

INTRODUCTION

In the United States there are over 27,000 teachers of high school physics who serve students in over 20,000 public and private high schools. While many of these physics teachers are excellent educators, fewer than half have a major or minor in physics or physics education. Physics consistently rates as a K-12 education field with a “severe shortage” teachers, in which demand far exceeds supply for open positions. At issue is the low number of new physics teachers prepared each year: over 70% of U.S. secondary education programs failed to graduate even a single teacher with a physics major in a recent three-year period.

The Physics Teacher Education Coalition (PhysTEC) is guided by a vision of educating sufficient numbers of qualified teachers to provide an excellent physics education for *all* students. Each year, about 1400 new teachers are hired to teach high school physics, but only about 600 have a major or minor in physics or physics education. If colleges and universities collectively prepare about 800 more physics teachers per year, the national need could be met.

To date the PhysTEC project has funded over 40 institutions as Supported Sites to build model physics teacher education programs. These PhysTEC Supported Sites have demonstrated significant successes in increasing the number of highly-qualified physics teachers, and Comprehensive Sites have collectively tripled the number of PhysTEC graduates. A coalition of over 300 PhysTEC Member Institutions is served by an annual national conference and other opportunities to improve and promote physics teacher education. In addition, the project has conducted research, developed assessment instruments, and published a number of books, reports and peer-reviewed articles on physics teacher preparation. More information is available on the project website at www.PhysTEC.org.

PROGRAM DESCRIPTION

The PhysTEC project seeks to add several more Supported Sites, and this document describes the Request For Proposals (RFP) for *Comprehensive* Sites. *Comprehensive* Sites are expected to establish programs that address the entire teacher education continuum, including recruiting, early teaching experiences, a pedagogically sound curriculum, induction and mentoring of new teachers, among other aspects. A significant aspect of Comprehensive sites is the Teacher in Residence (TIR), an expert physics teacher who serves as an ambassador for teaching in the physics department and plays a central role in program operations. Each site will implement these elements within a particular local context, giving rise to different exemplars for improving physics teacher education.

For this RFP, the project seeks to further improve the *Comprehensive* Site model, with an aim of establishing “thriving” physics teacher education programs that graduate five or more physics teachers per year. A recent PhysTEC study of “thriving” programs characterized common practices of these highly successful programs, and offers ideas to inform improvements to the

Comprehensive Site model. Thriving program practices are summarized in the Physics Teacher Education Program Analysis (PTEPA) rubric;¹ it is not expected that new *Comprehensive Sites* will adopt every single practice of every thriving program, but that institutions will thoughtfully assess which ideas best fit their needs and have the most potential to advance physics teacher preparation within their context. In addition, creative new ideas for improving physics teacher preparation are welcome in response to this RFP.

PhysTEC Supported Sites are envisioned to have impact beyond the local institution, and will be held up as national models in areas of success. These sites must have a significant campus commitment to sustaining the project beyond PhysTEC funding, demonstrating the viability of institutional change toward improving teacher education. Institutions will be asked 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. For more information on PhysTEC Supported Sites and for detailed profiles of their activities please visit www.PhysTEC.org.

Considerations for potential Comprehensive sites

Comprehensive sites are expected to graduate relatively large numbers of teachers, with an aim of becoming thriving programs that graduate five or more physics teachers per year. Institutions should assess their potential to recruit more physics teachers. The most accessible pool for recruiting future teachers is physics majors. Beyond the physics department, students in closely allied disciplines offer further opportunities for recruiting physics teachers.² These disciplines can include, for example, applied physics, astronomy, materials science, math, chemistry, and some branches of engineering. Education majors, physics graduate students, and career changers have also contributed to the ranks of PhysTEC teachers. Institutions should have a plan for how they will bring students from other disciplines into a teacher education program. Institutions that are most successful at increasing the number of physics teachers have multiple pathways into the physics teacher education program for students at various stages in their academic career.

Just as important, institutions should carefully consider their capability to sustain efforts after PhysTEC funding ends. PhysTEC sites are expected to maintain programs post funding; all successful proposals since 2012 committed to sustaining major program elements (for example, the Teacher in Residence [TIR], Learning Assistants [LAs], or new teacher education courses) for at least three years beyond the funded period. The institutional commitment of resources to sustain programs should be commensurate with requested funding levels.

The project will offer significant financial and intellectual support to selected institutions to

¹ See www.PhysTEC.org/THRIVING to learn more about the study of thriving programs, which included some PhysTEC Comprehensive Sites and other leading physics teacher education programs in the U.S. The Physics Teacher Education Program Analysis (PTEPA) rubric is also available from the webpage.

² Any student who has a physics major, minor or equivalent coursework and who completes a program of teacher education can be counted as a PhysTEC graduate.

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

The PhysTEC project is focused on pre-service teacher education, which is an often neglected and critical part of teacher education. Proposals that are primarily or exclusively focused on in-service teachers will not be accepted as there are many existing models of in-service programs as well as other funding streams to support teacher professional development.

AWARDS

The project will fund up to four *Comprehensive* sites to begin activities in 2019. *Comprehensive* sites can request funding of up to \$100,000 per year for three years (maximum total request of \$300,000). Profiles of sites funded from previous solicitations are available on www.PhysTEC.org.

ELIGIBILITY

Eligible organizations

The lead organization must be a university or four-year college that offers a physics degree and teacher certification program, and be located and accredited in the U.S. A consortium of institutions may also include two-year colleges or non-profit entities.

PI eligibility

The principal investigator (PI) must be a tenure-track or tenured faculty member in the physics department. Programs are strongly encouraged to have collaborative arrangements with the School of Education or appropriate unit housing the teacher certification program, which may include a co-PI in Education.

PROPOSALS

Institutions that would like to be considered for PhysTEC funding are required to submit an initial proposal, due **13 April 2018 at 5 p.m. local time**. A small number of selected institutions will be invited to submit a full proposal, due 27 July 2018 at 5 p.m. local time. Email proposals

as an electronic attachment in PDF format to David May at may@aps.org. Late proposals will not be accepted.

There will be a webinar on the PhysTEC RFP on 13 February 2018 at 2 p.m. ET. Details will be available on www.PhysTEC.org/solicitation. Project management welcomes inquiries and consultation during the proposal writing process. Please contact Monica Plisch (phone: 301-209-3273, email: plisch@aps.org) or David May (phone: 301-209-3252, email: may@aps.org).

INITIAL PROPOSAL

Initial proposals are limited to 3 pages for Comprehensive sites. Proposals that exceed the page limit will not be read beyond the stated page limit. Text should be single-spaced, written in Times 12-point font or larger, with at least 1 inch margins. While sustainability and institutional support should be addressed in the initial proposal, actual letters of support will not be accepted. Please send a document that includes the following information as appropriate:

- **Institutional context.** Briefly describe the institution, including how teacher education fits with the mission, and whether it is a minority-serving institution. Also, briefly describe the physics department, including major education initiatives.
- **Teacher education.** List existing program(s) to educate physics teachers. Also, describe the need for physics teachers in your region or state.
- **Data table.** Provide a data table with the following: (a) the number of students who received bachelor degrees in physics for each of the last 3 years, and (b) the number of graduates from physics teacher education programs for each of the last 3 years.
- **Project goals.** Give a numerical goal for increasing physics teachers, and define other major project goals.
- **Project activities.** Outline a plan of action for achieving stated goals. It is expected that projects will address each of the six PTEPA rubric standards³ described in more detail below in the *Full Proposal* section.
- **Project team.** List key faculty and staff who will implement the project, and briefly describe their experience relevant to physics teacher education.
- **Sustainability.** Provide a brief description of plans for sustaining the project's activities beyond the PhysTEC funding period.
- **Budget.** Provide a budget summary. Note that the project team should include a Teacher in Residence (TIR)⁴ as indicated below in the *Full Proposal* section.

³ See www.PhysTEC.org/THRIVING for more information on the Physics Teacher Education Program Analysis (PTEPA) rubric standards. Note that the individual "items" of the PTEPA can be considered as suggestions for the types of activities an institution might undertake. However, it is not expected that proposals will address all or even most of the PTEPA items, nor should these items be considered an exhaustive list of all possible activities.

⁴ A PhysTEC TIR is an expert high school physics teacher who serves in a college or university physics department to advance physics teacher preparation. See www.phystec.org/keycomponents/tir for more on how PhysTEC Sites have engaged TIRs in many critical roles in physics teacher preparation programs, including full-time and part-time TIRs.

Please keep in mind that while a brief description of existing efforts can be useful to provide context, the emphasis of the initial proposal should be on the types of actions to be undertaken as a result of PhysTEC funding, and how these efforts will result in substantial improvements in physics teacher education.

FULL PROPOSAL

If your institution has been invited to submit a full proposal, please follow the guidelines in this section. The full proposal format is similar to a standard NSF proposal. Review criteria listed in the following section indicate how proposals will be evaluated.

Project description

The project description should be a maximum of 15 pages. Text should be single-spaced, written in Times 12-point font or larger, with at least 1 inch margins. Also include a one-page project summary suitable for the web, which will not be included in the page count for the project description.

Comprehensive sites must include and clearly identify the following elements in the Project Description section:

- **Project goals.** Give a numerical goal for increasing physics teachers, and define other major project goals during the period of PhysTEC funding and beyond.
- **Background.** Provide background information on your institution as indicated below.
 - **Institution profile.** Include a brief description of the institution, including student enrollments, demographics, and percentage in-state; and institutional mission.
 - **Physics department profile.** Include a brief description of undergraduate and graduate programs as applicable, with numbers of degrees in the last 3 years.
 - **Physics teacher education.** Briefly describe existing program(s) to educate physics teachers and the number of graduates in each of the last 3 years.
 - **Synergistic programs.** Briefly describe existing programs or initiatives relevant to the PhysTEC effort and outline the nature of any interactions.
- **Project activities.** Describe how you will address the six PTEPA rubric standards listed below in your local context.⁵
 - **Institutional commitment.** Describe the commitment of university leaders to establishing and maintaining a supportive climate for STEM teacher preparation, and alignment of the institutional mission with teacher education. Specify how program activities will be sustained by the institution after PhysTEC funding ends, including commitments of resources.

⁵ See www.PhysTEC.org/THRIVING for more information on PTEPA rubric standards. Note that the individual “items” of the PTEPA can be considered as suggestions for the types of activities an institution might undertake. However, it is not expected that proposals will address all or even most of the PTEPA items, nor should these items be considered an exhaustive list of all possible activities.

- **Leadership and Collaboration.** Name the team members who will lead and carry out the project and indicate their roles and responsibilities;⁶ also, describe team members' expertise, activities and positions of leadership that are relevant to building a strong physics teacher preparation program. Describe the roles and responsibilities of the Teacher in Residence (TIR),⁷ which is required for Comprehensive sites. In addition, describe how the physics department will work collaboratively with the school of education or relevant unit housing the teacher certification program to further project goals.
- **Recruitment.** Indicate the populations from which the program will recruit prospective teachers, including physics students and others in aligned majors, and describe the strategies that will be used to reach these populations and actively recruit them to physics teaching. Describe opportunities for prospective teachers to participate in early teaching experiences, for example a Learning Assistants program, to help develop and confirm a passion for teaching (or decide it is not for them). In addition, indicate how the program will provide streamlined and accessible options for completing a physics degree and teacher certification that are attractive to students.
- **Knowledge and Skills for Teaching Physics.** Describe how the program will ensure that teacher candidates have strong physics content knowledge, and provide evidence of effective instructional practices in the introductory physics sequence. Also, describe how future teachers will gain knowledge specific to teaching physics, as opposed to general pedagogical knowledge. Provide information on how the program will ensure high quality teaching experiences in physics for future teachers to develop their skills.
- **Mentoring and Professional Support.** Describe how the program will provide comprehensive mentoring, academic advising and professional support to help students persist and complete a physics degree and teacher certification. Specify mentoring and any other supports for program graduates in finding their first teaching job(s), becoming successful as new teachers, and persisting in the profession.
- **Assessment.** Describe how your institution will measure success with respect to stated goals, including data you will gather and evaluation metrics. Provide a plan for tracking PhysTEC graduates and staying in contact with them. Explain how results will be used as feedback to improve the teacher education program. Also, provide a plan for communicating successes to key university administrators and other stakeholders to build support for the program.

⁶ PhysTEC asks that sites designate a champion and co-champion to provide some depth on the leadership team and to foster sustainability if the champion is no longer in a position to lead the team.

⁷ A PhysTEC TIR is an expert high school physics teacher who serves in a college or university physics department to advance physics teacher preparation. See www.phystec.org/keycomponents/tir for more on how PhysTEC Sites have engaged TIRs in many critical roles in physics teacher preparation programs, including full-time and part-time TIRs.

Additional proposal sections

Each of the additional proposal sections is required. None of the sections below will count toward the page limit for the project description.

- **References.** References should be included in a separate section from the Project Description.
- **Biographical sketches.** Provide an NSF-style, two-page CV for senior members of your project team listed in the project description.
- **Personal statement.** The PI should write a short personal statement (no more than one page) addressing motivations for taking leadership in physics teacher education.
- **Current and pending support.** If the proposed budget includes stipends or salary offsets for faculty, provide a NSF-style document listing current and pending support for each faculty member who will receive a partial salary from the PhysTEC grant.
- **Letters of support.** Commitments to sustain the physics teacher education program beyond the PhysTEC funding period should be documented in writing by letter(s) of support. Letters of support should include specific commitments of resources or other contributions. Letters that offer only endorsement rather than actual support are discouraged.

Budget

A NSF-style budget and budget justification is required with the full proposal. Include a budget for each project year and a summary budget for the entire project. The budget justification should include a description of each budget item. Funds must be spent on efforts primarily focused on improving the education of future physics teachers. Activities that, for example, benefit primarily science teachers in other disciplines or benefit physics majors at large without a special emphasis on teachers will likely not be allowed. No support for scholarships is allowed, although we encourage this type of student support through other funding sources.

- **Fringe benefits.** The fringe benefit rate on salaries is limited to the NSF negotiated fringe rate for the institution.
- **Travel.** At a minimum, travel support for the PI and the TIR to the PhysTEC conference each year should be included. We also encourage additional members of the leadership team to attend this meeting.
- **Indirect costs.** No indirect costs are allowed on the TIR salary or participant support including stipends for Learning Assistants, if applicable. The indirect cost rate is limited to the NSF negotiated indirect cost rate for the institution.

PROPOSAL REVIEW

All applications will go through an NSF-style review process. A panel composed of external reviewers and members of the PhysTEC project management team will evaluate proposals. Anonymous comments from individual reviewers and the panel discussion will be sent to all

Principal Investigators. Project management may conduct virtual site visits with top candidate Comprehensive sites in during September 2018. New sites will be announced in October 2018 after the entire process is completed. Funding will begin 1 August 2019 to allow for a planning period and time to find a TIR.

Review criteria

Panels will use the following criteria during review of initial letters and full proposals.

- Potential to increase the number of physics teacher graduates – *What is the potential to substantially increase the number of well qualified physics teachers? How large is the pool of potential physics teachers including physics majors and others? How well conceived is the plan to recruit future teachers, and retain them to successful graduation?*
- Potential to successfully implement PTEPA rubric standards – *How will PTEPA rubric standards be successfully addressed in the local context? What existing programs and efforts will support implementation of the program standards?*
- Potential to develop a national model – *What is the potential to build a highly successful program that can be promoted nationally to advance physics teacher education? Are there unique features that distinguish the program from other efforts and add to the PhysTEC model? Is there a well-conceived plan to evaluate and document successes?*
- Qualifications of team to carry out project – *Is the team well positioned to implement proposed changes in the physics department and school of education? What is the knowledge and experience of the team in physics education? How is the project informed by education research?*
- Evidence of institutional support – *What institutional resources will be leveraged in support of a successful program? What resources will the institution commit to sustaining the project after PhysTEC funding? How will the administration stay informed about and connected to the project? What is the nature of communication between the site leaders and administration members with budgetary responsibilities?*
- Extent to which the institution adds diversity – *What is the potential of the project to increase diversity of PhysTEC graduates? How does the type of institution and geographic location extend the portfolio of PhysTEC Supported Sites, and provide further examples of successful teacher education programs?*

AWARD ADMINISTRATION

Comprehensive sites will be expected to participate in project activities described below. While significant effort is required on the part of supported sites, the level of project support is commensurate. Such support includes a national profile for sites, advocacy by project leadership, ideas and models from national leaders in physics education, and assistance with fundraising by project management.

Communication

Each site will be asked to designate one person as the primary point of contact, and the management team will communicate with this person on all project matters. Communication will be facilitated by an email list and a monthly videoconference, and an online drive will be used to facilitate document exchange.

Memorandum of Understanding

The project will negotiate an institution-specific Memorandum of Understanding (MOU) with each Comprehensive site. The MOU will include a detailed list of activities to be carried out by faculty and staff during the project year (August 1 to July 31). The MOU will also include a budget for each project year.

Site visits

The PhysTEC project management will conduct site visits once a year for Comprehensive sites. The visit will last about one day and will include discussions with faculty, students, administrators and staff. The team will write up a synopsis of the visit that will be sent to the site but will not be published, and is intended to provide feedback to the site on project activities and suggestions for synergistic 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 PhysTEC Member Institutions committed to teacher preparation (see www.PhysTEC.org). Individuals from your institution may also be invited to take part in site visits to other institutions where there seems to be a mutual benefit to such a visit.

Site Leader activities

The Principal Investigator from each site is expected to participate in monthly videoconferences during the academic year and attend the annual PhysTEC Conference. The purpose of these meetings is to ensure smooth operation of the project, provide input on project policies, share ideas, and help spread knowledge of excellent teacher preparation activities. New awardees should also plan to attend the PhysTEC conference in early 2019 and will receive travel support.

Publications

We expect each site to author a significant publication based on their activities. This could, for example, be directed at the American Journal of Physics, Physical Review Special Topics – Physics Education Research, The Physics Teacher, The Forum on Education Newsletter or other similar venues. Sites should consider how they structure data gathering and documentation efforts in such a way as to make this a significant project outcome.

Annual reports

We ask each site to compile an annual report that we will place on the PhysTEC website to inform the broader community of its progress and activities. We have constructed a template for this report and will assist each site in making reports web-compatible.

Assessment

We collect data from every site annually to help with local assessment of progress and to characterize project success as a whole. Gathering this data may involve securing IRB approval at your institution. The project will expect the following from each Comprehensive site:

- Data and a clear description of methods used to count teachers for each year of the project as well as the three years prior to PhysTEC funding (to provide a baseline). These numbers will be used, in part, to measure your success. This should include separate categories for the number who graduate from your physics teacher education program and the number who are in the pipeline as future physics teachers.
- Updated contact information for all graduates that meet the definition of a PhysTEC graduate. We send a brief survey to all PhysTEC graduates each year to ask about employment outcomes. We ask each site to maintain contact with all graduates during the project and for a period of five years following funding, to assist with gathering employment and retention data.
- Survey data from physics students using the research-validated instrument *Perceptions of Teaching as a Profession (PTaP)* to assess departmental climate for teaching careers.
- Completion of the *Physics Teacher Education Program Analysis (PTEPA)* rubric to characterize program activities.
- Additional data and evaluation metrics as outlined in your proposal to measure success toward stated goals.
- We will also ask, from time to time, for short descriptions of project successes or activities. These feature innovative programs set up at your institution, or significant successes in your work toward the goal of improving teacher preparation.

ABOUT PHYSTEC

The PhysTEC project has support from the National Science Foundation and through individual and corporate gifts to the American Physical Society's (APS) Campaign for the 21st Century. The project is led by the APS and the American Association of Physics Teachers. More information about PhysTEC is available at www.PhysTEC.org.