



## INTRODUCTION

The Physics Teacher Education Coalition ([www.PhysTEC.org](http://www.PhysTEC.org)) is seeking to support additional institutions to help improve and promote physics and physical science teacher education. The project has support from the National Science Foundation and through individual and corporate gifts to the American Physical Society's (APS) Campaign for the 21<sup>st</sup> Century. The project is a joint effort between the APS and the American Association of Physics Teachers.

The PhysTEC project recently received a major grant from the National Science Foundation that will allow us extend this already successful initiative by supporting additional project sites over the next five to six years. We intend to seek new sites in each of the next three years (2009, 2010, and 2011) with additional sites added beyond that pending available funds. In this round we will be funding approximately three *comprehensive* sites and three *pilot* sites to begin activities in 2010. *Comprehensive* sites can request funding of up to \$100,000 per year for three years. *Pilot* sites can request funding of up to \$25,000 per year for three years. These types of sites are described below.

*Comprehensive* sites will be expected to implement programs that address all of the project's key elements including recruiting, early teaching experiences, implementing a pedagogically sound teacher education curriculum, induction and mentoring of new teachers, and tracking of all teachers throughout and for several years beyond the funded portion of the project. These sites must have a significant campus commitment to sustaining the project beyond funding and are expected to document project advances and setbacks in order to provide experience and information for others to adopt or adapt program elements developed as part of the project.

*Pilot* sites are being developed to demonstrate lower-cost elements of successful teacher education programs and to experiment with ways of building effective collaborations that further the education of physics teachers. Although not limited to these examples, pilot site activities might include: developing collaborations between two- and four-year colleges to recruit physics teachers from students attending two-year institutions; hiring part-time master teachers to improve teacher education programs; developing undergraduate learning assistant<sup>1</sup> programs with an emphasis on teacher recruitment and to help them understand the intellectual challenge behind establishing productive learning environments; building a viable program of physics teacher education in a predominantly undergraduate institution.

Successful sites can fund initiatives that align with current project activities and goals. Institutions are expected to make measurable progress in one or both of two areas: to use this funding to put in place systemic changes that will result in long-term improvements in teacher preparation; and to become a nationally visible model for significant change in improving teacher education in physics.

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<sup>1</sup> See for example, <http://www.phystec.org/components/learning-assistants/>

The Physics Teacher Education Coalition is a joint American Physical Society and American Association of Physics Teachers effort, with National Science Foundation and APS Campaign for the 21st Century funding.

The project has the following goals that address significant national needs in the preparation of K-12 physics and physical science teachers:

1. Demonstrate successful models for:
  - a) Increasing the number of highly-qualified high school physics teachers
  - b) Improving the quality of K-8 physical science teacher education
2. Spread best-practice ideas throughout the physics teacher preparation community
3. Transform physics departments to engage in preparing physics teachers

All new *comprehensive* sites will be expected to embrace goal 1a), and might also choose to include goal 1b) in their efforts under the PhysTEC project. The project is committed to increasing the number of high school teachers and to insuring high quality of every graduate. In addition, as this is a national demonstration project, each PhysTEC institution will be expected to publicly share information about successes and challenges faced by the site.

The project will work with your institution to help share and implement best-practice programs from a variety of programs throughout the country. One of the most important aspects of this program is the employment of practicing master teachers (called Teachers in Residence<sup>2</sup> or TIRs in this project) at each of the *comprehensive* sites. A significant portion of the funding is dedicated to this aspect. What follows is the application process and program elements that would be expected along with questions that should be addressed by your institution in seeking funding under this program.

#### APPLICATION PROCESS

- **Initial letter.** If your institution would like to be considered for PhysTEC funding, please send a letter stating interest, current graduation rate of high school physics teachers, institutional goals for educating physics and physical science teachers (including specific numbers of teachers), and a brief plan of how you would achieve those goals (no more than 3 pages for *comprehensive* sites or 2 pages for *pilot* sites). Send this letter via email to Theodore Hodapp, PhysTEC Project Director ([hodapp@aps.org](mailto:hodapp@aps.org)). Deadline for submission of these plans is 2 November 2009.
- **Full application.** After receiving initial letters of interest, a number of institutions will be invited to submit full applications. The full application will include a plan that explains how your institution will work toward the various goals outlined below, evidence of institutional support, institution-specific goals, measurable outcomes, timelines, and involvement of various personnel. Support must be obvious from the individual faculty member in charge, department chairs (both physics and education), and university administration. There must be a clear description of how university administration will monitor progress in an ongoing way and bring resources to the project. It is expected that the project will eventually demonstrate, to a national audience, the viability of change within your institution toward educating more highly-qualified secondary physics teachers and (if also included) increasing the quality of K-8 physical science teachers. Full proposals will be due 8 January 2010.

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<sup>2</sup> See for example, <http://www.phystec.org/components/master-teachers>

- **Announcement of funded sites.** All applications will go through an NSF-style review process. Project management will visit top candidate sites in Spring 2010 with the expectation of funding beginning in the summer of 2010. The project plans to announce new sites in Spring 2010.

The project will offer significant financial and intellectual support to achieve the stated goals. This will include sharing best-practice programs seen throughout the country; helping you to raise other local, state or federal funds; and making available expertise of dedicated individuals who are working toward similar goals throughout the country. The project will work with you to help you address the goals and questions outlined below. It should also be kept in mind that PhysTEC funding is limited, and we see PhysTEC funding as support for bootstrapping a nascent physics teacher education program rather than long-term funding of these efforts. Many of our previously funded programs found funding from other sources during and subsequent to the funded period. Starting from scratch with PhysTEC is probably not a recipe for a successful program. We expect you have already been thinking about this and have initiated discussions and activities to make this a successful and sustainable venture at your institution.

**COMPREHENSIVE SITES: PROGRAM ELEMENTS UNDER GOAL 1A)**

- **Project goals.** Your site must define goals and methods for increasing the number of high school physics teachers prepared each year.
  - How many teachers do you hope to graduate per year, and how will you go about achieving this goal?
  - How will changes implemented under the project become systemic changes, carried forward beyond the end of this project's support?
  - How will you work to adjust the culture of your department to value the preparation of teachers as one of its important roles?
  - What role will your institution's administration play in advocating for and funding of this effort both during PhysTEC funding and beyond?
  - How do recruiting efforts for the physics major overlap with and inform recruiting efforts for prospective physics teachers?
- **Program elements.** Your program should include the following components:
  - **Recruitment.** What specific recruiting techniques will you use?
  - **Early teaching experiences.** How will you provide prospective teachers with an introduction to a teaching career? This should typically occur in the first or second year of a student's college experience. How will this be structured so students begin to appreciate the complexities and challenges of effective instruction?
  - **Interactive engagement.** How will you provide, in the critical introductory physics course and in other courses required for certification, a setting that will allow prospective teachers to learn as they will eventually teach (i.e., using

interactive engagement)?<sup>3</sup> What courses will help prospective teachers learn how to teach in the context of physics instruction (as opposed to general or even other science instruction)?

- **Physics specific education curriculum.** How will prospective students learn principles and methods of instruction in a physics context?
- **Mentoring and induction.** How will you assist the teachers coming from your program in the first one to three years of their initial teaching assignments to overcome initial hurdles of classroom management, help with content breakdown, provide logistical support, etc.? Since mentoring begins during pre-service years, how will you build a cohort of secondary science and math teachers to form a peer-support network? How will you track new teachers and stay in contact with them?
- **Overarching concerns.** Less obvious, but as important is the overarching goal of how you promote teaching as a challenging and critically important career option, and nurture student's development into this profession.
  - How will your physics department work collaboratively with the education department and local school districts to further the goals of the project?
  - How will your department make use of master teachers to assist in the operation of the project and provide the recent experience in the classroom that is essential to helping prospective teachers understand the challenges and rewards endemic to the teaching profession?<sup>4</sup>
  - How will your program be attentive to potential teachers and help them through the often-difficult maze of coursework, certification, and support pathways?<sup>5</sup> Will advising occur in the physics department or elsewhere?
- **Assessment data.** We collect data from every site annually to help with local assessment of progress and to characterize the project's success as a whole. Any site wishing to vary

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<sup>3</sup> Courses need to use research-tested curricula and pedagogical methods such as Tutorials in Physics, SCALE-UP, Peer-instruction, Interactive Lecture Demonstrations, etc. If changes to courses or pedagogy are a part of your proposed efforts you will need to describe how these changes relate to education research-tested methods. Efforts that attempt to develop new materials will not be supported.

<sup>4</sup> Every PhysTEC *comprehensive* site supports a Teacher-in-Residency (TIR) or Master Teacher to help in this role. The project site may have other ways of providing this support as well, and these should be described.

<sup>5</sup> The National Task Force on Undergraduate Education, in its "SPIN-UP" report (<http://www.aapt.org/Projects/ntfup.cfm>) describes numerous ways in which departments were able to attract and retain larger numbers of majors in a national climate where the number of physics majors was decreasing. Permeating their recommendations was the significant idea of listening to and valuing students through relatively inexpensive measures such as providing a study space or designing program tracks that allowed flexibility in the major. The PhysTEC project has seen these same sorts of attitudes pervading departments that have been most successful at attracting and retaining students into the teaching profession.

from this course will need to provide a reason and comparable measure. The project will expect the following from each funded site<sup>6</sup>:

- Data and a clear description of methods used to count teachers for the past 3 years of your existing program. These numbers will be used, in part, to measure your success in this proposed project. This should include separate categories for the number who develop into teachers, and the number who are in the pipeline to become practicing high school physics teachers.
- Number of future teachers in related disciplines who are likely to become physics teachers (e.g., astronomy, mathematics or chemistry majors) if appropriate (this depends on state licensure requirements).
- Number of teachers mentored by your Teacher-in-Residence (this includes teachers who have graduated from your institution, other teachers in schools where your TIR is available to give mentoring help, and future teachers still in classes).
- Names of faculty and staff involved, from both physics and education departments (to help measure faculty buy-in to project goals)
- Data to support the claim that the teachers from this program are indeed “highly-qualified.” The project can share expertise on when and where to use these instruments to most accurately gather meaningful responses. Any instrument used must have some relation to published work so that a comparison can be made and progress against a known standard measured. This includes a set of assessment types, namely:

Content assessments of introductory courses designed for majors (using standardized tools like *FCI*, *CSEMS*, *BEMA*<sup>7</sup>, etc.)

Student GPA and a comparison of average GPA for students in the same major and at the institution in general (or similar measures of comparable quality such as SAT scores, etc.).

Pedagogical assessments. There are a number of these, and we are continuing to develop appropriate protocols for using these instruments that will apply to all sites.

- Retention data of PhysTEC teachers. To measure retention, we collect data from all of our teachers each year and ask basic questions. We ask each site to identify and poll *all* of their physics teacher graduates during the project and for a period of at least five years following funding.
  - We will also ask, from time to time, for short descriptions of project successes or activities. These are typically innovative programs set up at your institution, or significant successes that work toward your goals of improving teacher preparation.
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- **Project support.** The PhysTEC project will provide financial and intellectual support for helping to initiate a program or improve an existing one. We have a number of institutions that have had significant successes in increasing the numbers of high school teachers through program developed or supported by PhysTEC. The project can support

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<sup>6</sup> Additional information can be found at: <http://www.phystec.org/components/assessment>

<sup>7</sup> A good reference for these assessment tools is: <http://www.ncsu.edu/per/TestInfo.html>

travel to visit and observe these program first hand, and to assist your institution in adapting or adopting these.

- **Funding Level and Duration.** We expect funding to be given for three years, with some follow-on for up to three years after funding (assessment data collection primarily). Funding can be up to \$100,000 per year depending on local needs and locally available funds. Funding for special projects that can have national impact is also considered.
- **Institutional Support.** How will your institution support these efforts?
  - The institution must provide significant matching funds to those provided by the project.
  - The institution must provide, in writing, its plan for sustaining support beyond project funding. Specifically, how will the changes become standard practice, or how will support be provided to continue these efforts? **There must be an institutional commitment, in writing, of resources to support these efforts beyond PhysTEC funding.**
  - There must be a clear plan in place for how information about the project is communicated to administration officials throughout the project's lifetime.
- **Project Participation.**
  - **Annual Report.** In addition to reporting the statistics outlined above, we also ask each site to compile an annual report, and to place that report on the web. We have constructed a template for this report, and will assist each site in making the initial report web-compatible. Examples of these reports can be found on [www.PhysTEC.org](http://www.PhysTEC.org).
  - **Site Visit.** The project management will conduct a site visit, typically once each year. The visit will last about 1.5 days and will include discussions with faculty, students, administrators and staff. The project management will write up a brief synopsis of the visit that will be sent to the site but not published by the project, and is intended to provide feedback to the site on project activities. The site will be given an opportunity to comment on the validity and accuracy of the report before it is finalized. Site visits often include members from other PhysTEC sites or from the larger Coalition of institutions committed to teacher preparation (see [www.PTEC.org](http://www.PTEC.org)). Individuals from your institution may also be asked to take part in site visits to other institutions where there seems to be a mutual benefit to such a visit.
  - **Leadership Council.** The faculty leader from each site is expected to participate in the project's "Leadership Council". The Leadership Council may meet occasionally via teleconference, and in person twice each year (once at the annual PTEC meeting, and once at the summer AAPT meeting). The purpose of this Council is to ensure smooth operation of the project, provide input on project policies, share ideas, and help spread knowledge of excellent teacher preparation activities.
  - **Significant Writing.** We expect each site to author a significant work of writing based on their experiences and/or program elements for publication in a peer-

reviewed setting. This could, for example, be directed at the American Journal of Physics, Physical Review Special Topics – Physics Education Research, or a forthcoming volume on physics teacher preparation being assembled by the project. Sites should consider how they will structure data gathering and documentation efforts in such a way as to make this an obvious project outcome.

Although we do not require the presence of physics education research (PER) faculty, we have found our most successful sites have faculty with this specialty within the physics and/or education departments. Often their research emphasis is not specifically in teacher education, however, they can provide a source of knowledge that compliments project goals and activities that is not in the purview of most physics faculty members. Consequently, we encourage departments to engage PER faculty whenever possible to help inform the project.

#### **COMPREHENSIVE SITES: PROGRAM ELEMENTS UNDER GOAL 1B)**

- The project will also support additional activities aimed at institutionalizing the use of known research-tested curriculum for improving the quality of physical science education pre-service elementary- and middle-school teachers. Examples of this include introducing curricula such as Physics and Everyday Thinking, Physics by Inquiry, or Powerful Ideas in Physical Science<sup>8</sup>. Project sites will need to show how the funding will produce systemic changes within the department.

#### **PILOT SITES**

In the United States there are over 500 predominantly undergraduate institutions (PUI), and almost 1200 community colleges. PUIs graduate about half of the nation's undergraduate physics majors each year and are a significant source of future teachers. Community colleges play an increasingly critical role in assisting students into the education system and with articulation agreements onto four-year degrees in all fields. *Pilot* sites are an opportunity to experiment with different models for establishing effective programs in teacher education that may lie outside the typical programs funded by PhysTEC in the past. Our aim is to provide an avenue for exploring alternative ideas and collaborations that ultimately will establish cost-effective ways of improving teacher education. Examples are given above, but these are meant as a guide more than a prescription.

Programs must follow well-understood principles for effective teacher education, but may choose to focus on particular aspects. Since support is significantly reduced, so too are the expectations of the extent to which a program will touch on each of the key elements described above. Project sites will be expected to conform to data gathering requirements of all sites, and we anticipate a single site visit sometime during the funded period. We will also ask that site leaders attend project meetings, and provide updates and reports, and document their efforts similarly to *comprehensive* sites. Assessment data will be required, but for *pilot* sites, we will

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<sup>8</sup> References to these curricula can be found at: <http://www.phystec.org/components/elementary-teachers>

consider alternative measures that will lead to well-understood progress along stated project goals.

Sustainability will also be a key element of these projects. To the extent they will require internal or other funding, they will need to demonstrate, like *comprehensive* sites, how information flows between faculty and staff members implementing programs and administrators who oversee and make funding decisions. It is further understood that like *comprehensive* sites, *pilot* sites are designed to be used as national models for further demonstration. Documentation, attention to implications for other types of university settings, and outreach to the community are all assumed to be a portion of these awards.