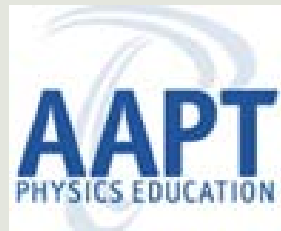
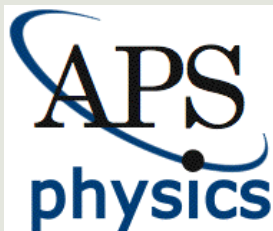


Task Force on Teacher Education in Physics: Preliminary Results

Stamatis Vokos

Task Force Chair

Professor of Physics
Seattle Pacific University



The National Need

Need for High School Physics Teachers

Relative Demand by Field

Fields with Considerable Shortage (5.00 - 4.21)

Severe/Profound Disabilities (Spec. Ed.) 4.42

Multi-categorical (Spec. Ed.) 4.36

Emotional/Behavioral Disorders (Spec. Ed.) 4.32

Mild/Moderate Disabilities (Spec. Ed.) 4.32

Physics 4.31

Mental Retardation (Spec. Ed.) 4.23

Learning Disability (Spec. Ed.)

4.22

Mathematics Education 4.21

Fields with Some Shortage (4.20 - 3.41)

Visually Impaired 4.20

Chemistry 4.16

2004 AAEE (*American Association of Employment in Education*)

Educator Supply and Demand in the United States Report

Calls to Action

▣ Rising Above the Gathering Storm:

Action A-1: *Annually recruit 10,000 science and mathematics teachers by awarding 4-year scholarships and thereby educating 10 million minds.*

Action C-1: *Increase the number and proportion of US citizens who earn physical-sciences, life-sciences, engineering, and mathematics bachelor's degrees by providing 25,000 new 4-year competitive undergraduate scholarships each year to US citizens attending US institutions.*

Calls to Action

America COMPETES Act of 2007

- ❑ Double funding for the National Science Foundation to \$11.2 billion by 2011
- ❑ Expand the Robert Noyce Teacher Scholarship Program
- ❑ Develop and implement programs for bachelor's degrees in math, science, and engineering with concurrent teaching credentials and part-time master's in education programs for math, and science teachers to enhance both content knowledge and teaching skills.

Tapping America's Potential: The Education for Innovation Initiative, Business Roundtable, July 2005

- ❑ Double the number of STEM graduates by the year 2015

Calls to Action

We know that the quality of math and science teachers is the most influential single factor in determining whether a student will succeed or fail in these subjects. Yet, in high school, more than twenty percent of students in math and more than sixty percent of students in chemistry and physics are taught by teachers without expertise in these fields. And this problem is only going to get worse; there is a projected shortfall of more than 280,000 math and science teachers across the country by 2015.

That is why I am announcing today that states making strong commitments and progress in math and science education will be eligible to compete later this fall for additional funds under the Secretary of Education's \$5 billion Race to the Top program.

President Barack Obama, 27 April 2009 (NAS Speech)

Federal Funding

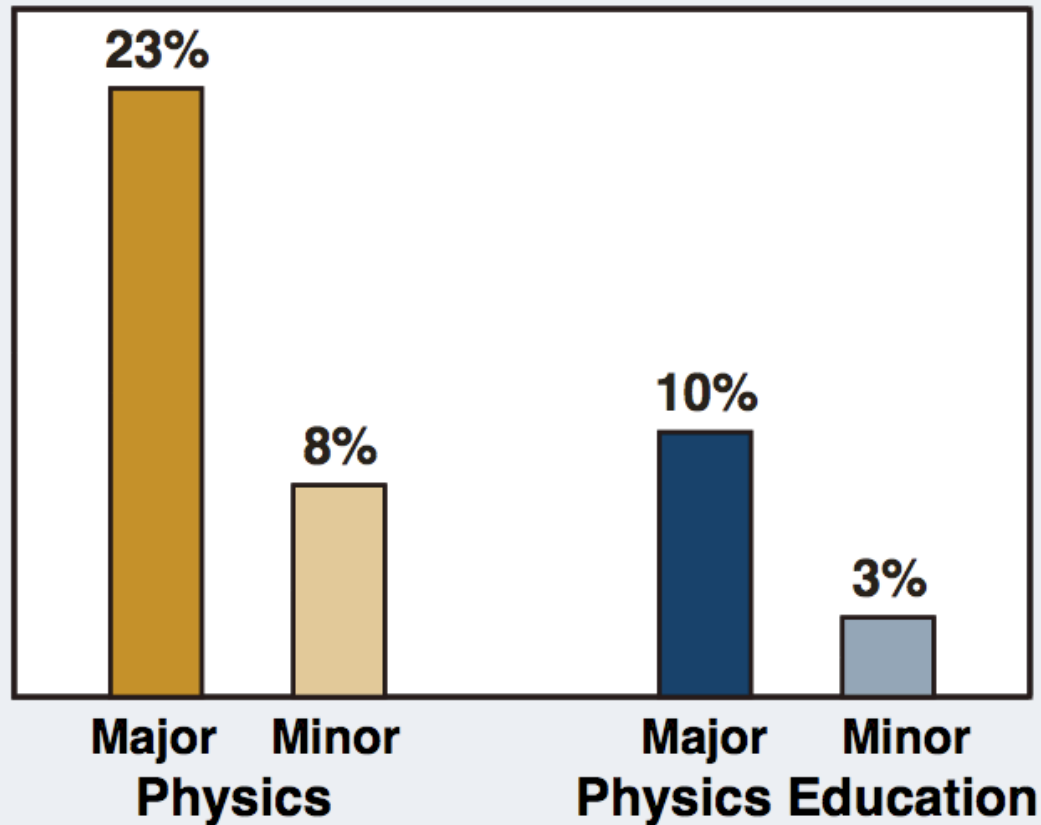
June 2008: \$40 million additional:

- ▣ \$20 million additional for Noyce Scholarships (current FY08 appropriation is \$10.6 million)
- ▣ \$20 million for Noyce: “Sec. 10A: NSF Teaching Fellowships and Master Teaching Fellowships”
 - ▣ Minimum \$10k/year salary supplement during service
 - ▣ 4-5 years of service required

February 2009: \$85 million additional:

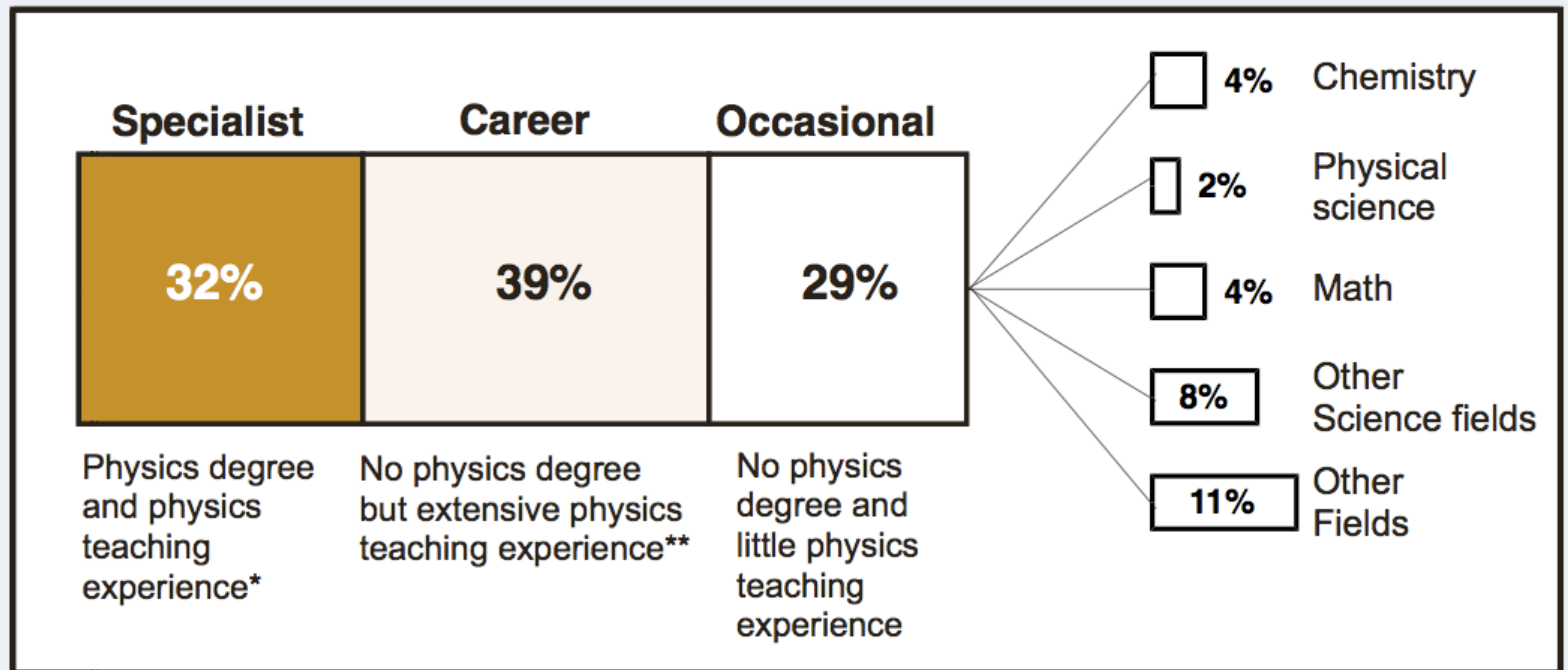
- ▣ \$60 million additional for Noyce Scholarships
- ▣ \$25 million additional for Math Science Partnerships

Physics Teacher Education



AIP Statistical Research Center: 2004-05 High School Physics Survey

High School Physics Teacher Preparation



*Teachers with physics degrees but insufficient physics teaching experience are excluded from this figure (3%).

**Career physics teachers include those who have taught physics as much as, or more than, any other subject, or have taught it for ten or more years. The distribution of highest degree earned by career teachers was spread evenly across the sciences, with 25% in math or engineering, 23% in biology, 17% in chemistry, 18% in other science fields and 17% in other fields.



Demographics of High School Physics Teachers

- 23,000 Physics Teachers Nationwide
- 1,200 new physics teachers each year
- ~400 of these have physics major or minor

Physics
enrollment
growing by 1%
p.a.



Physics and Physical Science Certification

Students in US Public Schools Taught by Teachers with No Major or Minor, and no Certification in the Subject Taught, 1999-2000

Discipline	Grades 5-8	Grade 9-12
English	17%	6%
Mathematics	22%	9%
Physical Science	41%	16%
Biology-Life science	29%	10%
Chemistry		9%
Physics		17%

SOURCE: National Center for Education Statistics. Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987-1988 to 1999-2000. Washington, DC: US Department of Education, 2003.

Teacher Retention

The National Response

- PhysTEC project
- Task Force on Teacher Education in Physics

PhysTEC Project



Demonstration Project (PhysTEC)

- 12 National Sites
- Comprehensive Program
- Teacher-in-Residence
- Physics, Education Collaboration

National Coalition (PTEC)

- National Conference
- Recognized Programs
- Community Leaders
- Sharing Innovative Ideas
- Broad Dissemination

PhysTEC Project Participants

Project sites:

Ball State University

Cal Poly San Luis Obispo

Cornell University

Florida International University

Oregon State University

Seattle Pacific University

Towson University

University of Arkansas

University of Arizona

University of Colorado

University of Minnesota

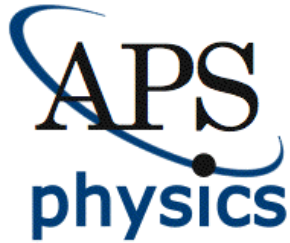
University of North Carolina - Chapel Hill

Western Michigan University

Xavier University of Louisiana

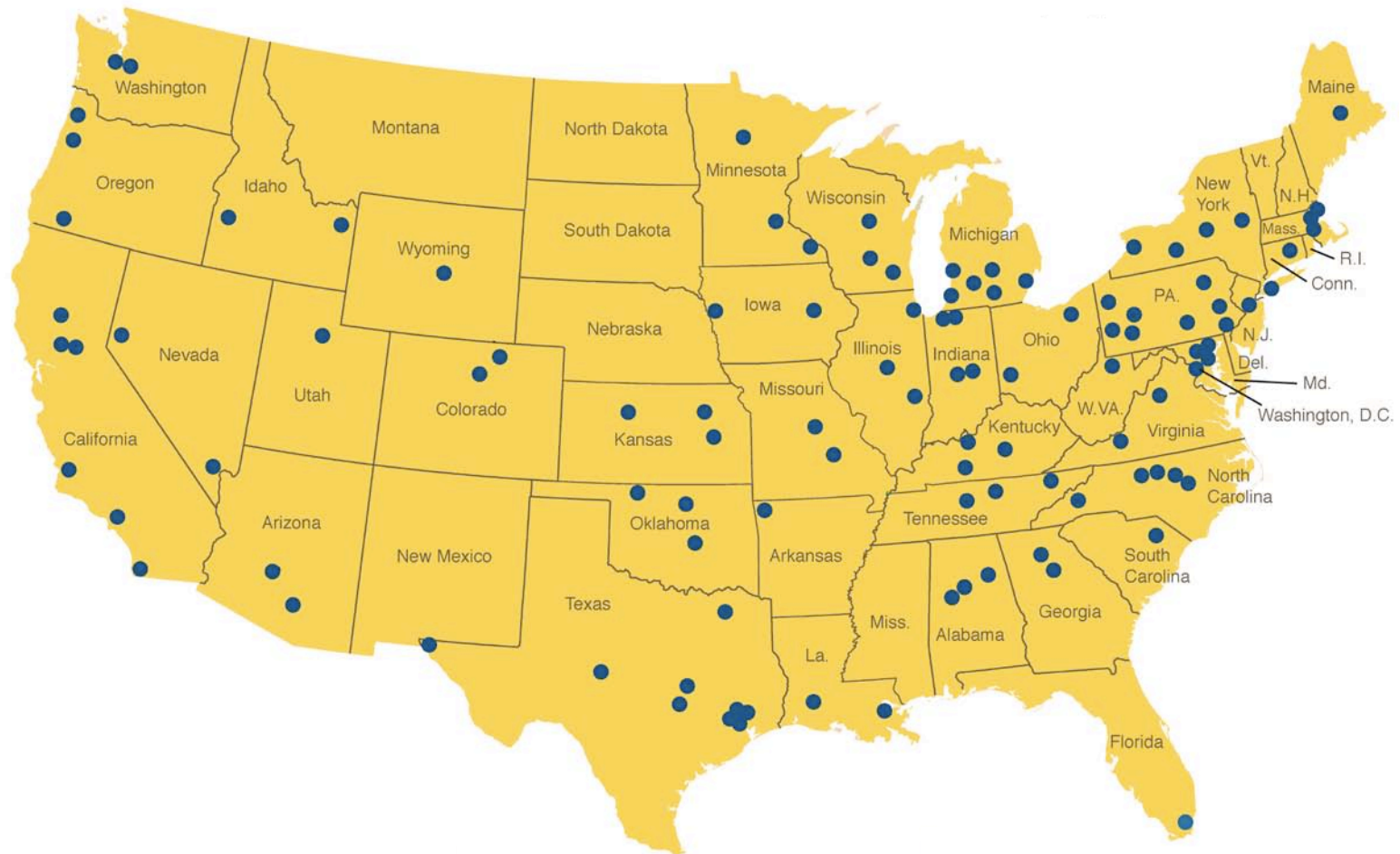
PTEC Members (136):

Oranim Academic College	Boston University	St. Joseph's University
Weizmann Institute of Science	Bridgewater State College	University of Pittsburgh
Women's Christian College	Tufts University	University of Pittsburgh at Greensburg
Jacksonville State University	Andrews University	Francis Marion University
University of Alabama	Calvin College	South Dakota State University
University of Alabama at Birmingham	Hillsdale College	University of South Dakota
Arizona State University	Hope College	King College
University of Arizona	Michigan State University	Middle Tennessee State University
University of Arkansas	National Superconducting Cyclotron Laboratory	Tennessee Tech University
Cal Poly Pomona	University of Michigan-Dearborn	University of Tennessee, Knoxville
Cal Poly-San Luis Obispo	Western Michigan University	Angelo State University
California State University-Chico	Bemidji State University	Lone Star College-North Harris
California State University-Sacramento	Hamline University	San Jacinto College
University of California-Davis	University of Minnesota	Texas A&M University-Commerce
University of San Diego	Winona State University	Texas Southern University
University of Colorado at Boulder	Jackson State University	Texas State University-San Marcos
University of Northern Colorado	Missouri University of Science & Technology	University of Houston
University of Connecticut	University of Missouri-Columbia	University of Texas at Austin
George Washington University	University of Nevada-Las Vegas	University of Texas at El Paso
Florida International University	University of Nevada-Reno	Brigham Young University
Georgia State University	Rutgers University	James Madison University
Kennesaw State University	Buffalo State College	Radford University
Spelman College	Colgate University	Randolph College
Boise State University	Cornell University	Seattle Pacific University
Brigham Young University-Idaho	Hofstra University	University of Washington
Chicago State University	Medaille College	Fairmont State University
DePaul University	Rensselaer Polytechnic Institute	West Virginia State University
Eastern Illinois University	SUNY Fredonia	Wheeling Jesuit University
Illinois State University	Elon University	University of Wisconsin-Madison
Trinity Christian College	Johnson C. Smith University	University of Wisconsin-Stevens Point
Anderson University	North Carolina State University	University of Wisconsin-Whitewater
Ball State University	University of North Carolina at Asheville	Casper College
Saint Mary's College (IN)	University of North Carolina at Chapel Hill	University of Hawaii
University of Notre Dame	Winston-Salem State University	
University of Southern Indiana	Hiram College	
Morningside College	Wright State University	
University of Northern Iowa	East Central University	
Dodge City Community College	Northwestern Oklahoma State University	
Emporia State University	Oklahoma State University	
Fort Hays State University	Oregon State University	
Kansas State University	Pacific University	
University of Kentucky	Southern Oregon University	
University of Louisville	California University of Pennsylvania	
Western Kentucky University	Chatham University	
McNeese State University	Indiana University of Pennsylvania	
Xavier University of Louisiana	Millersville University	
University of Maine	Misericordia University	
Johns Hopkins University	Pennsylvania State University	
Loyola College in Maryland	Slinnerv Rock University	
Towson University		
University of Maryland-Baltimore		



PTEC Member Institutions

... committed to improving the education of physics and physical science teachers



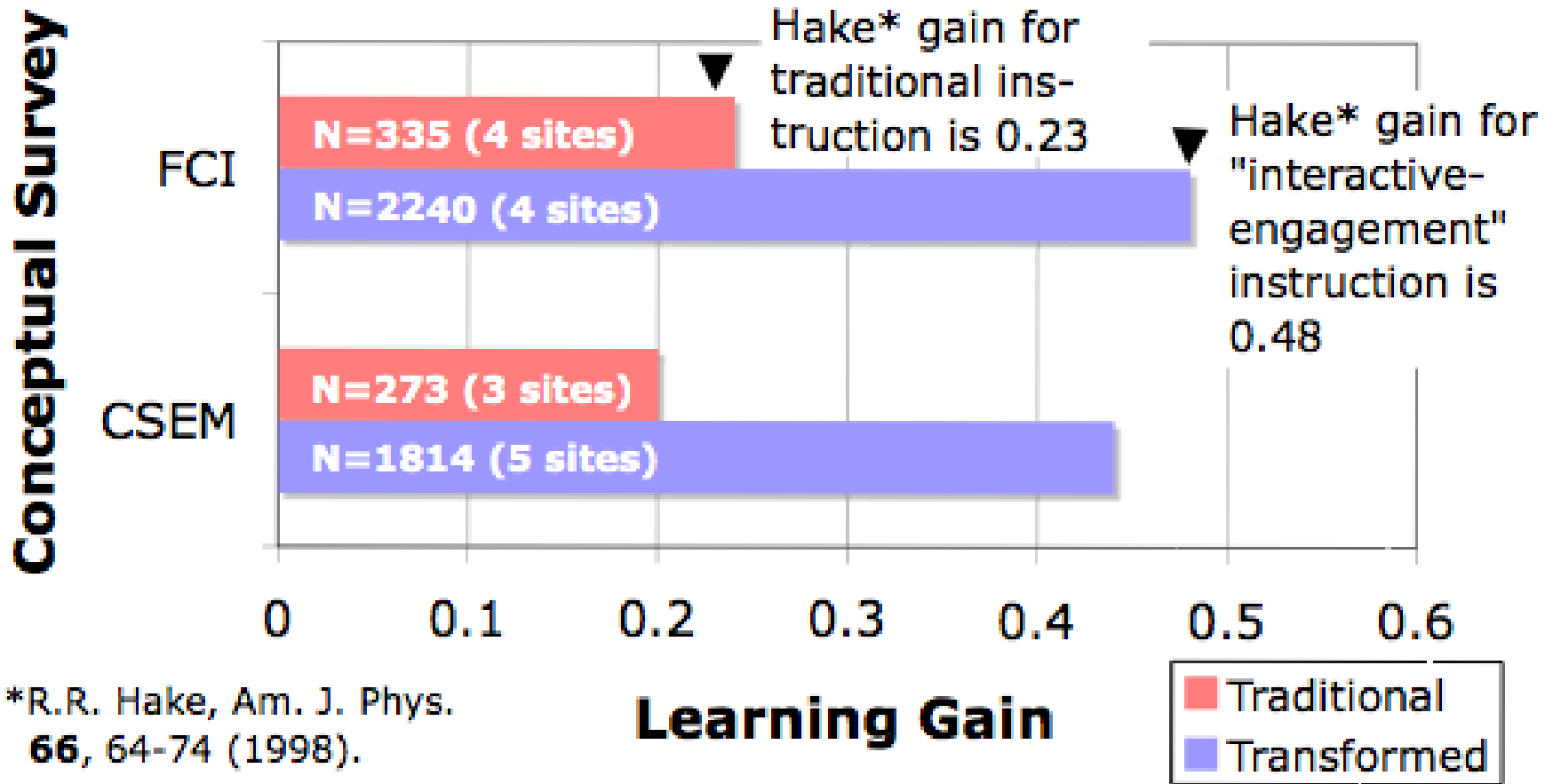
PhysTEC Project Goals

- Demonstrate and provide models for:
 - Increasing the number of highly qualified high school physics teachers
 - Improving the quality of K-8 physical science teacher education
- Spread best practice ideas throughout the community
- Work toward transforming physics departments to re-engage in the preparation of physics teachers

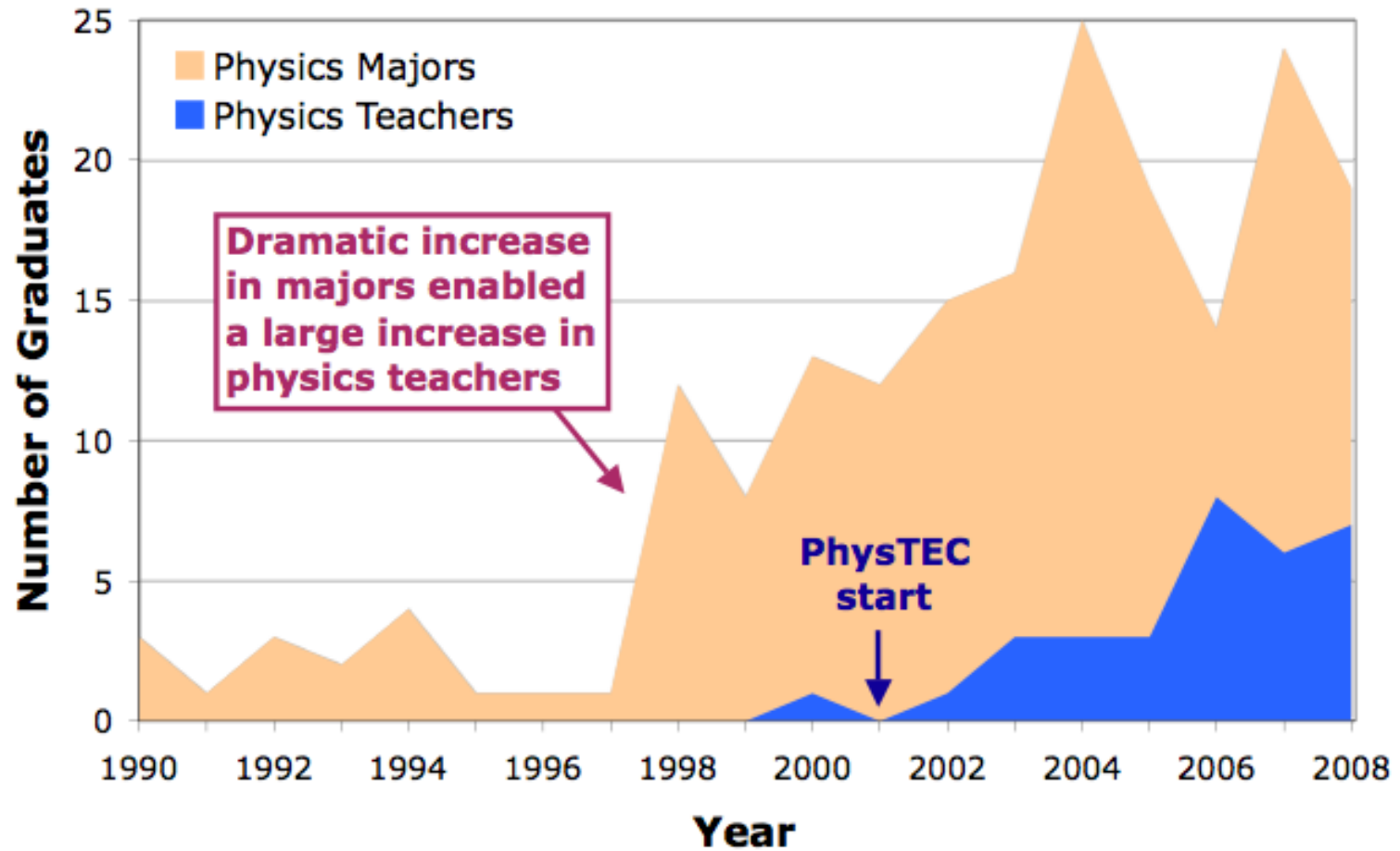


Increase in Physics Teachers Educated at PhysTEC Sites

Improved Learning Gains in Transformed PhysTEC Courses



Case Study: U of Arkansas



Coalition Activities

- National Conference on Physics Teacher Education:
 - Mar 2008** Theme: *Master Teachers* (Austin)
 - Mar 2009** Theme: *Institutional Transformation* (Pittsburgh)
 - Feb 2010** Theme: *Diversity* (DC, w/ NSBP & NSHP)
- Physics Teacher Education Digital Library www.PTEC.org
- National workshops of exemplary programs (LAs, RTOP)
- Regional workshops (PTEC-NC, Aug 07; PTEC-NW, Oct 08)
- Best-practice book to bring together information on Physics Teacher Education (2010 expected publication)
- Building coalitions with other professional societies (ACS, NASULGC)
- National Task Force on Teacher Education in Physics

Coalition Activities

- National Conference on Physics Teacher Education:
 - Mar 2008** Theme: *Master Teachers* (Austin)
 - Mar 2009** Theme: *Institutional Transformation* (Pittsburgh)
 - Feb 2010** Theme: *Diversity* (DC, w/ NSBP & NSHP)
- Physics Teacher Education Digital Library www.PTEC.org
- National workshops of exemplary programs (LAs, RTOP)
- Regional workshops (PTEC-NC, Aug 07; PTEC-NW, Oct 08)
- Best-practice book to bring together information on Physics Teacher Education (2010 expected publication)
- Building coalitions with other professional societies (ACS, NASULGC)
- **National Task Force on Teacher Education in Physics**

Task Force Membership

- Eugenia Etkina (Rutgers)
- J.D. Garcia (Arizona)
- David Haase (NCSU)
- Drew Isola (Allegan Public Schools)
- Eugene Levy (Rice)
- Valerie Otero (CU)
- Mary Ann Rankin (UT Austin)
- Stamatis Vokos (SPU), chair

- Jack Hehn (AIP)
- Warren Hein (AAPT)
- Ted Hodapp (APS)
- Cathy O’Riordan (AIP)
- Monica Plisch (APS)

Senior Consultant:

- David Meltzer (ASU)

Former members:

- Pinky Nelson (WWU)
- Jim Stith (AIP)

Other significant contributions to date

- Eric Brewe (FIU)
- Charles Coble (NASULGC)
- Larry Coleman (UC Davis)
- Nicole Gillespie (KSTF)
- Paula Heron (UW)
- Mel Sabella (CSU)
- Rachel Scherr (UMd)
- Peter Shaffer (UW)

Task Force Charge

- Identify
 - *Generalizable strategies to increase the number of teachers qualified to teach physics in grades 9-12*
 - *Best practices (recruitment, advising, professional preparation, induction)*
- Articulate research, policy, funding implications
- Develop strategy for initial dissemination of results to
 - All physics departments
 - All colleges/schools of education
 - Physics education research community
 - Funding agencies
 - News media, state and national policy makers

Data collection strategies

□ Nationwide surveys

- Request for self-nomination sent to all physics departments in US (late spring '08) to identify institutions with large yearly output (three or more physics teachers) and positive derivative
- National teacher production data collected and triangulated from several state and national sources (e.g., AACTE and state officials responsible for certification and/or endorsement)
- Extensive questionnaire sent to small sample of respondents (and non-respondents)
- Portfolio of institutions developed for site visits (Fall '08-Fall '09)
 - Geographic distribution
 - Size/Type/Mission/Diversity
- Nationwide survey developed with AIP SRC (Early summer '09)

Data collection strategies

- Site visits to-date
 - Rutgers University
 - Illinois State University
 - SUNY Buffalo State College
 - University of Colorado—Boulder
 - University of Northern Iowa
 - Brigham Young University
 - California State—Fullerton
 - Arizona State University
 - University of Arkansas
 - CUNY City College



Some Challenges/Questions

- Many and significant regional definitions of what constitutes a “physics teacher.”
 - Counting small numbers turns out to be surprisingly complex.
- What constitutes a “good” physics teacher? A “good” program?
 - What should a good beginning physics teacher know/be able to do?
 - What is appropriate depth of subject matter preparation?
 - What, in addition to SMK, should a beginning teacher possess?
 - What should physics departments do to ensure the best teacher preparation program?

Brainstorm

- In consultation with your neighbor, come up with *the* most important type of knowledge/skill/ disposition that a well prepared beginning physics should have.
- How does your institution measure/ensure that the novice teachers it prepares possess that knowledge/skill/disposition?

Task Force Report

- The report will be presented to the community during a Joint Symposium in February 2010 in Washington, DC, at the Joint Meeting of APS and AAPT (which follows the 2010 PTEC National Conference and is concurrent with the Joint Meetings of NSBP and NSHP).
- Stay tuned...

Preliminary Result—Successful Programs: *Pied Piper/Research Group Leader*

- Champion program at institution
- Develop physics-specific curriculum (Pedagogical Content Knowledge)
- Obtain funding
- Advocate for students
- Bridge between Physics/Education/K-12 schools
- Knowledge of issues/research literature
- Recruiting lead

Testable hypothesis: Study correlates of changes in sign of derivative of production