CHAPTER 11
SUSTAINABILITY AND SOURCES OF FUNDING

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CHAPTER HIGHLIGHTS

- Sustainability planning begins when the project is conceived.
- Successful projects require sustained leadership from the university and school administration, however, plan for transitions.
- Ongoing communication among all stakeholders creates a sense of community and shared responsibility.
- Building an infrastructure to prepare Fellows for teaching, communicating with the public, and outreach to students and Teachers can allow projects to continue when initial funding ends.
- Projects that are flexible and responsive to university needs, school district requirements, and Teacher and Fellow time are more likely to be sustainable.
- Sustainable projects honor and recognize the contributions of all and develop a culture of shared responsibility.
- Sustainability requires communicating success to all partners.
- Sustainability requires buy-in and investment.
- Funding exists to begin new projects or continue existing ones.

SUSTAINING A PROJECT beyond a grant funding cycle is perhaps the biggest priority for anyone who has invested the time, energy, and resources to build a university–K-12 partnership. However, building a sustainable partnership is a major challenge. Many great projects are stymied by leadership changes, institutional priorities, school district shifts in organization and curricula, and the inadequate incentives for faculty and teachers to invest in a transformative change of teaching and curricula; all such hurdles must be anticipated.

In this chapter, we highlight ways to plan for sustainability from the outset. We discuss types of leadership teams and how to plan for transitions in leadership. We emphasize that communication is key to sustainability and provide guidelines for the clear communication between team leaders and university and K–12 schools, and with potential sponsors and community leaders, to build support for project longevity. Sustainable partnerships integrate the core project elements into institutional culture and promote a "change agent" attitude in GK–12 Teachers and Fellows to help them continue to employ new pedagogical and communication strategies. Finally, we provide sources for initial funding and tips for developing a fund-raising plan for sustainability.

LEADERSHIP

We begin with a simple, but often overlooked, point: Sustaining a successful project requires sustained leadership. Even if a project is running smoothly, with logistical kinks removed and no apparent challenges on the horizon, changes in leadership are inevitable and can pose a considerable risk to the project's health and continuity. On the positive side, changes to a project can be beneficial. In this section, we focus on mechanisms for ensuring smooth transitions in leadership.

Above all, plan ahead. There are countless examples of institutionally "successful" projects that were created and led primarily by one person for many years, so that the projects became inextricably identified with that leader. In such cases, the departure of the person or a reassignment of his or her duties may rob the project of its soul. Long before that happens, current leaders need to identify, recruit, and prepare potential successors. Fortunately, the easiest time to convince someone to accept a large responsibility is well before that responsibility becomes a reality! We recommend that potential recruits be placed on advisory boards or steering committees, providing them with an opportunity to learn how the project functions and to ponder its challenges and opportunities. If they attend meetings regularly and become engaged in activities, they are likely to be a good fit for leadership and are much more apt to accept an offer of leadership than if they were approached "cold."

On the university side, faculty with active research labs may have an edge in marshaling support from university administrators for GK–12 activities; they tend to have institutional clout. Equally important, they generally have experience building and guiding teams of diverse collaborators and are in a position to understand the wide variety of constraints and challenges already imposed on faculty and students. Many GK–12 projects include nontenured faculty members who nonetheless may have more expertise in establishing partnerships with K–12 schools. Faculty from colleges of education may seem like a natural source for recruiting leaders for GK–12 projects. We caution, however, that faculty who are not scientists or engineers will likely encounter a significant cultural divide between their college or department and departments from which GK–12 Fellows are typically drawn. For smaller projects, centered in a department or in a research center with outreach components, education and outreach coordinators can be highly effective.

Because all sustainable GK–12 projects are partnerships between a university and a K–12 school system, leadership from both sides of the partnership is essential. On the university side, we recommend a project director who is a faculty member of a science or engineering department or who already directs a center of science education or outreach. With respect to K–12 leadership, we recommend a science or math teacher with significant classroom experience. In larger districts, this person might have the title of science/math coordinator. The person should be provided with release time and/or compensation from the school district to meet regularly with the project director and the Fellows involved in the project. Assuming that he or she has been fully endorsed by school administrators and is actively engaged in the project's activities, the designee will be well positioned to respond to problems that inevitably arise in K–12 schools and that might otherwise threaten the long-term health of the project. As with faculty leadership, it is critical to identify, recruit, and train someone for this type of position long before a change in leadership becomes necessary. An alternative model is for school district science coordinators to meet with the project director on a monthly basis. Finally, leadership and guidance can be provided by advisory boards composed of school and university leaders, senior faculty, and GK–12 Fellows and Teachers.

> "Education has the capacity to transform, as long as you remember that your present state doesn't have to be your permanent state."
>
> —GK–12 Fellow, Howard University

ONGOING COMMUNICATION

All GK–12 projects must engage in ongoing communication (e.g., daily or weekly) with partnering schools and university scientists and researchers. The frequency and means of ongoing communication should be established by the leadership at the beginning of the project. This strategy can help the project team uncover persistent challenges to a project's implementation and identify potential opportunities. Ongoing communication also helps build sustained, long-term relationships between the university and partnering schools that can help initiate new projects. Ongoing communication with schools may involve email updates on project activities and events, phone conversations to resolve unforeseen setbacks, and at least monthly face-to-face meetings to review the progress of the project. Many projects also make presentations to school boards or to parent–teacher organizations. In this section, we provide tips on establishing and maintaining communication with all stakeholders.

Communicating with Schools

Ongoing communication between a university-based K–12 STEM education project team and teachers in a potential partnering school is paramount to project success. Moreover, the STEM project team must regularly engage with and update school principals, since their implicit and explicit support of project activities communicates to the school's teachers and staff the importance of the project to the school and its students. GK–12 projects have employed a range of approaches, depending on the size and scope of the project. Some projects span several school districts and others serve a single school. Communication challenges and strategies vary with the scope of the activities and partners. Having participating Teachers give talks at conferences and publish about their work builds support for both the Teachers and administrators, especially when these activities are advertised to school audiences. Some GK–12 projects have annual meetings at which invited faculty mentors and school district personnel publicize the results attained by Teacher–Fellow teams.

Regular communication with school partners allows the project team to identify problems and fix them before they become intractable. For example, if a GK–12 Fellow makes a significant effort to prepare inquiry-based, hands-on STEM lessons, but the GK–12 Teacher fails to provide comments on the length of the lesson or the appropriateness of the language for the intended students, then the Fellow may begin to lose enthusiasm. This type of awkward dynamic between Fellow and Teacher can develop slowly and will eventually erupt; frequent (perhaps scheduled) opportunities for communication throughout the school year can easily prevent such trouble.

Communicating School Needs

Most teaching and learning activities in the K–12 classrooms are driven by learning standards and, increasingly, by pacing charts and student performance data. Teachers have deep familiarity with the standards and how various units, lessons, and activities align with the standards. Thus, if the lessons offered by Fellows are not aligned with the standards, Teachers will not be receptive and the GK–12 project will not be sustainable. Again, ongoing communication between Teachers and Fellows is the solution. To accomplish this, many GK–12 projects have planning meetings of all Teacher–Fellow teams at least once a semester, supporting face-to-face communication about lessons learned, allowing adjustments to be made, and creating a sense of community and teamwork.

Communicating Researchers' Needs

GK–12 Fellows are often graduate students with many responsibilities on campus, including completing their course work, laboratory experiments, fieldwork, data analysis, exams, writing, and travel. For the Teacher–Fellow partnership to be sustained, it is critical that all stakeholders understand these multiple responsibilities. For example, if a Teacher understands that a Fellow will not attend a previously planned activity because of conflicting professional requirements, then the Teacher will more likely be supportive of the Fellow. In short, the GK–12 Fellows' overall success and satisfaction is paramount to their sustained participation in any GK–12 project.

FLEXIBILITY AND ADAPTATION

No matter how smoothly a project operates at a given time, change is inevitable. On the one hand, change that results from neglect, misguided leadership, or the type of attitude encapsulated by Mark Twain's quote, "I'm all for progress. It's change I can't stand," is obviously a threat to sustainability. On the other hand, leaders who can anticipate and respond to shifts in the needs of Fellows, Teachers, faculty, and administrators can help GK–12 projects become more sustainable. The key is to turn challenges into opportunities by seeking input from all involved and responding in an open and deliberate manner.

Many projects allow Teachers and Fellows to negotiate which days the Fellows are in the classroom. For example, in the Problems and Research to Integrate Science and Mathematics (PRISM) GK–12

KEYS FOR SUCCESS

- Anticipate and facilitate changes in leadership.
- Require leaders from the university and the K–12 school system.
- Cultivate new leaders.
- Invite principals and science chairs to observe Fellows in the classroom.
- Build in a routine means of communication between Fellows and Teachers: email, phone, and formally scheduled, weekly face-to-face meetings to reduce miscommunication about the timing of lessons, content, and changes in Fellow or Teacher schedules.
- Create time and space for Teachers and Fellows to share their different professional cultures, including communication styles, methods, expectations, professional jargon, responsibilities outside the partnership, and ideas on autonomy and collaboration.
- Seek input from all stakeholders.
- Establish mechanisms for regular communication with K–12 personnel and university administrators about challenges, opportunities, and successes.
- Ensure that all participants make their needs and expectations explicit.

project at Emory University, Fellows could be in class for an entire week each month or for one to two days per week. Teachers appreciate this type of flexibility and Fellows sometimes require it. Responding to changes in Teacher assignments and school schedules required flexibility and often meant reassigning Fellows or altering the timing of their commitments.

Flexibility in Project Structure

NSF GK–12 grants provided many projects with initial funding to build partnerships. As funding diminished, projects adapted by finding new ways to sustain graduate student involvement in K–12 classrooms. For example, many projects found institutional resources that subsidized graduate students, albeit for a reduced amount of time, or that replaced a portion of their regular graduate fellowship amounts. Some projects adapted models and materials from other projects, to reduce time commitments and to provide Teachers with exemplary materials. Some projects recruit Fellows and Teachers to disseminate materials and pedagogy through workshops for other Teachers and Fellows. Many projects have continued by collaborating with other university- or school-based strategic initiatives and other projects funded by grants.

INFRASTRUCTURE

Building the infrastructure to continue preparing graduate students for work with K–12 schools and for communicating science is important in sustaining a GK–12 project. The impact of GK–12 projects on graduate students' leadership, communication skills, and teaching is a prime motivator for changes in graduate projects. Some GK–12 projects used courses from their education schools to prepare Fellows for the classroom. Other projects developed their own courses (e.g., "Communicating Science" and "Teaching Science" courses at Emory University and "Presentation Boot Camp" at Florida Institute of Technology). Still other institutions have taken things one step further and implemented undergraduate and graduate courses in which the student's primary responsibility is to go into the K–12 classroom to work with teachers and students, much as GK–12 Fellows do themselves. Because these courses proved their success, they became institutionalized; that is, they remain as sustainable elements of the GK–12 projects that created them. (See the Emory University exemplar at the end of the chapter.) Some institutions have used these elements as a foundation to create projects that lead to certificates for STEM graduate students, who enroll in the courses to receive formal, documented training in outreach and communication. Projects of this type are relatively easy to establish and sustain because their structure of courses, credits, and faculty assignments is already familiar to universities.

Likewise, developing web archives of lessons and materials is a way to capture the work of GK–12 projects and to extend their impact to other Teachers and schools. (See Table 11.1.) Doing so can foster growth and sustainability because local users will likely become advocates of the project and can contribute in numerous ways that collectively strengthen the project, making it easier to sustain. Over time, archived data and lesson plans represent a library resource as new lesson plans are developed by incoming GK–12 Fellows. As more of these plans are adopted by local schools, the easier it will become to recruit new teachers for the GK–12 project and to ease the transition of new Fellows into local schools, both approaches of which are important for sustainability.

FINDING FUNDING

Sustaining any GK–12 project beyond its current funding term requires systematic planning and the implementation of a fund-raising strategy. Viewing initial support as seed money and identifying key components that stakeholders value leads to continued support. Moreover, the project team must develop a plan that aspires to scale up the project by identifying critical measures of success that will

KEYS FOR SUCCESS

- Embrace the project's goals and flexibility will facilitate success.
- Allow projects to evolve in scope or structure to meet new challenges or expectations.
- Establish courses or projects to train STEM graduate students in outreach and communication to create a sustainable infrastructure for GK–12 projects.
- Make lesson plans and other resources developed by your project widely available and easily accessible.
- Build on resources already assembled. Archives should contain shared, unique resources.

Table 11.1 Websites of Materials Developed by NSF GK–12 Projects

Institution	Thematic focus or grade level
Idaho State University	Physical and life sciences, and robotics activities, for grades 5–12
Kent State University	Geoscience activities and lesson plans, and links to and reviews of activities, from the Digital Library for Earth System Education (DLESE)
Michigan State University	Lessons in general science, biology, ecology, earth science, chemistry, and physics; arranged by grade level
North Carolina State University	Hands-on lessons with engineering applications
Penn State University	Multiday standards-aligned instructional modules using the theme of advanced transportation technologies
University of Colorado	Lessons and activities on the TeachEngineering.org Digital Library Collection that use engineering as a vehicle for hands-on integration of science and math learning
University of Montana	Ecological inquiries for K–12 and natural history guide for Teachers and students
Elementary School Grades (K-5)	
Ohio State University	Science investigations for grades 3–5
St. Joseph's University	Natural science units for grades K–5
University of Alaska	Activities focused on earth, life, and physical sciences
University of South Carolina	Inquiry-based engineering, science, and math activities for the K–8 classroom
University of South Florida	Lessons, experiments, and modules (genetic engineering, biosensors, robotics, and nanotechnology) based on Sunshine State Standards
Middle and High School Grades (6-12)	
California State University Northridge	Mathematics activities for middle school and high school students
Colorado School of Mines	Hands-on middle school mathematics and science activities with connections to engineering
Cornell University	Resources for science projects developed by graduate and undergraduate students in collaboration with middle and high school Teachers
Emory University	Problem-based lessons for middle and high school science and math
Illinois State University	Biology, chemistry, and math lessons
Texas A&M University	Curriculum materials that support students in grades 6–12 in their use of spatial thinking, GIS, and remote sensing
University of Alaska	Activities focused on earth, life, and physical sciences
University of Arkansas	Math and science lessons for students in grades 6 and 7
University of Central Florida	Inquiry-based lessons geared for upper middle and lower high school students
University of Florida	Inquiry-based lessons focused mostly on ecosystem health and sustainability for middle schools.
University of Illinois Urbana–Champaign	Chemistry units featuring visualization and models; American history units; inquiries involving water; and geology units featuring visualization of earthquakes and plate tectonics

SOURCE: HTTP://WWW.GK12.ORG/RESOURCES/STEM-ACTIVITIES-AND-RESOURCES-FOR-K-12-TEACHERS-AND-STUDENTS/

resonate with future funders and donors. Using quantitative data, as well as qualitative and anecdotal information, project leaders can communicate successes to key constituencies (e.g., students and Teachers of K–12 schools, as well as Fellows, researchers, and faculty at the university).

Collaborating with Other Grant Projects

University-based GK–12 project leaders can engage with leading STEM researchers on their campuses and assist in the planning and design of innovative strategies that (1) bring state-of-the-art research tools and techniques to the K–12 environment; (2) engage Teachers as professionals on university research teams, allowing the Teachers to experience the modern research process and revitalize their own interest in scientific discovery and technological innovation; and (3) excite students about STEM studies through creative, standards-aligned classroom lessons or summer research internships. Many GK–12 projects received support from other grants, such as NSF and NIH Center grants with outreach components; the NSF's Integrative Graduate Education, Research, and Traineeship Program and Science and Technology Centers; and the U.S. Department of Education's Mathematics and Science Partnership grants and Race to the Top funds. Local foundations are another source of sustainable funding (see the exemplars at the end of the chapter). Graduate Assistantships in Areas of National Need (GAANN) grants from the Department of Education support the development of teaching skills and may be sources of funds for the support of Fellows in GK–12 activities. Such a partnership between the STEM research community and K–12 STEM education projects will be mutually beneficial through new grant awards and will enhance the profile of K–12 STEM education projects within the higher education community. The National Science Foundation website (www.nsf.gov) should be consulted for up-to-date project priorities and initiatives.

Collaboration with Faculty Researchers to Support Broader Impacts

Many federal and state granting agencies and some foundations require recipients of funds to explicitly identify and communicate the broader impact and societal benefits of their research. GK–12 project leaders should offer their experience and expertise to faculty researchers seeking to communicate their research effectively to K–12 Teachers and students. Inviting faculty researchers to GK–12 project meetings, events attended by Teachers, or the project's K–12 classroom activities can lead to additional funding and foster an institutional culture that values outreach. Faculty who participate can also benefit directly by being able to (1) offer authentic broader impact statements and societal benefit statements in their research proposals and (2) distinguish their research proposals from their competitors' and increase their likelihood of being funded.

Collaboration with a School of Education to Support Teacher Preparation Projects

Schools of education are the primary resource for numerous educational and professional development projects for pre- and in-service teachers. Yet, they often do not have access to practicing scientists and engineers with considerable content knowledge and current STEM research experience who can convey the excitement of science and engineering to K–12 constituencies. K–12 STEM education projects within schools of science and engineering develop deep and sustained relationships with K–12 constituencies. In a sustainable collaboration, (1) schools of education could conduct professional development for students and faculty at schools of science and engineering and, in so doing, expose them to the science of learning; (2) the partners from both schools could collaborate to develop content-rich, standards-appropriate, and pedagogically relevant K–12 STEM lessons and conduct Teacher professional development projects; and (3) preservice students from schools of education could enroll in challenging, content-rich STEM courses at schools of science and engineering and develop proficiency in lab practice and the process of science. Such a collaborative approach can enable the partner schools to tap into new resources to develop innovative K–12 STEM education projects.

Collaboration with Schools and Districts for State Funding

Many states have adopted national standards for math and science in the K–12 educational system (e.g., the Common Core State Standards for Math and the Next Generation Science Standards). Moreover, frequent calls from industry captains, professional societies, and policymakers are beginning to draw the attention of state and local education officials to shortages in the scientific and engineering workforce. In fact, states such as Massachusetts have developed and integrated academic standards for engineering education at the K–12 level and treat engineering as equivalent to various science disciplines (Foster 2009). Finally, recent federal efforts, such as the Race to the Top, have provided significant financial resources to many state departments of education for planning and implementing innovative STEM

KEYS FOR SUCCESS

- Success builds on success; communicate clearly what your project has accomplished, and provide a vision for continued success.
- Partner with faculty to include current and potential project activities in new grant proposals, especially those which feature broader impacts and education.
- Partner with K–12 schools to provide Teachers with professional development and access to STEM faculty and graduate students.
- Take advantage of state funding opportunities for K–12 activities.
- Work with development officers at universities and school districts to solicit funds from individuals and corporations.

education projects to prepare effective STEM Teachers who can educate their students for college readiness and for a competitive global economy.

Therefore, university-based K–12 STEM education projects currently have numerous opportunities to collaborate with local school districts and state departments of education. Specifically, the K–12 STEM education projects can offer their expertise on (1) familiarity with K-12 STEM curriculum and its appropriateness to prepare students for college; (2) the professional development needs of Teachers in STEM content and lab practices; and (3) the appropriate integration of modern scientific and technological tools to educate, engage, and excite students in STEM studies. For example, university faculty can participate in the design of state science and math standards that are aligned with the national core standards. Moreover, university K–12 STEM education projects can help state departments of education prepare teachers in local school districts to implement STEM curriculum with high fidelity to the emerging core standards. Finally, K–12 STEM education projects can offer challenging summer enrichment programs to K–12 students that allow the students to explore career options in STEM disciplines.

Collaboration with Development Teams for Fund Raising

Development teams at universities are tasked with identifying and prioritizing the funding needs of the universities' various projects. Moreover, these teams develop and maintain a list of philanthropic and corporate foundation projects, as well as a list of prospective individual donors, including university alumni and alumnae. In order to match various university needs with foundation projects and potential donors, development staff spend a good deal of time meeting with faculty and researchers. Many foundations and individual benefactors often support projects that explicitly and convincingly demonstrate a societal impact. Fortunately, university-based K–12 STEM education projects can demonstrate the vast number and kinds of benefits that K–12 students and teachers derive from projects that involve teacher–scientist partnerships in content- and technology-rich classroom instruction or inquiry-based hands-on STEM lessons and activities.
Thus, development teams frequently seek out and prominently feature K–12 STEM education projects in their fund-raising activities (Table 11.2).

As development teams partner with K–12 STEM education projects, it is critical to align any proposed project with the funder's goals. Some funders may be driven by standards-based school or curriculum reform, while others may seek to broaden STEM education opportunities to underrepresented minorities and women. For example, even if a K–12 project is initially funded by a federal or state grant to broaden the educational experience of scientists in training through a Fellow–Teacher partnership (e.g., an NSF GK–12 project), fund raising from foundations and individual donors for sustaining such a project will often require articulation of the benefits of such a project primarily for K–12 constituencies, with the benefits to the scientist in training being secondary. K–12 STEM education projects can facilitate their development teams' fund-raising campaigns by (1) maintaining a project website that highlights project activities and impacts; (2) keeping data on participants (schools, teachers, students, university-based STEM students, faculty, etc.) current; (3) broadly disseminating outcomes of projects, including announcements about events, accomplishments of project teachers and students, etc., through print media, television, etc.; and (4) acknowledging sources of support in all public communications related to the project. Often, K–12 STEM projects may find it helpful to partner not only with the university's development team, but also with the media and marketing team, to accomplish their fund-raising goals.

FOR MORE INFORMATION

- Chaney, B. 1995. *Student outcomes and the professional preparation of eighth-grade teachers in science and mathematics.* NSF/ NELS. Westat, Rockville, MD.
- Foster, J. 2009. The incorporation of technology/ engineering concepts into academic standards in Massachusetts. *The Bridge*, 39(3), 25–31.
- Iskander, M., Kapila, V., and Kriftcher, N. 2010. Outreach to K–12 teachers: Workshop in instrumentation, sensors, and engineering (WISE). *ASCE Journal of Professional Issues in Engineering Education and Practice*, 136, 102–111.
- Iskander, M., Yu, E., and Yakubov, N. 2009. A course in instrumentation and monitoring and condition assessment for civil engineers. *ASCE*, GSP No. 186, 624–631.
- Sanders, W.L., and Rivers, J.C. 1996. *Cumulative and residual effects of teachers on future student academic achievement.* University of Tennessee Value-Added Research and Assessment Center, Knoxville, TN.

Table 11.2 Sources of Grants

FEDERAL SOURCES OF GRANTS

Grants.gov allows searches by topic area for all federal grants; search for opportunities to extend your project.
http://1.usa.gov/Zy2bGW

The Science Education Partnership Award (SEPA), offered by the National Institutes of Health (NIH), funds grants to create partnerships among biomedical and clinical researchers, on the one hand, and K–12 teachers and schools, museums and science centers, media experts, and other educational organizations, on the other hand.
http://www.ncrrsepa.org/

National Science Foundation projects, www.nsf.gov:

Advanced Technological Education
http://1.usa.gov/10uUK5Q

Arctic Research Opportunities
http://1.usa.gov/14ClC9E

Climate Change Education
http://1.usa.gov/10swbqB

Cyberlearning: Transforming Education
http://1.usa.gov/XGjJ8R

Dynamics of Coupled Natural and Human Systems
http://1.usa.gov/16tNqeH

Innovative Technology Experiences for Students and Teachers
http://1.usa.gov/XbfReH

Math and Science Partnership (MSP)
http://1.usa.gov/YZ54l5

National STEM Education Distributed Learning
http://1.usa.gov/Zy2PnY

Research Experiences for Teachers (RET) in Engineering and Computer Science
http://1.usa.gov/10mjQ81

Robert Noyce Teacher Scholarship Project in Cyberlearning: Transforming Education
http://1.usa.gov/10syREw

SOURCES OF GRANTS FOR TEACHERS

Best Buy Teach Award
http://bit.ly/14CntLz
The Best Buy Teach Award rewards schools for creating and implementing successful interactive projects that focus on children using technology to learn standards-based curriculum.

EducationWorld
http://bit.ly/X05w1e
EducationWorld provides a grants database.

GrantsAlert.com
http://www.grantsalert.com/gsft.cfm
Search for education grants and identify new funding opportunities.

http://www.grantwrangler.com/STEMresources.html
A site with a searchable list of foundations and other organizations that support STEM education.

ING Unsung Heroes® Award
www.ing-usa.com/us/unsungheroes/
ING Unsung Heroes helps turn Teachers' great ideas into reality for students. Each year, 100 educators are selected to receive $2,000 to help fund their innovative class projects. Three of those chosen receive the top awards of an additional $5,000, $10,000, and $25,000.

National Education Association (NEA) Grants
http://bit.ly/16tPhAh
The NEA Foundation awards grants in support of closing achievement gaps, developing creative learning opportunities for students, and enhancing the professional development of teachers.

SchoolGrants
http://www.schoolgrants.org/
A searchable site with many grant sources and resources for effective grant writing, including sample proposals.

The Science Education Grant Index
http://bit.ly/YQxWzb
The index provides access to all the science, math, computer science, engineering, and technology grants covered in recent issues of *Technology Grant News*.

The Teacher Network
http://Teachersnetwork.org/Grants/grants_science.htm
Lists small-grant opportunities and provides some grant-writing resources.

Toshiba America Foundation
http://www.toshiba.com/taf/
Toshiba America Foundation provides up to $5,000 grants to 6th–12th-grade science and math teachers to acquire instructional equipment that will make learning more exciting for students.

Toyota TAPESTRY Grants for Science Teachers
http://www.nsta.org/pd/tapestry/
Toyota TAPESTRY Grants provide up to $10,000 in awards to implement innovative, community-based science projects in environmental science, physical science, and the integration of literacy and science.

EXEMPLARS

SHARED FINANCIAL SUPPORT FOR SUSTAINABILITY

University of Florida – Science Partners in Inquiry-based Collaborative Education (SPICE)

http://www.spice.centers.ufl.edu/

The sustainability model for SPICE is based on a system of shared financial support for Fellows and a two-tiered structure of those Fellows. Deans from each of the three main colleges that train STEM graduate students have committed one Fellowship ($24,000 plus tuition and fees) per year, with the understanding that the Fellowship will be awarded to a student in the contributing college after an open solicitation for applications that are reviewed by a committee, including a representative from that college. In addition, $500 per year is contributed for classroom supplies. In general, the Fellowships are not a drain on a college's budget, because the funds are allocated from a relatively large pool of graduate Fellowships that were already in place before the start of SPICE.

When a graduate student accepts a $24,000 SPICE Fellowship, he or she must commit to the project for two successive years. In the first year, Fellows receive training through a two- to three-week summer institute and become Type I Fellows, spending one to two days per week in middle school classrooms, facilitating inquiry-based learning and becoming mentors. The following year, they become Type II Fellows, receiving far less financial support ($4,000) but committing to much less time: They do not need summer training, do not typically need to prepare as extensively for a lesson (because they prepared the same lesson the previous year), and do not need to be in the classroom as frequently as Type I Fellows (two days per month vs. one to two days per week). Of the $4,000 provided, $500 is set aside for classroom supplies. The remaining amount, a $3,500 stipend, is intended to replace a portion of the financial support that the students would otherwise have been provided by their respective departments or colleges. Consequently, it does not include tuition and fees. The $4,000 is provided by four matching contributions of $1,000 from the chair of the student's department, the dean of the department's college, the provost, and the vice president for research. Importantly, all parties must agree to this support for a student's Type II Fellowship before a Type I Fellowship is awarded. This two-tiered system of Fellowships has two important benefits. First, it provides a critical mass of Fellows in a given year (six instead of three). Second, it ensures continuity of people and experiences between years, including experienced peer mentors (Type II Fellows) for incoming participants (Type I Fellows). Most important, the model provides sustainability by creating a multitiered system of shared financial support; the financial obligations of each contributor are relatively small, but all contributors understand that the funds they provide are needed to acquire the necessary funds from other contributors.

BUILDING INFRASTRUCTURE AND FUNDING FOR SUSTAINABILITY

Emory University – Problems and Research Integrating Science and Math (PRISM)

http://www.cse.emory.edu/prism/index.cfm

PRISM uses problem- and case-based learning as its key pedagogical strategies. The project is supported by grant funds and by the Emory Graduate School, the Office of the Provost, Emory College of Arts and Sciences, and the research mentors of the participating Fellows. The institutional support is an essential component of PRISM's sustainability. The support is strong because of the project's impact on graduate student training and the extent of its impact in the K–12 community.

Emory GK—12 Fellow discusses comparative primate anatomy with Teachers at the 2008 Evolution Revolution Teacher workshop at Emory.

For example, PRISM has disseminated project materials and lessons learned through 357 cases published on the CASES Online website (http://www.cse.emory.edu/cases) and 73 presentations and workshops by

EXEMPLARS (CONTINUED)

graduate students and Teachers at regional, national, and international meetings. Likewise, PRISM has built an increasing web of activities promoting the development of teaching and communication skills for graduate students (e.g., a course titled "Communicating Science"; see below). PRISM has even been effective in unanticipated ways that strengthen Emory's mission of fostering undergraduate education. In particular, several veteran Fellows collaborated with faculty to enhance undergraduate courses in anthropology, biology, chemistry, and psychology with problem-based learning techniques. Altogether, these resources and activities have created a sustainable project because they are so tightly integrated and constitute such an important part of Emory's Center for Science Education that it would be difficult for administrators to withdraw support.

The "Communicating Science" course at Emory provides an introduction to communicating science through "elevator speeches," essays, science journalism, web communications, and teachable units for science cafés, undergraduate courses, and teacher workshops. The course teaches methods and content necessary for writing and communicating about science to general audiences. Through assigned readings, guest speakers, class discussions, student projects, and assignments, students learn different styles of communicating science to a variety of audiences. Students learn to think creatively about how best to communicate their research to different target audiences. Toward this end, students create a portfolio that reflects their ability to teach to different groups of people.

PRISM has also achieved sustainability by seeking outside funding. For example, the Arthur M. Blank Family Foundation has provided funds for several years to support graduate students, undergraduates, and teachers in problem-based learning. Similarly, PRISM has offered Fellowships to graduate students and Teachers from the Coan Middle School through a Learn and Serve Georgia grant and the donor-funded Graduation Generation project. Additional support has come through a partnership with an NSF CREST center at Clark Atlanta University.

Continuing growth in the PRISM team's expertise in problem-based learning (PBL) curriculum has led to partnerships with other Emory projects as well. For example, PRISM staff members and former Fellows train medical students and undergraduates in PBL facilitation to prepare them to lead the Emory Pipeline Project (an after-school experience for high school students). Moreover, the PRISM team continues to hold PBL pedagogy sessions during its numerous professional development workshops for teachers unaffiliated with its GK–12 project. Finally, the PRISM team has developed a new partnership with Morehouse College and Clayton County schools, under which it will offer teacher workshops on PBL pedagogy and new case materials.

Since 2008, PRISM coordinator Jordan Rose has led teaching modules as part of the course numbered NS570R: "Neuroscience: Communication & Ethics." In four to eight sessions each year, Rose guided graduate students as they developed lessons for K–12 science courses, practiced implementing those lessons among their peers, and then implemented the lessons in real public school classrooms as part of Emory's Brain Awareness Month outreach activities in March.

A MULTIFACETED STRATEGY FOR SUSTAINABILITY

Polytechnic Institute of New York University (NYU–Poly)

http://gk12.poly.edu/amps-cbri/ and http://raise.poly.edu

The sustainability of project RAISE (Revitalizing Achievement by using Instrumentation in Science Education) has been driven by a constant outreach to the university, schools, community leaders, and public and private grant-making agencies. RAISE's outreach efforts have focused on communicating the successes of GK–12 Fellows and Teachers to the university and school leaders. Moreover, the project directors sought financial support from funding agencies for an array of synergistic activities. Sustainability efforts focused on three constituencies: Fellows, schools, and the university.

To raise funds from philanthropic foundations, the directors of the RAISE project teamed up with the university's Office of Corporate and Foundation Relations. Together, they highlighted the GK–12 project approach to embed scientists and engineers with content expertise so as to support school Teachers and enrich STEM education of underrepresented students, while addressing the K-20 STEM pipeline issue.

EXEMPLARS (CONTINUED)

The project team received grants from the Independence Community Foundation of New York, the J.P. Morgan Chase Foundation, and the Hebrew Technical Institute, allowing the team to support 14 Fellows who collaborated with Teachers to enrich classroom science and math through hands-on engineering activities.

Both NYU–Poly and its partner schools invested significant funds to acquire modern sensing and data acquisition equipment, which remains at the participating schools on a permanent basis. Therefore, even after the conclusion of the RAISE project, most RAISE Teachers were able to continue the sensor-based curriculum in their classes – strong evidence of sustainability. The project team conducted several teacher professional development workshops, which included nearly 60 non-RAISE teachers, to broaden and sustain sensor-based labs in the high schools. A grant from the New York State Education Department supported a “Summer Workshop in Instrumentation, Sensors, and Engineering.” Sensor-based projects, adopted from the RAISE effort, introduced 20 teachers from Lower Hudson, Long Island, and New York City school districts to hands-on engineering design in a two-week summer workshop (Iskander et. al. 2010).

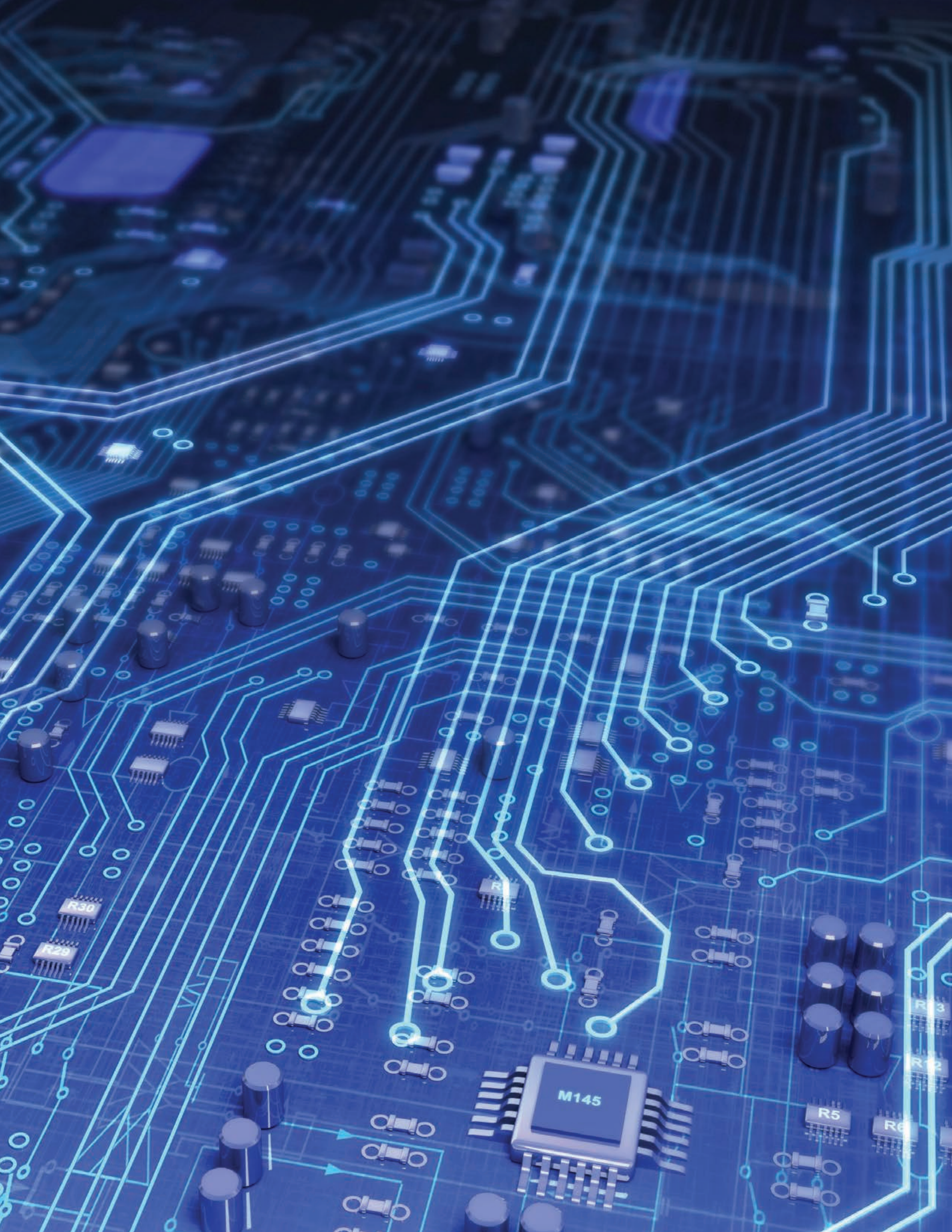
January 17, 2011
Robots Teach; More Brooklyn Kids Learn
Brooklyn Community Foundation Grant Expands Highly Successful NYU–Poly Robotics Outreach Project

Two Brooklyn institutions today announced an expanded partnership to help encourage Brooklyn’s young people to explore careers in the fields of science, technology, engineering, and mathematics (STEM). Brooklyn Community Foundation’s $500,000 grant to Polytechnic Institute of New York University (NYU-Poly) could triple the number of under-resourced Central Brooklyn elementary, middle and high schools that employ students’ fascination with robots to engage their interest in STEM subjects.

One of the project directors created a graduate-level course titled “Instrumentation, Monitoring, and Condition Assessment of Civil Infrastructure” (Iskander et al. 2009). Since 2006, this course has been offered annually at NYU–Poly with an enrollment of 25 to 30 students. Over 300 practicing engineers have taken a continuing education version of the course through the American Society of Civil Engineers.

Finally, in summer 2007, under the support of the Independence Community Foundation of New York and the J.P. Morgan Chase Foundation, the Central Brooklyn Robotics Initiative (CBRI) began as a pilot program for the AMPS (Applying Mechatronics to Promote Science) GK–12 project, and it has synergistically supported the AMPS project since its initiation in 2008. From 2008 to 2010, the AMPS–CBRI effort received a series of additional awards from the Independence Community Foundation of New York, J.P. Morgan Chase Foundation, Motorola Foundation, and New York Space Grant Consortium. Beginning in spring 2010, the CBRI was transformed into the Central Brooklyn STEM Initiative (CBSI), to scale up the AMPS–CBRI effort from 12 schools in 2009–2010 to 36 schools over three years. The AMPS–CBSI project has received a series of single- and multiyear awards from the Black Male Donor Collaborative, Brooklyn Community Foundation, Daniel and Joanna Rose Foundation, J.P. Morgan Chase Foundation, Motorola Foundation, New York Space Grant Consortium, White Cedar Fund, and Xerox Foundation. In 2011–2012, the AMPS–CBSI project is supporting seven doctoral and seven master’s Fellows who are working with nine faculty, 23 Teachers at 23 schools, and over 1,650 students. This public–private partnership has allowed the AMPS project to support an additional 19 graduate Fellows from non-NSF funds.

Numerous standards-aligned STEM lessons, which utilize LEGO-based automated lab apparatuses and robotics devices, have been developed and class-tested by Fellow–Teacher teams and are available at http://gk12.poly.edu/amps-cbri/html/resources/classroom.html. To facilitate the sustainability of its robotics-focused K–12 STEM lessons and to expedite the migration of out-of-school LEGO robotics projects into STEM classrooms, the AMPS project team continues to conduct “Teaching STEM with Robotics” workshops.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