PhysTEC Noyce Scholarship Program Launched

The American Physical Society (APS) and the American Association of Physics Teachers (AAPT) recently won a $750K award from the National Science Foundation (NSF) to provide Noyce Teacher scholarships to around 30 future physics teachers over the next 5 years. These teachers, who will receive up to $15,000 of scholarship support per year for up to two years, will be selected from institutions participating in the PhysTEC project.

Funding for the scholarships comes from the NSF’s Robert Noyce Teacher Scholarship program, which is designed to support future science, technology, engineering, and math teachers. According to NSF Program Officer Joan Prival, the Noyce program began in 2002, and as of Fall 2007 had supported approximately 1500 teachers from 91 institutions. For every year of scholarship support teachers receive, they commit to teach for two years in a “high need” school district, which is defined as any district in which at least one school has a high proportion of low-income students or out-of-field teachers, or a high teacher turnover rate.

These criteria include a significant fraction of schools in the U.S., not just the most needy. According to Gay Stewart, a University of Arkansas physics professor and PhysTEC site leader who also administers an independent Noyce project, “the increase in teachers five or more teachers every year. Project data also show that most graduates of PhysTEC programs go into the classroom, where they have an opportunity to make a difference in the lives of many students each year. Of the PhysTEC graduates whose early career outcomes are known, 83% of these graduates are currently teaching or seeking teaching employment, and another 4% are teaching at the college level. Over three-quarters of teaching physics or physical science. Other commonly taught subjects include math and chemistry, which is not surprising given AIP data showing that 74% of physics teachers also teach other subjects. PhysTEC’s results suggest that it is possible for U.S. institutions to address the need for more qualified physics teachers. However, this would require significantly more qualified physics teachers.

Increase in Physics Teachers Educated at PhysTEC Institutions

PhyTEC Teachers Come to Edmonton

This summer, eight PhysTEC teachers attended the American Association of Physics Teachers (AAPT) Summer Meeting in Edmonton, Alberta. On a day of programming designed specifically for them, they attended a three-hour workshop of teaching activities on physics topics they had requested, and met with project leaders and Teachers-in-Residence for an afternoon of discussion about assessment and classroom experience. The teachers were also encouraged to attend AAPT workshops and sessions during the rest of their time in Edmonton.

Besides providing professional development and receiving feedback from teachers, PhysTEC project leaders hoped to engage the teachers in an effort to assess the impact of the project on students in PhysTEC teachers’ classes. Specifically, the project will be collecting student scores on a widely used physics concept assessment, and comparing their learning gains to those of students in other teachers’ classes. The project also sought to begin developing a PhysTEC teacher community similar to the Teacher-in-Residence community that has grown over the course of the project.

To further build community, the project is creating an electronic discussion forum for PhysTEC teachers.

Both the teachers and the TIRs gave positive evaluations of the event, with a number of teachers expressing that they would have liked more time for both the workshop and the PhysTEC discussions. Vera Lyman, a CU-Boulder graduate who now teaches middle school physical science in Denver, said, “I enjoyed connecting with other young teachers who are...
PhysTEC Noyce Scholarship

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“Try not to fix students’
problems of teacher turnover and out-of
field teaching are so widespread, espe-
cially in science, that my Noyce teachers
easily able to find qualified high need
schools to work in.” A recently
published study from AIP sug-
gests that, not
surprisingly, schools that are
socioeconomically less well off tend to be
more strongly affected by these
problems. And, as Stewart points out, this is exactly
the type of student population many teach-
ers want to serve—provided they can a-
ford to.

She says, “The Noyce scholarships
allow my students to spend their time learn-
ing to teach instead of working or worrying
about loans. We have an award-winning
Master of Arts in Teaching program, but it
is full time, and students don’t get support
or have time to work. We should not ask our
students to choose teaching over higher-
paying professions, and then tell them they
need to go into debt to become a teacher.”

Arkansas award-
ed 17 Noyce scholar-
ships—including 7 to
future physics
teachers—in
2007-2008, its
first year of
Noyce funding.

T h e
P h y s T E C
Noyce proj-
et will award
scholarships to teachers from Ball State
University, Cornell University, Seattle
Pacific University, the University of
Arkansas, the University of North Carolina,
and Western Michigan University. Along
with Arkansas, the PhysTEC sites Seattle
Pacific, University of Arizona, and
University of Colorado at Boulder already
run Noyce programs that provide scholar-
ships to some of their science teachers, and
the project is poised to take advantage of
the expertise these sites have gained.

In addition, PhysTEC institutions Cal Poly San Luis Obispo, Florida
International University, and the University of Minnesota have all received indepen-
dent Noyce awards during this round of
funding, which will also support teachers
in multiple science disciplines.

According to Prival, the PhysTEC
Noyce is the first Noyce award to focus on
a single science discipline, as well as the
first given to a professional society. Monica
Plusch, APS assistant director of education
and project leader, explains that “by pool-
ing applicants from multiple universities,
APS and AAPT are able to award these
scholarships all to future physics teachers,
which are the hardest teachers for schools
to hire in any math and science field. We
are especially excited that the PhysTEC
Noyce project will allow us to place teach-
ers in the underserved communities where
they are needed the most.”

Projects at PhysTEC Institutions

Many PhysTEC institutions have
been able to use the synergy be-
tween PhysTEC and other projects
to enhance the value of PhysTEC funding
and make major progress in teacher prepa-
rations. Even better, some sites have been
able to leverage PhysTEC to secure addi-
tional funding that allows them to continue
or expand upon project activities and suc-
cesses. Below is a list of teacher prepara-
tion-related projects at PhysTEC sites.

• Ball State University was cho-
   sen by the Woodrow Wilson National
   Fellowship Foundation to participate in
   a program sponsored by the Lilly
   Endowment to encourage undergradu-
   ates and career-changers to teach math
   and science at high-need schools in
   Indiana. Fellows in this program will
come to work on a master's degree in secondary
   education with licensure in mathematics,
   physics, or physical science. New teach-
   ers from this program will be mentored
   and supported by experienced teachers
   based on the successful model devel-
   oped by the Ball State PhysTEC
   project. For more information, see www.
   bsu.edu/teachers/wwfellows.

• Florida Internation University’s (FIU)
   Center for High-Energy Physics
   Research and Education Outreach
   (CHEPREO) program has created a
   strong learning community and a model
   for educational reform at the university.
   The PhysTEC project takes advantage of
   these existing resources to develop FIU’s
   teacher preparation program. For more
   information, see www.apo.org/units/fed/
   newsletters/summer2008/chepréo.cfm.

• Seattle Pacific University’s (SPU)
   Department of Physics and the School
   of Education are developing a collabora-
   tive model of teacher preparation with
   support of the Boeing Company. The
   Department of Physics also has a five-
   year, 1.5 million-dollar NSF Teacher
   Professional Continnum (TPC) grant
   to develop diagnostic tools for teach-
   ers. These efforts provided a strong
   foundation for SPU’s PhysTEC efforts.
   For more information, see www.apo.
   org/units/fed/newsletters/summer2007/
   close.html.

• A University of Arkansas state
   Math-Science Partnership provides
   professional development opportuni-
   ties for high school science teachers
   to gain physics content knowledge, de-
   velop their teaching strategies, and inte-
   grate instructional technology into their
   teaching. This program brings together
   recent PhysTEC graduates and more
   experienced teachers who often have
   less content preparation, which allows
   for “a significant exchange of expertise”
   according to Gay Stewart, the project
   leader. For more information, see http://
   shareus.uark.edu/umsp/. In addition, a
   recent award from the National Science
   Foundation will provide funding for,
   among other things, expanding many
   of the successes from PhysTEC to the
   mathematical sciences departments.

• The University of Colorado at
   Boulder’s PhysTEC project supported
   the growth of the Learning Assistant
   Program in the physics department, and,
   coupled with a related research project
   called LA-TEST, allowed Colorado
   faculty to evaluate the effectiveness of
   the Learning Assistant Model for re-
   cruiting, preparing, and retaining math
   and science teachers. Colorado recently
   won a major award from the National
   Math and Science Initiative to create the
   CUTeach program, which is based on
   the University of Texas at Austin’s
   UTeach program and which will draw
   students from the Learning Assistant
   program into a complete teacher prepa-
   ration program. For more information,
   see http://stem.colorado.edu/.
Teacher Prep Quotes

“The best thing we can do to help our children succeed in math and science is to invest in the success of their teachers... We cannot expect our teachers to teach what they themselves do not know.”
— U.S. Rep. George Miller (CA-7th), chairman of the House Committee on Education and Labor

“...that's all well and good, but who is going to provide the 75 physics teachers I need next year?”
— Judy Jeffrey, Director, Iowa Department of Education

“Think about this: in the past four years, our 15 schools of education at the University of North Carolina turned out a grand total of three physics teachers. Three.”
— Erskine Bowles, President, University of North Carolina

“STEM [Science, Technology, Engineering and Mathematics] education is no longer only for those pursuing STEM careers; it should enable all citizens to solve problems, collaborate, weigh evidence, and communicate ideas.”
— U.S. Sen. Barack Obama (IL)

“We have lit a thousand pilots, but we have never lit the central heating system.”
— Tom Luce, National Math and Science Initiative

“PhysTEC is the largest effort in the country focusing on physics teacher education. APS is very pleased to see evidence that these efforts are having a significant impact on this serious problem, which affects not only the physics community but also our nation’s economic future.”
— APS President Arthur Bonnemont

Increase in Teachers Graduating

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Early Careers for PhysTEC graduates*

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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<tr>
<td>Teaching 6-12</td>
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<tr>
<td>Physics/Physical Science</td>
<td>17%</td>
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<tr>
<td>Other</td>
<td>13%</td>
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<td>Teaching College</td>
<td>4%</td>
</tr>
<tr>
<td>Not teaching</td>
<td>6%</td>
</tr>
</tbody>
</table>

*based on known outcomes for 90% of PhysTEC graduates

“If there were support for 10 times as many institutions to replicate PhysTEC's efforts, major progress could be made toward putting highly qualified teachers in every one of our country's physics classrooms.”
— Ted Hodapp, APS Director of Education and Diversity

more funding than is currently available, according to Ted Hodapp, director of education and diversity for APS, who says, “If there were support for 10 times as many institutions to replicate PhysTEC's efforts, major progress could be made toward putting highly qualified teachers in every one of our country's physics classrooms. With today's highly competitive technical workplace, the need for physics teachers has never been greater.”

Teacher-in-Residence Profile: Nancy Bresnahan

Physics teacher and 2007-2008 University of Minnesota Teacher-in-Residence Nancy Bresnahan admits, “learning physics was a challenge for me. I had never considered myself an analytical person when I was young. I was in my middle 20’s when I began to study physics. I wasn’t exactly old but saw myself through a previously formed lens. It took a shift in how I viewed myself to become successful.”

Perhaps Bresnahan’s unconventional path as a physics learner foreshadowed her extraordinary 25-year (and counting) teaching career. On top of being a top-notch classroom teacher—Bresnahan won the 2003 Minnesota Academic Excellence-Teacher Achievement Award—she has taught physics and chemistry to gifted and talented urban youth at the Science Museum of Minnesota, Native Americans through a program called Vision Quest, at-risk youth at an alternative program run by her school district, and in-service elementary teachers at Bemidji State University and Hamline University, both in Minnesota. In 1993 she joined the University of Minnesota’s Physics Force team, exciting audiences of elementary, middle, and high school students with large-scale physics demonstrations like the Monkey and Hunter, Bed of Nails, and Barrel Crash. It was through this experience in the high school setting, Minnesota aims to recruit physics teachers principally through its Learning Assistant program, which gives students who have previously taken a course an opportunity to help current students master the materials. At Minnesota, the Learning Assistants facilitate discussions among small groups of students in a lecture hall, “creating a class within a class,” as Bresnahan puts it. “This is totally different from how this class was taught in the past, and it would not have been possible without the Teacher-in-Residence. Instructors who have been teaching the same way their whole lives need support to make changes like this.”

Bresnahan is also working to involve Learning Assistants in the Physics Force and another program she developed called Parents and Children Experiencing Science, or PACES, which puts on short, fun evening courses in science for families. Bresnahan says the goal of PACES is to “light the spark of excitement about science in parents who are disinvested in, and often terrified of, school. For the Learning Assistants, it gives them a chance to develop the stage sense that is so important for a teacher.”

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Cattell says, “What impresses me the most about Nancy is her creativity in seeking solutions and trying different ways to integrate Learning Assistants into our existing physics course structure.” As much as the Minnesota teacher preparation program may have benefited from Bresnahan, she says she benefited just as much from her year as a Teacher-in-Residence. “At first I was intimidated by my physicist colleagues, but I soon realized that the faculty members truly valued my perspective as a teacher and wanted to know what I thought. After my year with PhysTEC, I can say this with more pride than I have in my entire life: I am a teacher.”

“After my year with PhysTEC, I can say this with more pride than I have in my entire life: I am a teacher.”
— Nancy Bresnahan

Minneapolis Teachers-in-Residence Nancy Bresnahan (2007-2008) and Jon Anderson (2008-2009) discuss the finer points of teacher preparation. Photo by Patrick O'Sarry, University of Minnesota
T he brand new UNC-BEST (University of North Carolina Baccalaureate Education in Science and Teaching) program was built on the existing alternative licensure (alternative entry) program that the School of Education (SOE) operates for professionals in other fields who wish to become licensed as teachers. In it, physics, biology, chemistry or geology majors can meet all (or almost all) of the requirements for licensure by the time they complete the BS or BA degree in their science field. Thus, for a footprint-intensive set of three Education courses, plus one course in the pedagogy of their science that is taught within their major department and counts toward the requirements for their major.

By very careful construction of the syllabus of the four required courses we were able to meet all of the standards for licensure (including required fieldwork) set by the North Carolina Department of Public Instruction (NC DPI) within this extremely compact program. Further, the courses in the program fulfill general education requirements (in social science and experiential education) and in the College of Arts and Sciences (CAS). The students need to use only one free elective to meet the licensure requirements—a critical factor in attracting students pursuing our rigorous BS curricula. The final requirement for licensure is 10 weeks of full-time student teaching.

The first step was to implement the program we designed, which required appropriate personnel. In order to develop and teach the new pedagogy courses within the science departments, we needed instructors who were well-versed in the relevant science, the theoretical and practical aspects of effective pedagogy, and the North Carolina Standard Course of Study that public school teachers must teach. Further, the state requires that the instructors for the pedagogy courses be licensed as teachers. No such faculty existed on our campus; so we needed to hire new people in order to launch the program. We decided to pilot the program in biology, the discipline with by far the largest pool of candidates. The initial goal was to hire twice as many as the three other disciplines combined—and add the other disciplines later. We pitched the program to our Provost, who is certain well aware of the severe shortage of qualified science teachers in the state and the small number produced by the UNC system schools each year. If she had not known about it before, the fact that the President of the 16-campus system mentioned it in his inaugural speech would have brought it to her attention. Recognizing the large benefit that could be obtained at modest cost, she provided funding for a Lecturer in the Biology Department to implement the program. We were able to hire a very talented person with BS and MS degrees in biology and BS and Ph.D degrees in science education (the PhD awarded by our own SOE) as well as an NC teaching license. Shortly thereafter, the Physics & Astronomy Department was selected as a PhysTEC site, and on the strength of that grant we were able to persuade the Provost to provide an additional Lecturer position to establish the program in physics. We hired another very talented person with a PhD in physics education research. She lacks a teaching license, but because the PhysTEC grant provides funding for a Teacher-in-Residence, we are able to fulfill the state requirement and bring real-world experience to bear by having the two of them co-teach the physics pedagogy course.

Our program is still in its infancy, but we have accomplished much in a short time. We now have approval for all aspects of the program from the CAS, the SOE and the NCDPI; we have taught the biology and physics pedagogy courses for the first time; and have admitted the first cohort of students into the program. We expect to graduate our first teachers in May 2009. We are currently working to implement the program in geology, and that department has made a request to the Dean of CAS for a faculty line to support the program. This last is particularly significant, because this request was made instead of a request for a tenure-track faculty line that would also contribute to the research activities of the department.

We have learned that it is important not to underestimate the public relations value of doing the right thing. The program has yet to graduate a teacher, and yet it has already brought praise for the physics (and biology) department from the Dean, the Provost, and the Chancellor. It has been cited as an excellent example of “public engagement” in a major report on that subject prepared by our campus in response to a directive from the President of the UNC system. There is much to be said for having something other than publications on the theory of big-bang cosmology to cite when asked for examples of the contributions being made by my department to the state of North Carolina. But the real benefits will be in the longer term, when more students who come to our campus have been taught physics by teachers who truly know and love their subject. I’m looking forward to that.

Laurie McNeil, University of North Carolina physics professor and PhysTEC leader

Nuts and Bolts of Teacher Preparation

By Laurie E. McNeil

PhysTEC Teachers Come to Edmonton

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“I am a brand new teacher, so it especially helped me to meet other new teachers who not only survived their first year, but also love their jobs.”

–Debby Ramsey, Seattle Pacific PhysTEC graduate, 2008

The project is committed to making the summer teacher gathering a yearly tradition, and will incorporate the first class of PhysTEC Noyce scholars in 2010 (see article, page 1).