

# PREPARE, PRACTICE, PARTNER

Innovative Strategies from the NSF Robert Noyce  
Teacher Scholarship Program Conferences



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COVER: (L) PHOTO FROM PAGE 13; (R) PHOTO FROM PAGE 17.

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# Prepare, Practice, Partner

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## Innovative Strategies from the Robert Noyce Teacher Scholarship Program Conferences

For more information about the NSF Robert Noyce Teacher Scholarship Program see <http://nsfnoyce.org/>

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**National Science Foundation  
Robert Noyce Teacher Scholarship Program**

*The data in this report come from information available from 2011 completion data.*

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Dear Colleagues:

This report is a celebration of community, a community that has evolved over ten years since the Robert Noyce Teacher Scholarship Program was initiated by an act of Congress in 2002 in response to the critical need for high-quality K-12 science and mathematics teachers, particularly in high-need schools.

Over the past decade, with reauthorization by Congress, first under the America COMPETES Act in 2007 and then under the America COMPETES Reauthorization Act in 2010, the program has expanded beyond the original scholarships and stipends for preservice student to include summer internships for prospective preservice students; the NSF Teaching Fellowship and Master Teaching Fellowship tracks to support STEM career-changers and to develop master science and mathematics teachers; and a Capacity Building track to support the development of exemplary preservice teacher preparation and inservice professional development programs. It also includes a robust research agenda that will allow us to increase the knowledge base of effective teacher preparation practices, particularly with regard to the design of effective programs, coursework, and activities to meet the needs of all science and mathematics teachers. The current portfolio of 350 projects involves nearly 470 institutions of higher education and over 700 districts in 45 states, Washington, D.C., Puerto Rico, and the Virgin Islands. These projects are projected to produce 10,000 teachers and 430 Master Teachers.

While the program's outcomes have been laudable, the true richness of the Noyce program is revealed only when the community is gathered together, as at these PI meetings. The projects described in this report epitomize the creative practices and strategies for recruitment and mentoring, as well as the novel learning resources, alternative certification programs, and partnerships that were shared at the Noyce conferences in 2009, 2010, and 2011 and that characterized the Noyce portfolio of projects.

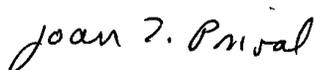
The Noyce conferences are opportunities for NSF staff, Noyce PIs, Noyce Scholars, Teaching Fellows, and others to learn from one another—both what works and what doesn't work. They are an opportunity for the community to exchange ideas about the challenges and opportunities inherent in the preparation of new generations of teachers in the face of the changing landscape of formal education, teaching technology practices not yet envisioned, new science, and fading boundaries between in-school and out-of-school learning.

We are hopeful that the successful projects detailed in this report will inform the entire education community: school administrators and teachers, education and STEM faculty in higher education, policymakers, and the public. The projects described here and the work that will grow from them will allow us to prepare not just more teachers, but teachers who have both the STEM and pedagogical content knowledge to meet the challenges of the classrooms of the future.

We are deeply grateful to the American Association for the Advancement of Science for their leadership in organizing the Noyce conferences and developing this report.



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MAY 2012

LETTER FROM THE AAAS LEADERSHIP

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Dear Colleagues:

The American Association for the Advancement of Science (AAAS) is pleased to work in partnership with the National Science Foundation (NSF) to support the Robert Noyce Teacher Scholarship Program. We share NSF's commitment to building a cadre of 21<sup>st</sup> century science, technology, engineering, and mathematics (STEM) teachers. In addition, we have been honored to work on the yearly conference that brings together the community of Noyce Scholars, Fellows, faculty, and program directors.

We are also pleased to have collaborated with NSF in producing this document, *Prepare, Practice, Partner: Innovative Strategies from the NSF Robert Noyce Teacher Scholarship Program Conferences*. In this report, we share some of the innovations and exemplary efforts that have emerged across the program to address some of the major challenges involved in bringing talented STEM students to the teaching profession.

This document explores recruitment strategies, mentoring opportunities, resources developed to support program participants, alternative certification programs, and the benefits of partnerships among institutions in cultivating Noyce Scholars and Fellows.

The findings from these projects extend beyond Noyce, informing efforts throughout the country to realize the President's goal of greatly expanding the number of highly qualified teachers of STEM, whether through regular or alternative pathways. Achieving this goal will require many participants and strong partnerships across universities, K-12 systems, and government agencies, as well as the larger STEM community.

We are proud to join in this effort and hope that this report will be a resource that can inform and spur action nationwide. We commend the NSF for its leadership role in the development of 21<sup>st</sup> century STEM teachers.



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# Introduction

*“ . . . to every young person listening tonight who’s contemplating their career choice: If you want to make a difference in the life of our nation; if you want to make a difference in the life of a child—become a teacher. Your country needs you.”*

— President Barack Obama  
2011 State of the Union address

In 2010, the President’s Council of Advisors on Science and Technology (PCAST) issued the report, *Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America’s Future*.<sup>1</sup> The report lays down a cohesive plan to ensure that the United States will become the leader in STEM education over the upcoming decades. A key recommendation zeroes in on the essential role played by exemplary teachers: “The most important factor in ensuring excellence is great STEM teachers, with both deep content knowledge in STEM subjects and mastery of the pedagogical skills required to teach these subjects well.”

The Robert Noyce Teacher Scholarship Program has been working toward educating STEM teachers of the highest caliber for almost a decade. Begun by an Act of Congress in 2002, the program was reauthorized under the America COMPETES Act in 2007 and the America COMPETES Reauthorization Act of 2010. The

program funds institutions of higher education, which in turn distribute scholarships, stipends, and support to talented STEM majors and post-baccalaureate students holding STEM degrees who commit to teaching in high-need K-12 school districts.<sup>2</sup> A goal of the Noyce program is to recruit individuals with strong STEM backgrounds who might otherwise not have considered a career in K-12 teaching.

## The Robert Noyce Teacher Scholarship Program Tracks

The Noyce program encompasses three tracks: Robert Noyce Teacher Scholarships; National Science Foundation (NSF) Teaching Fellowships/Master Teaching Fellowships; and Capacity-Building Projects.

The *Robert Noyce Teacher Scholarship* track gives scholarships to juniors and seniors majoring in one of the STEM disciplines, and to post-baccalaureate students, including STEM professionals seeking to become K-12 teachers. In addition, the program provides support for summer internships for freshmen and sophomores. The purpose of these internships is to provide early field experiences in formal and informal STEM education settings as a means of sparking interest in teaching.

Since students attending a fifth-year post-baccalaureate program for teacher certification also are eligible for scholarships, undergraduate students may receive up to three years of scholarship support

<sup>1</sup>The President’s Council of Advisors on Science and Technology. *Prepare and Inspire: K-12 Science, Technology, Engineering, and Mathematics (STEM) for America’s Future*. September 2010.

<sup>2</sup>A high-need school district is defined as one that serves a large percentage of individuals from families with incomes below the poverty line; has a significant number of secondary school teachers not teaching in the content area in which they were trained; and/or has a high teacher turnover rate.

beginning in the junior year and including a fifth year. For every year of funding, students must agree to teach in a high-need school district for two years. Noyce Scholars must honor their commitment within eight years of completion of the teacher certification program. Stipends for STEM professionals seeking to become K-12 teachers also are available.

There are two categories of proposals within the scholarship track: Phase I supports new programs, and Phase II supports the continuation and further development and evaluation of activities funded under a previous Phase I award. Successful proposals show evidence of partnerships both among faculty in STEM and education departments and among the institution (or institutions) of higher education and a local school district (or districts), and an exemplary teacher preparation program, as well as an infrastructure supportive of new teachers.

The *NSF Teaching Fellowships/Master Teaching Fellowships* track, which was introduced in 2009, supports fellowships and programs for STEM professionals (recent graduates as well as older career changers) interested in redirecting their career path. Referred to as NSF Teaching Fellows, they enroll in a master's degree program leading to certification to teach a STEM discipline. Teaching Fellows must serve as STEM teachers in a high-need school district for four years, and the obligation must be completed within six years of completing the program. Fellowships also are available for STEM teachers already holding a master's degree who would like to become Master Teachers and commit to teaching for five years in a high-need school district. Teaching Fellows and Master Teaching Fellows receive an annual \$10,000 salary supplement while they are fulfilling their teaching obligation.

The fellowships track requires partnerships that include the following:

- a department within an institution of higher education that provides an advanced program of study in mathematics and science;

- a department or entity within an institution of higher education that provides a teacher preparation program; a two-year institution that offers a teacher preparation program; a dual enrollment program; or an articulation agreement with an institution that credentials teachers;

- at least one high-need school district and a public school within this district; and

- at least one nonprofit organization with the capacity and expertise to support the goals of the project.

The *Capacity-Building Project* track was added to the Noyce program in 2011. It provides an opportunity for institutions to establish the infrastructure and partnerships for implementing a future Noyce Teacher Scholarship project, an NSF Teaching Fellowship, or a Master Teaching Fellowship project. This can be accomplished by developing innovative models for recruiting and preparing teachers and master teachers. Potential projects include new teacher preparation programs for career changers that can be completed in one year; the development of new courses and field experiences; and the development of programs that involve master teachers in pre-service education. Partnerships between two- and four-year institutions are strongly encouraged, as are collaborations with school districts, informal science education institutions, and industry.

To date, has the Robert Noyce Teacher Scholarship Program made it easier to recruit well-qualified STEM educators? Results from the 2010 Noyce Program Evaluation (<http://www.cehd.umn.edu/EdPsych/NOYCE/default.html>), conducted by researchers from the University of Minnesota and completed in 2010, indicate that the answer is “yes.” Based on data gathered from 66 principal investigators (PIs) in 2007, 90% reported that Noyce funding had increased their ability to recruit students with degrees in science and mathematics committed to becoming teachers and working in high-need schools. About 80% said that the funding had improved their ability to recruit underrepresented students, a finding illustrated by

*“I love my job because I get to share science with students every day. Whether it is something simple, such as the parts of a cell, or something more complex, such as the steps of photosynthesis, I love the challenge of connecting the concepts we cover in class with the real world. Even though I’ve been in the classroom only four years, I know that I have made an impact on students of all ability levels and socioeconomic backgrounds. Some tell me directly. Some parents tell me for their students. Some stop by and tell me the next school year.”*

—Mika Hunter  
Riverside High School (Durham, NC)  
Panelist, 2010 Noyce Conference

the demographics of the Noyce Scholars. Together, African Americans, Hispanics, and Asians made up approximately one-third of the Noyce population, a significantly higher proportion than that of the minority teachers currently teaching science and mathematics in the nation’s schools, which is 9% to 14%, depending on subject and grade range.<sup>3</sup>

School district staff, too, have noted the positive impact of the Noyce program. They were able to find more well-qualified science and mathematics teachers, as well as more minority candidates. School district staff also thought that the Noyce program strengthened their relationships with institutions preparing future teachers.

## Building on a Strong Foundation

Over the years, Noyce has grown into a robust program, with students from different institutions and diverse backgrounds participating and becoming strong STEM teachers in schools where they are needed the most. Despite all the gains made, however, much work remains to be done. Noyce programs nationwide face similar challenges: recruiting appropriate candidates and encouraging them to pursue teaching; finding teachers in the schools to serve as mentors; and finding suitable placements for graduates. While many participants in the Noyce program have recognized the value of partnerships, they require working with different institutional cultures and values. To forge such relationships, strong leadership and consensus-building skills are needed. As a way to address these and other concerns, Noyce PIs and their partners have developed, refined, and shared innovative strategies now used at many institutions nationwide.

This report describes some of the teacher education innovations that have been successful at institutions across the country. For those who are not familiar with the Noyce program, this publication is a way to learn about strategies they may not have considered. Program grantees can compare notes and find colleagues who are pursuing similar approaches on their respective campuses. Policymakers and educators in other fields can peruse the report for a quick look at cutting-edge teacher education practices.

The strategies highlighted in this publication focus on various aspects of the Noyce program:

- **Recruitment:** Identifying and selecting appropriate candidates for Noyce Scholarships and keeping them engaged and interested in teaching.
- **Mentoring:** Identifying and selecting appropriate professionals—for example, classroom teachers in partner school districts—to support Noyce

<sup>3</sup>Weiss I., Banilower, E., McMahon, K., and Smith, P. (2001). 2000 National Survey of Science and Mathematics Education. Horizon Research, Inc. <http://2000survey.horizon-research.com/>.

Scholars as they work to become teachers or teacher leaders and helping to ensure that the relationship is successful.

- **Learning Resources:** Teaching Noyce Scholars and Fellows about exemplary curriculum materials and providing instruction on how to use them in the classroom, as well as offering innovative curricula as part of the Scholars' and Fellows' education.
- **Alternative Certification:** Different models of fast-track certification programs that ease the way for “career changers,” STEM professionals who want to segue more quickly into teaching.
- **Partnerships:** The value of partnerships as a way to increase the scope and depth of a project, resulting in more scholars and more school districts benefiting from their expertise.

By striving to select qualified students and improving the way they are prepared for the classroom, Noyce is an important partner in answering the call to action articulated in the PCAST report: “We must *prepare* all students, including girls and minorities who are underrepresented in these fields, to be proficient in STEM subjects. And we must *inspire* all students to learn STEM and, in the process, motivate many of them to pursue STEM careers.”

### **Innovative Strategies from the Noyce Conferences**

The Noyce conferences held in 2009, 2010, and 2011 in Washington, DC, showcased more than 250 projects, many of which illustrated how strategies for recruitment, mentoring, learning resources, alternative certification, and building partnerships can be implemented in different settings. PIs, along with current and former Noyce Scholars, also had an opportunity to share their work, exchange ideas, and learn from one another.

The following section describes 19 projects that were among those presented at the three conferences. Although each project has been placed in one of the five categories listed earlier, or summarized in a sidebar, many cut across categories. For example, a project with an innovative recruitment strategy also may have an interesting mentoring component. The main classification of each project was based on interviews with the PIs. In addition, the data given for each project are from the summer of 2011. Finally, interspersed among the project descriptions are “Voices from the Field,” quotations from current and former Noyce Scholars and Fellows.

For more information about the Noyce program and all NSF Noyce awards, as well as information about the national conferences that have been held, please visit <http://nsfnoyce.org/meetings/>

# Recruitment

There are three elements to successful recruitment. Noyce PIs need to make the campus community aware of the program. Then they must identify and recruit potential candidates. Once students are identified, it is equally important to keep them engaged and excited about teaching. The following programs have developed effective strategies in one or all of these recruitment areas.

## FLORIDA INTERNATIONAL UNIVERSITY:

### Get Educators in Math and Science

Miami, Florida

- **Type of Noyce participant:** Undergraduate math and physics scholars; Phase 1
- **Period of the grant:** 2009-2012
- **Number of scholarships awarded**  
Undergraduate scholars: 11
- **Number of participants hired by a school district as a regular teacher**  
Undergraduate scholars: 2
- **Number of scholars still pursuing their teaching credential**  
Undergraduate scholars: 9

At Florida International University (FIU), Noyce PI and Professor of Mathematics Julian Edward has found that the best way to recruit students is to put promising candidates into the classroom—as undergraduate Learning Assistants (LA). Similar to teaching assistants at the graduate level, LAs help improve undergraduate education and offer students a taste

of what teaching is like. “It’s a good way for students to test-drive teaching,” Edward points out. “Not only do LAs have opportunities to teach in the classroom, they also engage in active learning and find out about education reform. The Learning Assistant program is our biggest recruiting tool for Noyce.”

Developed at the University of Colorado-Boulder, the LA program has gained traction at institutions nationwide. At FIU, the program began in the physics department and has since spread to math, chemistry, and biology. As the LA program grows across disciplines, it is rapidly becoming a pathway to teaching. What’s more, FIU has a formal agreement with Dade County’s associate superintendent that guarantees placement of Noyce Scholars in the district.

The LA program is altering perceptions about education throughout the university. “We’re bringing top students into the program,” notes Edward. “We’re changing the education system while showing students how teaching can change lives.”



*PI Julian Edward watches as a group of Noyce Scholars work with science equipment.*

## UNIVERSITY OF COLORADO BOULDER:

### The University of Colorado Noyce Teacher Scholarship Program

Boulder, Colorado

- **Type of Noyce participant:** Undergraduate and post-baccalaureate scholars in the biological sciences, engineering, geosciences, mathematics, chemistry, and physics; Phase II
- **Period of the grant:** 2009-2012
- **Number of scholarships awarded:** 24
- **Number of participants hired by a school district as a regular teacher**  
Undergraduate and post-baccalaureate scholars: 3
- **Number of scholars still pursuing their teaching credential**  
Undergraduate and post-baccalaureate scholars: 20

*Note: In this report, post-baccalaureates refer to undergraduates immediately taking a fifth year to earn their teacher certification, as well as STEM career changers.*

The Learning Assistant model was the brainchild of University of Colorado (CU)-Boulder astrophysicist and Distinguished Professor Richard McCray. He developed the program in 2003 to recruit and train talented K-12 science teachers, encourage faculty to recruit future science teachers, and improve science education for all undergraduates. Since then, the LA program has been instrumental in transforming more than 65 courses in 10 different STEM departments at CU-Boulder and has become a national model emulated by more than 30 universities across the country.

Faculty and departments use undergraduate Learning Assistants (LAs) in slightly different ways, but they do have some important elements in common. All departments have LAs engage groups of students in articulating, defending, and developing their ideas related to key

concepts and skills within a particular course. LAs are prepared for their roles by meeting with their lead STEM faculty each week and enrolling in a math and science pedagogy course taught in the School of Education.

Typically, about 120 students serve as learning assistants each semester, and they are each paid a \$1,500 stipend. The program offers a big return on this investment—about 10,000 students benefit from working with LAs each year. What’s more, about 12%-13% of LAs decide to go into K-12 teaching, and many of these students form CU’s pool for Noyce Scholars.

During the Phase II program, CU has focused on expanding its Noyce Scholars program through its newly funded CU-Teach program and increasing the diversity of CU Noyce Scholars by partnering with local informal science organizations. CU-Teach has been instrumental in recruiting new students interested in pursuing careers in teaching.

“We find that CU-Teach is working synergistically with both the Learning Assistant and Noyce programs in this effort,” explains Valerie Otero, Associate Professor in Education at CU-Boulder and PI of the Noyce grant. “During the summer of 2010, 10 internships of \$2,500 each were awarded to freshmen and sophomores to participate in summer teaching experiences, paid by CU-Teach. In the summer of 2011, the Noyce Phase II grant paid for seven such internships. LAs who want to return for a second semester often decide to enroll in a CU-Teach course to further explore the possibility of teaching.”

Noyce Scholars also have opportunities to work on discipline-based education research projects. Two scholars are involved with El Pueblo Magico, an after-school program developed by CU faculty to introduce inquiry-based health projects to K-5 students. Other scholars are involved with a program called “Streamline to Mastery,” part of the Master Teacher/Teaching Fellow strand of Noyce. What’s particularly exciting about this effort is that in-service teachers are working with pre-service teachers by collaborating on classroom research projects. “Because Noyce Scholars are developing a working relationship with teachers through the classroom research, this experience seems to be more substantive than the typical practicum placement,” notes Otero.

**KENNESAW STATE UNIVERSITY:**  
**Recruiting and Training Teachers in**  
**Physics and Chemistry**

**Kennesaw, Georgia**

- **Type of Noyce participant:** Undergraduate chemistry and physics scholars and Teaching Fellows; Phase 1
- **Period of the grant:** 2008-2012 for undergraduate scholars; 2010-2016 for Teaching Fellows
- **Number of scholarships or fellowships awarded**  
**Undergraduate scholars:** 39  
**Teaching Fellows:** 7
- **Number of scholars hired by a school district as a regular teacher**  
**Undergraduate scholars:** 14
- **Number of scholars and fellows still pursuing their teaching credential**  
**Undergraduate scholars:** 25  
**Teaching Fellows:** 7

Recruitment often begins by casting a wide net, trying to reach as many students as possible. At Kennesaw State, PI Gregory Rushton, Assistant Professor of Chemistry, and his colleagues have tried a range of strategies, including billboards placed along the highway, email blasts, signs placed in the chemistry department, and face-to-face informational sessions. Using multiple venues and remaining highly visible throughout the school year are important ways to send out the message about the Noyce program.

Equally important, however, is targeting the message to an appropriate group of students. Over time, Kennesaw's Noyce program has identified three key groups of potential candidates: engineering undergraduate students, graduate students in the STEM disciplines, and STEM professionals

interested in making a career change. A different recruiting strategy is used for each group.

To find engineering students interested in teaching, Kennesaw developed a partnership with the Georgia Institute of Technology (Georgia Tech). "Between 15% and 20% of students recognize that the engineering is not right for them," says Rushton. "These students are ripe fruit to recruit from." To date, about 12 Georgia Tech students are enrolled or have completed their coursework to become physics teachers.

Similarly, graduate students from Georgia Tech also are potential candidates. Attending meetings of professional societies, such as the Society of Hispanic Engineers, has proven to be effective both in identifying STEM professionals seeking a change and also locating those who are underrepresented in the teaching profession.

After Noyce Scholars are selected, they become a key part of the teacher education learning community, which in turn serves as a training ground for students and as a support system for new teachers. Members of the learning community meet monthly or bimonthly, and the interactive learning sessions range from seminars with a science supervisor from a local school district to workshops where students collectively develop a STEM class lesson. Once a year, the group participates in an all-day retreat, with multiple speakers and workshops, giving the scholars an idea of what a professional conference is like. These face-to-face meetings have been an effective way to keep the group together even after they graduate and begin teaching.

"Many people think that teachers are born, not trained, but our experience has been that both factors are at play," says Rushton. "By recruiting students and then training and mentoring them, we are helping these young people discover their true calling."

**UNIVERSITY OF ARKANSAS, FAYETTEVILLE:**  
**Noyce Scholarship Program for Mathematics,  
Science and Engineering K-12 Teachers**

Fayetteville, Arkansas

- **Type of Noyce participant:** Undergraduate scholars in science, engineering, and mathematics enrolled in a five-year program resulting in a Master of Arts in Teaching (MAT) and teacher certification; Phase I
- **Period of the grant:** 2007-2012
- **Number of scholarships awarded**  
Undergraduate scholars: 50
- **Number of participants hired by a school district as a regular teacher**  
Undergraduate scholars: 19
- **Number of scholars still pursuing their teaching credential**  
Undergraduate scholars: 9

Gay Stewart has a reputation on her campus. As Associate Professor of Physics and PI of the Noyce grant, she works the students hard! In her introductory physics class, for example, there is no shortage of homework. During class, students talk about the parts of the homework that were challenging and work together to develop problem-solving skills. Stewart believes this approach enables students to master difficult concepts. “We wouldn’t have a shortage of STEM majors if we put more emphasis on introductory courses,” she asserts. “It’s a perfect opportunity not to lecture, but to show them what science is really like.”

From this group of engaged students, LAs emerge, who, like those at FIU, go on to become Noyce Scholars. This class is a core requirement for most STEM majors, and students from other disciplines also say that it is the place where they became interested in teaching.

Among the benefits of being a Noyce scholar at U. of Arkansas is the opportunity to interact with



*Marshall Scott, the state of Arkansas’s first African American physics graduate—and a Noyce Scholar—discusses a science experiment with students.*

*“Every morning that I walk into a classroom, I have the opportunity to teach young people how to be successful learners, thinkers, and members of the community. With every student I teach, I have the opportunity to broaden their view of the world and to instill in them a thirst for knowledge and understanding. This responsibility is both exciting and humbling.”*

—Michael Kaminski  
Fifth year Noyce Scholar  
University of Arkansas

Voices from the Field

teachers. During summer workshops, the scholars are invited to assist in demonstrations of hands-on learning activities. Once engaged, they are brought into conversations with teachers about the concrete challenges they face every day in the classroom, such as how to conduct guided inquiry lessons and work with students from different academic backgrounds. This strategy has turned out to be an excellent way for students to get a feel for what it's like to be a teacher.

As other institutions have discovered, recruiting minority students is difficult, but it is especially difficult when an institution is not particularly diverse. In this case, the hard work of Stewart and her colleagues has paid off. The Noyce program is now more diverse than the institution. The program has Hispanic participants and recently, its first Native American, a female engineer/career changer. The first African-American male physics teacher in the state of Arkansas, a Noyce Scholar, just graduated magna cum laude. "We're thrilled that he joined the ranks of teachers," says Stewart.



*A research associate at the University of Missouri Science Education Outreach Center works with an intern.*

For the Noyce team at the University of Missouri, recruiting begins even before students arrive on campus. Based on recommendations from high school science and math department chairs and guidance counselors, Noyce staff send out a mailing to potential candidates accepted at the university. As freshmen, students can learn more about the Noyce program through the University's Freshman Interest Groups, or FIGS.

Table displays placed in dining halls—a simple, inexpensive strategy—turned out to “give us a big bang for our buck,” says Marilyn Soucie, Noyce Project Coordinator. While eating their breakfast, students read over the Noyce literature. Many students who applied to the program first learned about it in this way. This particular Noyce grant is unique, too, in that it offers students the opportunity to earn a bachelor's degree in education and in their content area in only four years.

For the last two years, the program has been offering internships for interested freshmen, sophomores, or juniors at local informal science settings such as museums and camps, an approach that has proven to be popular with students. Some who worked at the St. Louis Science Center have been invited back to work “on the museum's dime,” notes Soucie. This strategy shows promise as a way to bring in students into the Noyce program.

### **UNIVERSITY OF MISSOURI, COLUMBIA: Tomorrow's Teachers with Dual Degrees in Mathematics and Mathematics Education Columbia, Missouri**

- **Type of Noyce participant:** Undergraduate scholars in biology, geosciences, chemistry, physics, and mathematics; Phase II
- **Period of the grant:** science: 2009-2014; math: 2010-2015
- **Number of scholarships awarded**  
**Undergraduate scholars: 24**
- **Number of participants hired by a school district as a regular teacher**  
**Undergraduate scholars: 8**
- **Number of scholars still pursuing their teaching credential**  
**Undergraduate scholars: 16**

## What Characteristics Do Outstanding Teachers Share?

Since 2004, Sheila Vaidya, Associate Professor, School of Education at Drexel University and PI of a Noyce grant, has been working with a talented group of Noyce Scholars. Of the 20 teachers currently teaching in Philadelphia, several are outstanding. Vaidya wondered what qualities contributed to their success. In particular, she thought that the factors that made a difference in teachers' practice were (1) teachers' beliefs about the nature of learning; (2) their beliefs about learners; and (3) their beliefs in their own ability to make a difference.

To test out her idea, Vaidya set up a study based on a theoretical framework called academic optimism of teachers.<sup>4</sup> This framework emphasizes the mindset that teachers bring to the classroom. For example, are the teachers convinced that all students can learn? Are they confident in their ability to make a difference? Do they feel supported by their school and district?

To answer these questions, data were collected in five different ways:

- Scores on an academic optimism scale that measured teachers' confidence in their ability to teach and students' ability to learn, teachers' faith in the school to emphasize academics, and teachers trust in their students and parents;
- The school principal's report;
- Classroom observations;
- Teacher journals and interviews; and
- Interviews focusing on teachers' relationships to their mentors.

Based on preliminary findings, outstanding teachers are all "believers"; that is, they all believe that they are capable of making a difference and that the school is capable of "turning around" and becoming high achieving. What's more, their practice reflects their determination. For example, a third-year physics teacher in a high-need school didn't just teach his students about the physics of sound; he brought in his guitar and demonstrated how vibration was achieved (through striking, plucking, or bowing) and how the length and tension of the strings determine pitch. To reinforce learning, he then had small groups of students build an instrument and explain how the instrument's strings were designed.

Another teacher visited a student at home, noting in his journal that "meeting his grandmother (with whom he lived) and being in his house made you understand that you have got to help Michael come to school and learn."

"Clearly, these teachers believe that students can learn," notes Vaidya. "They are thoughtful, creative, and hard-working." As a way to guide new teachers, outstanding teachers such as these are now serving as mentors in an online community of learners.

Over the next few years, Vaidya plans to continue her research, looking for new ways to instill these positive qualities into teachers who are struggling. In the meantime, she is inspired by her outstanding teachers, who are "always motivated and always driven to do more."

<sup>4</sup>These findings come from an unpublished paper, "Breaking the Cycle of Underperformance: Developing Academic Optimism," by Sheila R. Vaidya and Cynthia Paul. The research was presented at the conference of the American Education Research Association (AERA), April 8-12, 2011.

# Mentoring

Pre-service teachers thrive when they receive more personalized attention, or mentoring, both in and out of the classroom. Sometimes mentoring extends into the early teaching years through teacher-induction activities, which include support and additional training in both content and pedagogy during the first three years of teaching. The following programs illustrate different ways that mentoring can be accomplished.

## **WEST VIRGINIA UNIVERSITY (WVU):**

### **Teaching Excellence at College for High Achievement in West Virginia**

**Morgantown, West Virginia**

- **Type of Noyce participant:** Undergraduates and post-baccalaureates in chemistry, math, biology, and physics; Phase I
- **Period of the grant:** 2009-2013
- **Number of scholarships awarded**  
Undergraduate scholars: 12  
Post-baccalaureates: 2
- **Number of participants hired by a school district as a regular teacher**  
Post-baccalaureates: 2
- **Number of scholars still pursuing their teaching credential**  
Undergraduate scholars: 12

From the first day of school, promising candidates for Noyce Scholarships are targeted and then selected to serve as Learning Assistants in introductory physics courses after completing the course themselves. The LAs immediately begin to strengthen their pedagogical skills by helping to develop instructional materials for the introductory classes, as well as active learning exercises and assessment tools. Those students who pursue the five-year teacher-preparation program, called the WVU Benedum Collaborative, are eligible for the three-year Noyce Scholarship.

One of the benefits for Benedum Collaborative students, including Noyce Scholars, is the opportunity to work closely with a faculty science mentor *and* a teacher mentor from one of the state's eight school districts. Clocking in 1,000 hours of clinical experience with their mentors, students gain valuable hands-on experience and guidance. As a culminating activity, all participants develop an action research project in partnership with their mentor teacher. The project is a valuable opportunity for Noyce Scholars to reflect on their teaching and begin to develop an identity as a teacher-scholar.

These efforts aim to build a cadre of qualified STEM teachers in grades 5-12 who are committed to teaching close to home. "We are selling teaching as a career," says PI Kasi Jackson, Assistant Professor in the Women Studies department, "and we are building an infrastructure that gives students ongoing support and encouragement."

## UNIVERSITY OF HOUSTON

### Robert Noyce Scholarship Program

Houston, Texas

- **Type of Noyce participant:** Undergraduate scholars; post-baccalaureate students; Phase I
- **Period of the grant:** science: 2008-2013
- **Number of scholarships awarded**  
Undergraduate scholars: 15  
Post-baccalaureates: 21
- **Number of participants hired by a school district as a regular teacher**  
Undergraduate scholars: 7  
Post-baccalaureates: 17
- **Number of scholars still pursuing their teaching credential**  
Undergraduate scholars: 8  
Post-baccalaureates: 4

Under the umbrella of *teachHouston*, the university's teacher education program for secondary mathematics and science, Noyce Scholars have the advantage of working with master teachers within the Department of Natural Sciences and Mathematics. "Our master teacher collaboration is a tremendous resource for our students," says PI Vera Hutchinson, Associate Professor & Chair of the Department of Curriculum and Instruction. "The master teachers and faculty from the Department of Curriculum and Instruction and the Department of Natural Sciences and Mathematics teach classes and organize meetings, demonstrations, and social events, focusing on issues such as lesson plan design and the psychological development of adolescents. Professional insights in these different areas give students a lens into teaching in diverse school environments."

The master teachers and faculty members are available to mentor students as they go into the classroom to complete their student teaching. The



*Noyce Scholars from the teachHouston program work together on a project.*

Noyce Scholars complete research at the end of their training. Topics include classroom management issues, inquiry-based instruction, and teaching literacy skills, such as how to read a word problem to English language learners.

The program also provides Noyce Scholarships to career changers pursuing a post-baccalaureate degree. Generally, these participants bring with them a strong knowledge base in STEM, which allows them to co-teach in the classroom from the outset. Both undergraduates and post-baccalaureates have proven to be committed to teaching. "They are passionate about what they're doing, and their skills have been recognized by our school districts," says Hutchinson.

## CALIFORNIA STATE UNIVERSITY SAN BERNARDINO (CSUSB)

### Robert Noyce Mathematics Teaching Fellows

San Bernardino, California

- **Type of Noyce participant:** Undergraduates, Teaching Fellows, and Master Teacher Fellows in mathematics and science
- **Period of the grant:** Noyce Scholarship: 2006-2012; Teaching Fellows and Master Teacher Fellows: 2009-2014
- **Number of scholarships awarded**  
**Undergraduate scholars:** 20  
**Teaching Fellows:** 5  
**Master Teacher Fellows:** 1  
*Note: The Master Teacher Fellow continues teaching while training to become a master teacher.*
- **Number of participants hired by a school district as a regular teacher**  
**Undergraduate scholars:** 8  
**Teaching Fellows:** 5
- **Number of scholars still pursuing their teaching credential**  
**Undergraduate scholars:** 12

Since 2006, CSUSB has been building its cadre of Noyce Scholars, with eight graduated mathematics and science scholars teaching and 12 currently working with a mentor teacher in the school district. Over the past couple of years, the program has added Noyce Fellows and Master Teacher Fellows to the mix, which has proven to be an exciting—and challenging—venture.

The project reflects a strong ongoing partnership between CSUSB PI Davida Fischman and Co-PI Joseph Jesunathadas, co-PI Carol Cronk, Math Coordinator in the office of the San Bernardino County Superinten-

dent of Schools, and Co-PI Sheree Jederberg from the San Bernardino City United School District.

“Noyce Fellows have a huge drive to improve instruction,” says Cronk. “They meet in the evening, they meet on Saturday. Their passion grows over time.”

For the program’s Noyce Scholars, Cronk and her colleagues work hard to match the mentors to the scholars. Care is taken to ensure that they are a good fit in terms of teaching style and personality. During the two-year teacher education program, the scholars sometimes spend both years with a single mentor. Others spend one year in middle school and one year in high school. Both years, they work with a handpicked mentor, who is a classroom teacher from the school.

The mentors also receive instruction. Once a month, they participate in professional development activities, reviewing such topics as instruction, discipline, and classroom management. “The teachers who are serving as mentors are really thirsty for help,” Cronk points out.

To ensure that all mentors are on the same page, a checklist of benchmarks has been developed. Throughout the school year, the mentors and scholars are observed to see how they’re working together. “We’re supporting the mentors to help scholars move through the benchmarks,” says Cronk. “We coach the mentors and offer strategies so that they, too, can improve their practice.”



CSUSB Noyce Scholars work on an activity at a seminar.

## A Closer Look at Induction Programs

For the past couple of years, Julie Luft, Athletic Association Professor of Mathematics and Science Education, University of Georgia\*, has been conducting a five-year study on induction, the period usually defined as the first three years of teaching. Working with teachers primarily in Arizona and Minnesota, Luft is studying three different kinds of induction programs. Each group has approximately 30 teachers.

The first group participated in a general induction program run by the school district. This program lasts for two years and is not specific to science, although teachers do have a science mentor assigned to them. The second group participated in an online mentoring group sponsored by the National Science Teacher Association's (NSTA) New Teacher Center and Montana State University, and it is focused on science teaching. The third group participated in a university-based induction program that links beginning science teachers with faculty members and graduate students in science education. The latter group meets approximately twice a month. Faculty or doctoral students observe the new teachers in their classrooms, and the new teachers meet with the university-based team. Faculty members and graduate students also are available to answer questions over email.

Midway through the study, Luft is seeing interesting results. "During the first year, there was a significant difference between the NSTA online program, the university-based science program, and the general school district program," she points out. "The science conversations among teachers in the NSTA online program and the

university-based science program tended to be deeper, with more discussions about inquiry and student learning than among teachers in the school district group. As a result, teachers from these two groups held more student-centered beliefs and used more inquiry activities."

In their second year, teachers across all three groups were given more duties and responsibilities. By the end of this year, the NSTA online group and the district group held beliefs that were less science-centered than the university-based science group. However, inquiry was still prevalent in both the NSTA online group and the university-based science group.

At this point, it is too early to say what the implications of this study are for future induction programs. Other research, however, points to the value of rigorous, science-specific programs. In fact, some studies suggest that teachers who participated in such programs are more likely to stay in the profession.<sup>5</sup>

ASU Noyce Scholars have benefited from the induction study. With funds from the Noyce Scholarship Program, there is now an induction component for graduating Noyce Scholars. "There is no doubt that beginning teachers need support," says Luft. "We know that they need help teaching science and evaluating student learning. With this generation of students, much of the support may go online."

\* Formerly at Arizona State University

<sup>5</sup>Smith, T. M. and R. M. Ingersoll. 2004. What Are the Effects of Induction and Mentoring on Beginning Teacher Turnover? *American Educational Research Journal*, Volume 41, Number 3, Fall 2004.

# Learning Resources

Pre-service teachers must master both the content of their field and the inquiry-based approach to teaching and learning. This section describes two different kinds of resources used by Noyce programs.

## WASHINGTON STATE UNIVERSITY:

### Underrepresented Engineers as Mathematics Teachers in their Home Communities

Pullman, Washington

- **Type of Noyce participant:** Undergraduate scholars in mathematics; Phase I
- **Period of the grant:** 2007-2011  
**Number of scholarships awarded**  
Undergraduate scholars: 16
- **Number of participants hired by a school district as a regular teacher**  
Undergraduate scholars: 11
- **Number of scholars still pursuing their teaching credential**  
Undergraduate scholars: 5

At Washington State University, Robert Olsen, Associate Dean of Undergraduate Programs and Student Services, and Tariq Akmal, Associate Professor of Teaching and Learning, looked for potential math teachers in an interesting place: the university's engineering departments. Just as PI Rushton from Kennesaw State University is looking for engineering students at Georgia Tech, so are Olsen and Akmal looking in their own engineering departments for students reconsidering their career focus. Those

recruited into the program major in mathematics education and minor in engineering.

Students begin the program at the end of their junior year or the beginning of their senior year and stay an extra year to earn a teaching certificate. This approach has taken hold. More students proved to be interested than could be admitted into the program.

The students use an engineering curriculum specifically designed for them. The curriculum focuses on different kinds of engineering, including civil and mechanical engineering and aeronautics, along with how math is applied to each field. The program also has a close partnership with the Pacific Northwest National Laboratories, so students have opportunities for research internships over the summer.

Graduates from this program become teachers who understand how to make math relevant to their students. "We go into classrooms where our students are now teaching, and we see entire bulletin boards about careers in engineering and lessons that show why math is important," says Olsen. "They are really able to teach the practical applications of math."

These new teachers also bring to the profession a sense that they want to contribute to their communities. Most go home to teach in schools that have Hispanic populations currently ranging between 25% and 76% of each school's population. "Half of our teachers are bilingual and can relate to these kids," Olsen points out. "They're helping to reverse the myth that math is a special language that only a few can master. In fact, math can be mastered by everyone."

## BAYLOR COLLEGE OF MEDICINE:

### Medical College Noyce Fellows

Houston, Texas

- **Type of Noyce participant:** Undergraduate scholars and Teaching Fellows in biology; Phase I
- **Period of the grant:** 2003- 2010  
**Number of scholarships awarded**  
**Undergraduate scholars:** 16
- **Teaching Fellows:** 23
- **Number of participants hired by a school district as a regular teacher**  
**Undergraduate scholars:** 15  
**Teaching Fellows:** 17

*Note: The project has ended, and no undergraduate scholars or Teaching Fellows are currently pursuing their teaching credential.*

Baylor's involvement in the Noyce Scholarship began with a partnership with Texas A&M, which had just received funding for a fast-track alternative certification program for scientists who wanted to become teachers. As more of the "scientists turned teachers" began entering the classroom, it became clear that content knowledge was not enough. They needed help understanding the pedagogy behind inquiry-based teaching.

During this time, biology online curriculum materials were starting to appear on the Internet. "We decided to develop our own online curriculum materials specifically for this group," says Nancy Moreno, Professor of Allied Health Sciences and Family and Community Medicine and PI of the Noyce grant, "and that's how BioEd Online started."

The materials, which were created in 2004, were used in workshops to help both fellows and new teachers learn how to teach. "We learned an important lesson," says Moreno. "Not everyone trained as

a scientist could be a teacher. Some struggled with pedagogy. Of course, many were really amazing, too."

The BioEd Online program (<http://www.bioedonline.org/>) proved to be an important tool in guiding these teachers' growth. Not only do lessons include information about the topic, they also provide links to other resources, as well as demonstrations about how to teach the lesson. Because the resources were so useful, they were made available to anyone interested in comprehensive biology education.

For new teachers beginning the difficult job of working in high-need schools, having accessible, easy-to-use biology curriculum resources was invaluable. "The financial support from Noyce helped us find teachers who were willing to stick it out," says Moreno. "And it helped us work with them to give them the teaching materials they needed."

*"While participating in Noyce conferences, I was struck by the large number of passionate veteran professionals in both secondary and post-secondary education that were so committed to supporting the development of excellent new teachers. They were genuinely interested in helping those of us on the front line."*

— Garnett Coy  
Menifee County High School (Frenchburg, KY)  
Panelist at 2010 Conference

# Alternative Certification

These fast-track programs all share the common goal of training career changers as quickly as possible. Because most career changers have a strong content background in STEM, alternative certification programs supported by the Noyce program tend to focus on pedagogy, often by getting the scholars into the classroom from the onset of the program. The following descriptions illustrate three different approaches to alternative certification.

## UNIVERSITY OF WISCONSIN OSHKOSH:

### ACT!: An Alternative Teacher Preparation Program for Talented Professionals

#### Oshkosh, Wisconsin

- **Type of Noyce participant:** Career Changers in biology, mathematics, geosciences, chemistry, and physics; Phase II
- **Period of the grant:** 2008-2012
- **Number of scholarships awarded**  
Career Changers: 29
- **Number of participants hired by a school district as a regular teacher**  
Career Changers: 24
- **Number of career changers still pursuing their teaching credential**  
Career Changers: 5

The focus of this program, called ACT!, is on career changers with a math or science degree and five or more years experience in a field related to math or science. Another characteristic of these individuals

*As a field biologist, I am struck by how my work can be done with the help of students to develop their skills and knowledge of what flora and fauna are present in their communities. I feel that if they are aware and understand the biological processes taking place around them and are a part of the research, they would be more apt to take an active role in their community's natural resources. I love working with these young people, helping to show them some of these wonders. The joy of sharing what I know with youth has led me toward teaching."*

— Scott Reilly  
Fifth year Teaching Fellow  
University of Wisconsin, Oshkosh, ACT!

Voices from the Field

is that they always had a strong desire to teach but didn't have the opportunity to "act" on this desire until now. Working in partnership with five neighboring two-year colleges, PI Michael Beeth, Professor in the College of Education and Human Services, University of Wisconsin, Oshkosh, and his partners are looking

for nontraditional students, especially women and minorities, who have been out of school for at least five years (average age is 39), and who need financial aid to realize their dream of becoming a teacher.

The program is projected to require about 18 months of part-time enrollment and has some unique perks that make it especially appealing to this group. For example, if candidates have experience learning about ecology in an informal setting, such as active engagement as a volunteer naturalist, and they show proficiency in the subject, they are given credit for their prior learning. This means that participants mostly have to take education courses, which are offered both online and on campus.

The program has overcome a number of administrative challenges, including negotiating joint admission to multiple institutions and providing career advice. Because participants are currently engaged in their communities and do not want to move, placing teachers within a 35-mile radius has not been easy. PIs are currently working with the career advising office to design networking opportunities.

“We’re selective about whom we accept because becoming a career educator is a big commitment,” says Beeth. “Making a career switch should be done for the right reasons.”

## UNIVERSITY OF MASSACHUSETTS BOSTON:

### Teach Next Year—Noyce Program

Boston, Massachusetts

- **Type of Noyce participant:** Noyce Scholars in biology, engineering, mathematics, chemistry, and physics; Completed Phase I and started Phase II.
- **Period of the grant:** Phase I: 2006-2010; Phase II: 2010-2015
- **Number of scholarships awarded**  
Noyce Scholars: Phase I: 44; Phase II: 7
- **Number of participants hired by a school district as a regular teacher**  
Noyce Scholars: Phase I: 34
- **Number of participants still pursuing their teaching credential**  
Noyce Scholars: Phase II: 7

Noyce Scholars begin the program in September by working full-time at the school site of their assigned mentor. They observe and work with small groups of students until the end of October, when they begin to



*President Obama visits TechBoston and the classroom of James Louis (standing at right), a Noyce alumnus.*

take over the teaching two periods a day. By January, they are teaching these two periods full time. This teaching residency program (TRP) is based on the medical model, where interns and residents learn how to be doctors firsthand, in the hospital.

Just as young doctors are supervised by attending physicians, so are these teachers-in-training monitored by mentors. As is often the case, however, what happens in real life is not quite what is expected. “From the Phase I grant, we learned that the relationship between teacher and mentor varies from school to school,” says PI Lisa Gonsalves, Associate Professor of Education. “Some mentors treat teachers like students, others treat them like colleagues, and still others form an apprentice-like relationship. These different approaches change the nature of the dynamic.” Sometimes, too, a school may assign one scholar to two mentors, each of whom has a different teaching philosophy. Clearly, it is preferable for each scholar to have one mentor, who assumes full responsibility for the rising teacher.

To address these issues, in the Phase II grant, Gonsalves plans to hold seminars for mentors and to pay them a small stipend for their services. A three-year induction program also has been added. As part of a large evaluation of the program, Gonsalves and her colleagues have interviewed more than 66 administrators, mentors, and interns, and they are learning much about the mentor-intern relationships and school dynamics.

But some things are simply out of their hands. “We can’t always control how the teachers and mentors are matched,” says Gonsalves, “nor can we tell the school not to use the interns to fill administrative gaps, such as supervising homeroom activities, especially when the need is there. It’s problematic when we are not on the same page as the school.”

While increasing the number of underrepresented scholars in the program is an ongoing challenge, the Phase II grant has gotten off to a good start. Many of the students in the first cohort are from un-

derrepresented groups. In fact, one Noyce alumnus, James Louis, had the experience of a lifetime. Louis met President Obama when he visited his classroom at TechBoston. The school was chosen for the visit because of its rigorous academic programs and its effective use of technology. Clearly, this Noyce program is part of exciting changes in urban education.

*“The year I spent earning my Master of Arts in Teaching prepared me for my own classroom in a way that nothing else could have done. Without the support provided by the Noyce program, both financially and personally, I might have started teaching, but I definitely would not have been as successful or have enjoyed my first years of teaching as much as I have.”*

— Penny McCool  
Lee High School and the STEM Academy  
(San Antonio, TX)  
Panelist, 2009 Noyce Conference

**GEORGIA STATE UNIVERSITY:**  
**Urban Mathematics Educator  
Program (UMEP)**

Atlanta, Georgia

- **Type of Noyce participant:** Noyce Scholars; career changers in mathematics.  
Completed Phase I
- **Period of the grant:** 2005-2011
- **Number of scholarships awarded**  
Noyce Scholars: 36
- **Number of participants hired by a school district as a regular teacher**  
Noyce Scholars: 33
- **Number of participants still pursuing their teaching credential**

*Note: The project has ended, and no undergraduate scholars or Teaching Fellows are currently pursuing their teaching credential.*

This intensive program, which includes career changers and those going for their fifth year master's degree, begins in summer and ends the following spring. The UMEP Noyce Scholars begin in

the summer with courses on what it means to teach, what's involved in research, the relevance of educational psychology to the classroom, and best practices in curriculum and instruction. By the fall, the participants are in the middle school every morning, spending their only semester with the younger students. In the winter, they move on to high school, where they complete their student teaching.

Along the way, all the participants complete an action research project, which enables them to develop a deeper understanding of how content and pedagogy work together in the classroom. Each member of the group develops a question and then collects data to answer it. Projects that students have pursued include collaborative learning, writing in mathematics, and motivational strategies in urban high school mathematics classrooms. At the end of the course, the participants present their research.

As a mature project, the group has come together to form a learning community, much of which takes place online. "The Noyce Scholars take a leadership role, heading up informal professional development sessions with newcomers," notes Christine Thomas, Professor of Middle/Secondary Education. "They bounce ideas off each other and share tips using online tools like wikis. It's been exciting to watch this evolve."



*Teaching Fellows from Georgia State collaborate on a project.*

# Partnerships

Partnerships are a way for institutions to join forces with nationally recognized organizations, other institutions, or community groups to work for change in STEM education. In the following examples, two large organizations are building multi-institutional partnerships that can scale up the rate of progress. But even small partnerships can make a tremendous difference.

## PHYSTEC PARTNERSHIPS WITH NOYCE

Type of Noyce participant: Undergraduates, post-baccalaureates, and Teaching Fellows in physics; Phase I

- Period of the grant: 2009-2012
- Number of scholarships awarded
  - Undergraduate scholars: 17
  - Post-baccalaureates: 3
  - Teaching Fellows: 2
- Number of participants hired by a school district as a regular teacher
  - Undergraduate scholars: 1
  - Post-baccalaureate: 1
- Number of scholars still pursuing their teaching credential
  - Undergraduate scholars: 16
  - Post-baccalaureates: 2
  - Teaching Fellows: 2



*PhysTec Noyce Teaching Fellow Jonathan Smythe is conducting a demonstration at the 2010 USA Science and Engineering Festival in Washington, DC. After graduating college with a degree in electrical engineering, he realized his true passion was teaching. With the help of a Noyce Scholarship, he received his teaching certification from Cornell and is now working in the public schools in Washington, DC.*

The Physics Teacher Education Coalition, known as PhysTEC, partners with physics departments at institutions nationwide to address the shortage of physics teachers. To provide additional support to PhysTEC, the American Physical Society (APS) and the American Association of Physics Teachers (AAPT) received a Noyce Scholarship grant. PhysTEC has then provided grants to six partner institutions—Ball State University, Cornell University, Western Michigan University, University of North Carolina at Chapel Hill, University of Arkansas, Fayetteville, and Seattle Pacific University.

“Noyce allows us to support Learning Assistants (LAs),” explains PI Monica Plisch of APS. “The LA program turns students on to physics teaching by providing an opportunity to become peer instructors in a well-supported environment. The LAs also take a pedagogy course, which focuses on how to ask open-ended questions, the importance of listening to student thinking, and how to do guided inquiry.”

Another innovative Noyce-funded feature is a Teacher-in-Residence (TIR) program. Physics teachers are brought on campus for five hours a week to help mentor the Noyce Scholars—and they can make a huge difference. At Cornell University, former TIR Jim Overhiser was in charge of the school’s LAs. In addition to helping students learn the ropes in the classroom, he also made time for them if they wanted to talk. “I tell the students I’m a safe place where they can go to talk about teaching,” says Overhiser. He also added a master LA program for returning students, who are given the opportunity to mentor new LAs and teach labs. The LA program has proven to be so successful that five out of the six Noyce sites now have one in place.

Finally, Noyce also provides PhysTEC with funding to offer discipline-specific induction to new teachers, a model developed by Julie Luft at Arizona State (see the sidebar on pg. 19). In these and other ways, Noyce enhances an already exemplary program.

## MATH FOR AMERICA SAN DIEGO NOYCE FELLOWSHIP PROGRAM

San Diego, California

- **Type of Noyce participant:** Teaching Fellows (first grant) in mathematics and Master Teaching Fellows (second grant) in mathematics; Phase I
- **Period of the grant:** First grant: 2009-2015; second grant: 2010-2015  
**Number of scholarships awarded**  
**Teaching Fellows:** 24 (first grant); 12 (second grant).  
**Master Teaching Fellows:** 6
- **Number of participants hired by a school district as a regular teacher**  
**Teaching Fellows:** 10  
**Master Teaching Fellows:** 6
- **Number of participants still pursuing their teaching credential**  
**Teaching Fellows:** 26

Math for America (MfA) is also a national organization with numerous sites nationwide, including its site in San Diego. For MfA San Diego, the University of California San Diego (UCSD) has taken the lead of this multi-institution partnership, which includes California State University (CSU) San Marcos, San Diego State, and five school districts. The Noyce funds are giving MfA San Diego more visibility, such as front page coverage in local newspapers, as well as the opportunity to make its efforts sustainable by establishing best practices in multiple schools throughout the state. Through a Noyce-funded evaluation effort, MfA also is working to demonstrate its impact on teaching and learning.

Working with different institutions takes time and patience, according to Project Director Barbara Edwards. “Every institution has its own ideas about

scholarship and professional development,” says Edwards. “To resolve such differences, you have to know what your core values and ‘non-negotiables’ are, and you must be supported by your institution.”

On the plus side, all the partner institutions believe in equity and are working together to improve the education in high-need districts. Everyone, too, is committed to recruiting minority students, including those who speak Spanish.

MfA San Diego also is working hard with its Master Teaching Fellows, to help them refine their teaching practices. Several strategies are in place; these include videotaping the teachers at work and then critiquing their lessons and providing on-site mentors to give the teachers ongoing feedback.

“We’re asking the new teachers to teach differently from the way they were taught,” adds Edwards. “It’s essential that we provide the support they need as they engage in this transformative process.”



*Math for America Teaching Fellows go over math concepts at a workshop specifically designed for girls.*

## Tuskegee University’s Noyce Scholarship Program—A Breath of Fresh Air for Poor Communities

“Across 11 states in the South, the Black Belt is among the poorest areas in the country. We can’t keep teachers. As soon as they’ve fully qualified, they move on. That’s why partnerships are so critical here. We take our Noyce Scholars out into the community, where they spend time with teachers. Then they come back on campus and inspire other students to get out there and help. The scholars persevere. After two years, we now have 10 Noyce Scholars, and all are wonderful. Two graduated this year and have accepted positions in Black Belt counties. One new teacher will teach chemistry and anatomy and physiology in

high school, and the second will teach physical science and life sciences in middle school.

This is all good news for our Noyce Scholars Program. What’s more, four scholars are juniors and four will be graduating next year. One student had to take the entrance exam a couple of times, but she eventually passed it. I learned a lot from watching her struggle and then succeed. She is going to be a great teacher.”

—Walter Hill  
PI, Tuskegee University  
Tuskegee, AL

## Creating Research Opportunities for the Noyce Program

The Science Teacher and Researcher (STAR) Program, which is managed by the California Polytechnic State University (Cal Poly) Center for Excellence in Science and Mathematics Education (CESaME) in San Luis Obispo, offers 9- to 10-week paid summer research internships to scholars and post-baccalaureates from Noyce campuses in California, Washington, Colorado, Maryland, and Tennessee. Placements have been made primarily at Department of Energy and NASA research labs. The philosophy of the program is to expose pre-service teachers to research to increase their content knowledge, enhance their perspective on the nature of science, and foster their identity as “teacher-researchers.”

Based on surveys done before the experience and after, STAR appears to be accomplishing its goals. The scholars report that they now view themselves as both teachers and researchers; are more committed to teaching; and feel that the teaching profession has more prestige than they originally thought.

An integral part of the program involves intensive mentoring both in the lab under the leadership of research scientists and during weekly education workshops run by a master teacher and a university education teacher liaison. These mentors build relationships with the scholars over the summer that endure over time. The science mentors help the scholars understand how challenging research can be. “STAR Fellows realize that even scientists don’t have all the answers,” explains PI John Keller, Professor of Physics at Cal Poly. “They see firsthand the power of collaboration and how it defines the culture of the research lab. These are important lessons that can be transferred to the classroom.”

At the end of the summer, a research colloquium is held, where the STAR Fellows present their research. Projects have run the gamut from studying the environ-

mental conditions of the San Francisco Bay to looking for biomarkers for sickle cell disease to studying how to use algae in astronauts’ diets during spaceflights. The community of STAR Fellows that forms each summer continues into the academic year via online forums and gatherings at professional conferences.

Although the STAR program has much to be proud of, it is still a work in progress. “We’ve made stronger gains among science teachers than in math,” notes Keller. “We hope to do a better job of helping future mathematics teachers see the relevance of the research experience to their future math classes.” As more STAR Fellows enter the classroom this coming fall, the program also plans to evaluate impacts of the program on classroom practice. “We’re working toward using these research-based internships to elevate the teaching profession in the eyes of students,” Keller points out, “leading to more highly qualified and enthusiastic teachers in the future.”



*2010 STAR Fellow Jordan Anderson examines phytoplankton and zooplankton to determine the abundance, distribution, and diversity of bioluminescent species at various ocean depths. Photo credit: Owen Hackleman*

# Future Outlook

As the NSF Noyce Scholarship Program marks its tenth year, it can point to many successes. A wide range of institutions now have NSF Noyce Scholarship Programs for undergraduate STEM majors and stipends for STEM professionals seeking to become K-12 teachers. The NSF Teaching Fellowships and Master Teaching Fellowships track supports fellowships and programs for STEM professionals enrolling in a master's degree program leading to certification to teach a STEM discipline and fellowships for current mathematics and science teachers who participate in a program for developing STEM Master Teachers. Many institutions offer early field experiences for freshmen and sophomores to introduce them to teaching as a possible career choice.

Noyce participants benefit from the program in many ways. STEM professionals who always wanted to be teachers but couldn't pursue that goal right after college can now take advantage of fast-track certification programs. These programs offer support while these teachers-in-training are cultivating their teaching skills and help them get into the classroom as soon as possible. Master Teaching Fellows have the invaluable opportunity to work closely with mentors as they develop leadership skills. The mentors observe these teachers in their classrooms, make suggestions on how they can improve their practice, and help them realize their full potential.

Many Noyce participants can also take advantage of research internships, which provide firsthand experience on the nature of science. When these pre-service teachers graduate and become teachers themselves, they can share this knowledge with their students.

Almost every Noyce institution can boast high graduation rates of science and mathematics teachers who are ready to use innovative teaching strategies. Some programs, too, have high teacher retention rates: Georgia State, which has completed its grant, has 33 teachers out of 36 still teaching after one to five years, as is the case in Philadelphia, where 20 out of 23 teachers from Drexel's program continue to teach beyond their teaching requirement.

Members of the Noyce community are in touch, sharing ideas and innovations. As a result, models such as the LA and TIR programs are being implemented on multiple campuses. In addition, Noyce recipients are becoming increasingly sophisticated in their recruiting techniques.

With the addition of capacity-building grants, even more innovation looms on the horizon. Moving forward, the program continues to grow and evolve, working to discover creative ways to bring exemplary STEM teachers into classrooms throughout the country.



*CSUSB Noyce Scholars celebrate at their graduation.*

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*A Math for America Fellow teaches at a workshop.*



*STAR Fellow Elin Deeb makes adjustments to the Circumsolar Telescope during her internship at the National Renewable Energy Laboratory in Golden, Colorado.*

*Photo credit: Daryl Myers, National Renewable Energy Laboratory*



*Arizona State University Scholar Nathan Glover works with students on a science project.*



*A Math for America Fellow helps out at a workshop designed specifically for girls.*



For more information about the NSF Robert Noyce Teacher Scholarship Program, see <http://nsfnoyce.org/>

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