Comprehensive Sites Offer New Models for Teacher Preparation

In August 2015, PhysTEC added four new Comprehensive sites that offer new models for physics teacher preparation. Comprehensive sites are funded for three years and receive up to $100,000 per year to address the entire teacher education spectrum. The capacity of an institution to sustain these programs beyond the award period is a critical factor in the selection process.

West Virginia University

WVU became a PhysTEC Comprehensive site and a UTeach replication site at the same time. The site leaders, veteran physics teacher educators from the highly successful program at University of Arkansas, will develop an integrated model for these two complementary programs. Key components of the PhysTEC program include an improved introductory calculus-based course sequence, a Learning Assistants (LA) program built around the reformed laboratory sequence, a Teacher in Residence to provide the reformed laboratory sequence, a Learning Assistant program built around a physical campus. The physics department at Rowan State University is one of the largest Hispanic Serving Institutions in the nation, located in central Texas amid a large Hispanic population, and prepares a larger number of teachers than any university with a physical campus. The physics department at Texas State University is seeking to enhance physics education research and teacher preparation as critical pieces of its mission. PhysTEC supported activities add a Teacher in Residence, increase

Rowan University

PhysTEC project activities at Rowan University promise to make an impact in southern New Jersey and the surrounding region. Rowan is well positioned with over 150 physics majors, a strong science education program, a new tenure-track line in physics education, and a thriving Learning Assistant program. New leadership has brought a host of new, innovative ideas with the momentum to match, including a reworked certification program that allows students to graduate in four years with a physics bachelor’s degree and a Master of Arts in Teaching. The PhysTEC comprehensive site award will help Rowan to establish a permanent framework for recruiting, retaining, training, and inducting and mentoring future physics teachers.

Texas State University

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Books Release: Recruiting and Educating Future Physics Teachers

PhysTEC is pleased to announce the publication of Recruiting and Educating Future Physics Teachers: Case Studies and Effective Practices. Three years in the making, this peer-reviewed volume sponsored by PhysTEC provides a practical guide to innovative, state-of-the-art programs. It includes articles in the following areas:

- Preparing Future Physics Teachers: Overview and Past History
- Case Studies of Successful Physics Teacher Education Programs
- Recruiting and Retaining Future Physics Teachers
- Structuring Effective Early Teaching Experiences
- Preparation in the Knowledge and Practices of Physics and Physics Teaching
- Mentoring, Collaboration, and Community Building

The book contains both invited and contributed chapters. There is a strong emphasis throughout the book on implementation advice, ongoing challenges, and lessons learned. The book’s intended audience is physics department chairs and faculty, as well as education faculty who are engaged in physics teacher preparation.

The book is freely available for download at: www.phystec.org. Recruiting and Educating Future Physics Teachers was edited by Cody Sandifer at Towson University, and Eric Brewe at Florida International University.

Solving the Physics Teacher Shortage by Monica Plisch, PhysTEC Project Director

If each institution educated one more physics teacher per year, the problem would be solved. The solution to the nationwide physics teacher shortage is within reach if physics departments become more engaged and see teacher education as part of their mission. The key to realizing this solution is a physics faculty member who cares about teacher education and is supported to take leadership in this area.

Two new models for physics teacher preparation have been added to the PhysTEC portfolio this year: the PhysTEC Comprehensive site model and the UTeach replication site model. Comprehensive sites are funded for three years and receive up to $100,000 per year to address the entire teacher education spectrum. The capacity of an institution to sustain these programs beyond the award period is a critical factor in the selection process.

The PhysTEC project has established a national coalition of more than 300 institutions that are committed to improving the education of future physics teachers, and identified over 700 faculty contacts at these member institutions who are passionate about educating physics teachers. Each member institution, with the support of their faculty champions, works to prepare one more physics teacher per year, the potential outcome is 300 additional new physics teachers per year.

PhysTEC has supported faculty champions to make improvements in teacher education at their institutions by offering conferences and workshops with leaders in the field. Going forward, the project will seek to foster institutional change more directly by offering resources to help

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Increasing Numbers Attend National Conference

Since the first conference in 2005, a total of over 270 institutions have sent one or more participants to the annual national PhysTEC conference. These institutions include a large fraction of PhysTEC member institutions and represent over one-third of all physics departments. Many faculty are regular participants, as seen by the growing fraction of returning institutions each year. Over 100 attendees were part of the 2015 PhysTEC conference, held in Seattle, WA, in February 2015. Participants attended plenary talks and workshops from leaders in the field and had opportunities to network and connect with the physics teacher education community.

The 2015 PhysTEC conference was held in conjunction with the Building a Thriving Undergraduate Physics Program Workshop, where teams of physics faculty worked to develop plans for increasing the numbers of majors in their departments, a significant concern at many smaller colleges and universities. The program was informed by strategies from the SPIN-UP (Strategic Programs for Innovations in Undergraduate Physical Project Report. Increasing the number of physics majors is critical to increasing the number of physics teachers, especially at bachelor’s degree granting physics departments, which collectively prepare over half of the new physics teachers in the nation. Attendee Josee Vedrine-Pauleus praised the conferences, saying, “The conferences served as an eye opener on the reality of physics programs across the nation and provided working models that really increase the number of physics graduates who can enter the field of teaching.”

The 2016 PhysTEC conference will be held in Baltimore, MD from March 11-13, in conjunction with the American Physical Society March Meeting.

Champion Profile: Brian Thoms

As associate chair and director of undergraduate studies in physics, Brian Thoms leads the Georgia State University (GSU) PhysTEC project. In the two years since GSU began their PhysTEC funding, the department has increased from an average of 1.6 physics teachers graduating annually, to 4 teachers annually. Another faculty member introduced Thoms to the cause of physics teacher education. After becoming aware of the need for high school physics teachers, he worked to develop a teaching track, while securing both PhysTEC and departmental funding to help establish the program. In addition, Thoms has led the department in an effort to reinvigorate the undergraduate physics program, resulting in dramatic growth in both the number and diversity of physics majors. Thoms explains that one of the greatest challenges he faces is lack of awareness: “I didn’t have much awareness of the broader issues, neither did my colleagues. Many colleagues will naturally be supportive, because they agree with the goals, but they lack the awareness.” He and his colleagues have worked to change the culture in the department so that faculty and students see teaching high school physics as a viable career path, even for students on track for graduate school.

When asked what advice he would give to other aspiring champions, Thoms stressed the importance of sharing information: “I’ve been generally surprised at how many physics students were interested once they knew that teaching is an option.” Rather than steering students away from other avenues and into teaching, he presents it as one of the many career options they have. The Teacher in Residence is an important part of this process, providing information about the advantages and rewards of teaching from a personal perspective. Thoms says, “As long as it’s an option, my experience is that there are students who will gravitate to that.”

LA Workshops: Instructing Peers as an Early Teaching Experience

One of the most effective ways to introduce students to the rewards of physics teaching is through early teaching experiences. Learning Assistant (LA) programs provide highly supported early teaching experiences to undergraduates and have been shown to improve student learning and attitudes toward science. CU-Boulder, a PhysTEC supported site, initially developed the LA program to improve instruction in introductory physics courses; the program also turned out to be an effective teacher recruitment tool. PhysTEC promoted the LA program nationally, co-sponsored a series of workshops, and formally adopted Learning Assistants as a key component of PhysTEC programs. Today the Learning Assistant Alliance, based at the University of Colorado Boulder, helps support institutions in the development and expansion of LA programs.

To provide opportunities for faculty looking to develop LA programs at their institutions, the Learning Assistant Alliance organizes national workshops each fall and will offer five regional workshops in the spring of 2016. The PhysTEC project has partnered with the Learning Assistant Alliance and the organizers of the national Learning Assistant Workshops since 2007.

The LA model is designed to partner STEM departments with their colleges of education to help students experience the rewards of teaching science while receiving pedagogical training. LAs show significant improvements in their own content knowledge, and those that became K-12 teachers were found to have significantly different teaching practices than teachers from the same program who were not LAs.

Teaching Physics Modules

The PhysTEC project partnered with Eugenia Etkina at Rutgers University to develop Teaching Physics Modules, which provide flexible, high-quality curriculum materials for physics methods courses. These modules are designed to help pre-service physics teachers learn how to be effective in the classroom. They focus on several crucial aspects of classroom instruction with the purpose of improving student learning, motivation, and confidence. The modules also show how to make Next Generation Science Standards science practices and crosscutting concepts integral parts of learning physics.

The five pilot modules are grouped around three themes: instructional, high-quality curriculum materials, and assessment questions. Instructors can incorporate modules into their pre-service physics teacher preparation program in many ways. Each theme, equivalent to a one-credit course, can be used alone or in combination with the others. Instructors can include modules as part of an existing science methods course, offer them as stand-alone elective course, or provide them as an independent study course.

Many PhysTEC contacts at member institutions downloaded one or more of the pilot modules. In a follow up survey a few months later, 20% of respondents reported using the modules, mostly with pre-service teachers, as part of an existing course or for independent study.

The modules are available for free on the PhysTEC website, along with presentation slides and a recording of a webinar.
I t may have taken Zachary Kovach a little longer than most to get to where he is today, but it is a path he would not have changed. Kovach always knew he loved physics and sought it out when he began college. Despite a clear interest in academics, like many students, Kovach was unsure of his direction and ended up taking eight years outside of school to figure it out. After dabbling in a variety of careers and interests, like running a skateboard camp and corporate training at an airline, Kovach finally found his way back to school with a clear head and goals—he’d pursue physics and teach high school.

Kovach became a highly regarded student at Arizona State University. As such, he was sought after for research opportunities and recruited by top firms. A career in teaching was not what many expected for a student of his caliber, but Kovach was steadfast. He finished at the top of his class in both his Bachelor’s of Science in Physics and his Bachelor’s of Arts in Education. Since beginning teaching at La Joya Community High School, just outside of Phoenix, Kovach is seeing his enthusiasm for physics and science education take root. In just three academic years, enrollment in physics classes has tripled from 45 students to the current 155. The school added an AP class and there is a subtle change in how the subject is viewed. For a course that is not a graduation requirement, especially in a low-income community, this is a huge accomplishment.

He sees his role as a teacher having many facets. Kovach is an educator first and a brand ambassador for physics and science literacy second. As an educator, he needs to reach his students, but as a brand ambassador, he also knows that reaching guidance counselors and other teachers is equally important, because they also need to be ambassadors. Kovach has seen the complacency that can be a result of teaching in challenging environments and he sees himself as raising the bar. When students come into his classroom, they know they have to work, but they also know they’re going to enjoy it. For Kovach, teaching science is less about teaching formulas or memorizing data, and more about “emphasizing the process of science as a verb, of doing something.” He wants all his students to walk away from his classes with exposure to critical thinking, problem solving, group dynamics, public speaking, and general scientific literacy. His efforts are paying off. Since he began teaching, six of his students have gone on to major in physics at Arizona State, at least one of whom is pursuing physics education. For an early career teacher in a challenging field, these numbers demonstrate a promising trend.✓

Teacher Profile: Zachary Kovach

Last year, PhysTEC announced the first inductees into The 5+ Club, a group of institutions that has graduated five or more physics teachers in a given year. The vast majority of U.S. institutions graduate less than two physics teachers a year, and the most common number of graduates from physics education programs is zero. In their 2014 report, the American Association for Employment in Education found that the teacher shortage in physics is number one among the 59 education subject fields. Graduating five or more physics teachers a year is a significant achievement and helps to address the severe national shortage of high school physics teachers.

Institutions designated as a member of The 5+ Club are poised to share information on their strategies for graduating large numbers of physics teachers. Institutions must apply for the recognition and confirm that all graduates have strong content knowledge in physics (i.e. a major, minor or equivalent coursework) and have completed a program of teacher education.

New awards for The 5+ Club will be presented at the 2016 PhysTEC Conference in Baltimore.✓

The 5+ Club Award

The 5+ Club

Bingham Young University (17) Illinois State University (10) Stony Brook University (8) Arizona State University (6) Boston University (6) University of Central Florida (6) Middle Tennessee State University (5) Rowan (5) Towson University (5) University of Arkansas (5) West Chester University (5) Western Michigan University (5)

The next generation of PhysTEC programs and help build the national infrastructure needed to solve the physics teacher shortage.✓

Sites continued from cover

The Colorado School of Mines (CSM) and the University of Northern Colorado (UNC) partnership is the first multi-institution site involving two universities. UNC is the premier teacher preparation institution in the state of Colorado, and CSM is a highly selective, small public research university devoted to engineering and applied science. CSM does not have a teacher certification program and is seeking to provide a new career pathway for students who want to become educators. UNC will provide a teacher certification program with a combination of courses located at CSM and online courses. A parallel effort at UNC will focus on increasing elementary teacher candidates’ interest in and ability to teach physical science in elementary school, reaching a large fraction of the new elementary teachers in the state of Colorado.✓

Mines-UNC

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Teacher Shortage continued from cover

Teacher Shortage

PhysTEC 2017 Conference

February 17-18, 2017
Atlanta, GA

Join us for the nation’s largest meeting dedicated to physics teacher education. This conference will be held in conjunction with the AAPT Winter Meeting.

Topics include:

• Recruiting high school physics teachers
• Physics teaching methods
• Advocacy and working effectively with administrators
• Assessments for physics teacher education
• Educating elementary and middle school teachers
• Building effective pathways to degree and certification

www.phystec.org/conferences/2017/

The 5+ Club

Physics Teacher Education Coalition

AAPS physics

AAPT

2017 PhysTEC Conference

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Sites

continued from cover
Perspective: Recruiting High School Physics Teachers
by John Stewart, Gay Stewart, and Alma Robinson

Physics departments are uniquely responsible for the annual shortfall of new physics teachers, in that they are the only academic units that can produce highly qualified physics teachers. Also, physics departments disproportionately benefit from improved high school (HS) physics instruction through an increase in the number of majors and a general preparedness of the students enrolled in physics courses.

Teaching HS physics is a career path that has many attractive features for students who find their personal goals are not well served by the 10 years of additional preparation (Ph.D. and postdocs), and resulting personal pressures placed on graduate students and postdocs, that are required to secure an academic position. Teaching HS allows students to directly apply skills learned in physics, in a dynamic environment, with rewarding personal interactions. With technology like robotics, cheap microcontrollers, and 3D printing, and pedagogical innovations, HS physics classrooms are exciting and creative workspaces for physics graduates. HS teachers are often more connected to physics than graduates pursuing industrial careers, which use reasoning and lab skills, but not the physics content knowledge.

Successfully preparing students to enter the HS classroom as a teacher requires some effort by physics departments. HS teaching as a respected possible career path in venues where career information is discussed. This includes, but is not limited to: advising sessions, freshman seminar, and Society of Physics Students meetings.

As with any prospective bachelor’s studies geared toward a certain career, the academic program must allow sufficient flexibility to incorporate the classes needed for entry-level positions. If a physics department wishes to graduate HS teachers, its degree requirements must include space for classes relevant to teaching, including electives that broaden the student’s knowledge (e.g., cosmology instead of a second semester of electricity and magnetism).

To illustrate the rich career trajectories available in education and to share advice on preparing future teachers, Alma Robinson, Physics Teacher Education Coalition (PhysTEC) Teacher in Residence (TIR) at Virginia Tech (VT), describes her experiences as a physics major who entered HS teaching:

“Physics teacher candidates are in your program: They just need the opportunity to discover how rewarding teaching can be.”

– Alma Robinson

At some point during adolescence, my formal education had become dull and uninspiring, but physics changed everything. Within the first few weeks of HS physics, I realized that my curiosity had found a place within the classroom walls. Physics wasn’t about memorizing facts. When I asked a question, my physics teacher responded with, “Let’s figure that out!” In fact, I can pinpoint the moment I knew I was hooked: during a grueling swim practice, my coach yelled at us, “Elbows up!” I immediately thought, “Oh, of course! That reduces my arm’s moment of inertia!” It was at that moment, surprised by my inner nerdiness, that I knew I should major in physics.

When I walked into my first physics course at VT, I fortunately stumbled into a class taught by Dr. Dale Long, an award-winning teacher, who taught his students to think about the concepts behind the equations. On one of my first visits during his office hours, he asked me about my long-term goals and I mentioned that I wanted to become a HS physics teacher. He smiled widely, regaled me with stories of his inspiring HS physics teacher, Alice Estes Martin, and encouraged me to work hard in hopes that I might also inspire young minds one day. I left his office feeling excited about my possible career, and a few years later, I received the Alice Estes Martin scholarship, an award created by Dr. Long to be given to a future HS physics teacher.

John Stewart and Gay Stewart are at West Virginia University, and Alma Robinson is at Virginia Tech. To learn more, please see the full article in the January edition of APSNews.

About PhysTEC

The PhysTEC project has a mission to improve and promote the education of future physics teachers.

The project funds selected universities, or supported sites, to develop physics teacher preparation programs into national models. The project began in 2001 with an initial cohort of six sites. Fifteen years later, the project has grown significantly and has a total of 46 supported sites that, collectively, have more than doubled the number of graduates who are highly qualified to teach physics.

The coalition (pictured in the map) now has more than 300 member institutions committed to the PhysTEC mission. These institutions all graduate physics teachers and comprise 40% of all U.S. physics departments. PhysTEC member institutions are located in 49 states, the District of Columbia and Puerto Rico, and educate over half of the nation’s highly qualified physics teachers.

To learn more about PhysTEC or to join the coalition, go to www.PhysTEC.org.