers. The Baylor Science Leadership Program/HU-LINC partners with the Houston Independent School District (HISD) to reform the science education practices of 177 elementary schools. In addition, the program works to involve parents, scientists, school administrators, and other local community organizations, acting as the coordinator of these efforts. This institution is well known for its high-quality and ever-expanding outreach programs, mainly because staff form strong partnerships directly with school districts and maintain relationships over time. The program currently serves elementary, middle and high school science teachers, students, and their parents.[40]

---

[33] http://www.biomedsci.creighton.edu/education/outreach.html

[34] http://www.med.uc.edu/admissions/summerenrich.cfm

[35] http://www.azscience.org/investigating_biotech.php

[36] http://www.calacademy.org/education/course_catalog/spring_summer_2002/teacher_workshops.html

[37] http://www.chicagobotanic.org/explorations/

[38] http://www.mos.org/doc/1812?id=666

[39] http://www.fairchildgarden.org/education/n_education.html

[40] http://www.cc.bcm.tmc.edu/ceo/

The Baylor programs have been extensively evaluated; however, results are unavailable to the public. Other programs with similar theories of action are located at the Cleveland Clinic Foundation in Florida and Ohio,[41] and the Duke University School of Medicine.[42] BioEd Online is a web-based resource designed to enhance the skills of high school biology teachers. This resource provides state-of-the-art information through streaming videos, slide libraries, and nature science updates.[43]

Programs in Organizations Focusing on Single Issues or Specialized Areas

Such programs have the advantage of a single issue-based focus that aligns naturally with the missions of their organizations. Further, they have ready access to experts who can demonstrate fieldwork techniques and science "in action," thus providing a science immersion experience for students and teachers.

For example, the Boston Waterfront Learning Project at the Children's Museum joins forces with Save the Harbor, Save the Bay and the Urban Harbor Institute at UMASS Boston to provide educational programs highlighting the Boston harbor and local wharves.[44] This project is strengthened through a partnership with Boston Public Schools, through which a regular rotation of classrooms is arranged. Similarly, the Chesapeake Bay Foundation, whose mission is to improve local water quality, invites classes of students to collect samples and observe marine life.[45] The Children's Discovery Museum of San Jose has created BioSITE, a program for students in grades 4 through middle and high school, to build awareness of the environmental issues of the local Guadalupe River.[46]

The Centers for Ocean Science Education Excellence (COSEE) offer week-long teacher professional development programs in the summer where marine fieldwork methods are practiced. Approximately 20 teachers from North Carolina, South Carolina and Georgia are selected.[47] The DNA Learning Center at Cold Spring Harbor Laboratories, New York provides field trips to local schools, where students can use state-of-the-art equipment to perform biotechnology techniques. The Center draws on its long history of DNA science, hosting exhibitions as well as online resources for teachers.[48] A program with a similar biotechnology focus is CityLab at Boston University's School of Medicine.[49]

Programs Promoting a Specific Method or Practice

A report covering 1990-95 describes how the Dartmouth Thayer School of Engineering created a summer course for K-12 science and math teachers that "represents a distinctive pedagogical

---

[41] http://cms.clevelandclinic.org/body.cfm?id=204

[42] http://www.duke.edu/~dbc4/boost/teachers/sci-immersion.html

[43] http://www.bioedonline.org/site/about.cfm

[44] http://www.waterfrontlearning.org/

[45] http://www.cbf.org/site/PageServer?pagename=edu_home

[46] http://www.cdm.org/biosite/about.htm

[47] http://www.scseagrant.org/se-cosee/teacher/06_leadership.htm

[48] http://www.dnalc.org/home.html

[49] http://www.bumc.bu.edu/Dept/Home.aspx?DepartmentID=285

strategy which mimics the actual practice of engineering." Teachers spent seven days at this institute, first experiencing immersion in this approach, and then determining ways to adapt this approach to their classrooms. At the time of the report, 155 teachers in 35 states had participated in the program.[50] This was the only example we found of a program that demonstrates a particular academic strategy that teachers are expected to reproduce in the classroom. Translation to the classroom works well because there is a concrete, successful pedagogical mode that can be presented effectively by the institution and replicated by participating teachers. It suggests that when teachers have time during the session to consider issues of classroom adaptation, it is more likely that they will follow through once school begins.

Collaborative Programs with Local, Rural and Native Populations

Scientists at the Dakota Science Center are making connections with local Native American tribes and rural populations to bring science and technology to students in grades 6 to 9 in the Science Circle of Life Program. A unique aspect of this program is its efforts to staff the program with tribal elders and Native American counselors, as well as with members of the Dakota Science Center. Though funding limitations are not allowing an expansion of this program, it has served 36 Native American and rural students.[51]

Several other programs work directly with Native American/Alaskan populations. A well-regarded program with a mission to serve Native American students is located at the Fred Hutchinson Cancer Center in the state of Washington; the Science Education Partnership at the center has expanded to include the provision of curriculum kits to local schools.[52] Another program, the Imaginarium, bridges native communities in Alaska through cultural and science events.[53] By working directly with community members to appreciate the cultural and lifestyle differences of Native American and rural populations, these programs report long-term relationships with not only participants, but with those connected to them (e.g., family members, community leaders, teachers, etc.).

Scientific Work Experience Programs for Teachers (SWEPTs)

As of 2000, there were approximately 72 SWEPT programs serving upwards of 1,300 teachers each summer around the country.[54] Pioneer institutions include the Columbia University College of Physicians and Surgeons,[55] offering laboratory experiences for teachers only, and Rockefeller University,[56] offering laboratory experiences for high school students and teachers of all grade levels. Several students from Rockefeller University have developed their research projects through the Westinghouse and Intel science competitions, earning awards in the finalist rounds.

---

[50] http://fie.engrng.pitt.edu/fie95/4b1/4b14/4b14.htm

[51] http://www.dakota-science.org/

[52] http://www.fhcrc.org/science/education/educators/sep/

[53] http://www.imaginarium.org/types%20of%20programs.html

[54] Bacon, W. S., ed. (2000). *Bringing the Excitement of Science to the Classroom.* Tucson, AZ: Research Corporation.

[55] http://www.scienceteacherprogram.org/indexorig.html

[56] http://www.rockefeller.edu/outreach/

The FoxChase Cancer Center in Philadelphia is another example of an institution that provides teachers and students an opportunity to conduct authentic research.[57] The opportunity for teachers and students to spend between four and nine weeks working in a research laboratory under the supervision of practicing scientists is considered by participants to be invaluable in helping students and teachers understand the nature of research and the scientific enterprise.[58]

Summary

A search of the literature for evaluations of pre-college STEM programs for comparison with findings of the current evaluation revealed that either evaluation is not conducted or programs have chosen not to publish evaluation findings. The few evaluations we reviewed and referenced earlier in this report were conducted by ORISE for Department of Energy projects. Findings of the Summer Institute with regard to variables, such as using the experience at Oak Ridge in teaching and satisfaction with the program, compare favorably.

The programs described in this section of the report can be considered best practices on the basis of their longevity and perceived effectiveness by administrators, funders and participants. Like the ARC-ORNL Summer Institute, many of the programs reviewed offer immersion experiences for both students and teachers. Programs are administered by higher education institutions and medical programs as well as informal science institutions, such as science museums and botanic gardens.

A positive attribute of these programs, like that of the ARC-ORNL Summer Institute, is their location at a prestigious institution where participants can use state-of-the-art equipment and work on meaningful, relevant projects. Unlike ARC's wide geographic reach, other programs have chosen to target populations in cities. When this occurs, local programs facilitate the development of ongoing partnerships with local school systems, which assists recruitment, ongoing assessment of participant needs and interests, and parent involvement. While some programs reviewed were longer, others were of similar duration to the Summer Institute. The programs that target student populations underrepresented in STEM appear to demonstrate a more sustained commitment to participants.

[57] http://www.fccc.edu/research/education/index.html

[58] For more insights into recently funded programs (2005), refer to the compendium of Math Science Partnerships funded by NSF and available online at http://www.ed.gov/programs/mathsci/nsfabstracts.doc