Critical Issues (and Solutions) Facing the Physics Community: Teacher shortages, Diversity

Theodore Hodapp
Director of Project Development
Sr. Advisor to Education and Diversity
American Physical Society
APS Education and Diversity Programs

- PhysTEC
- APS Bridge Program
- STEP UP 4 Women
- National Mentoring Community
- Conferences for Undergraduate Women in Physics (CUWiP)
- New Faculty Workshops
- APS Guide to Assessment: Effective Practices, Program Review
- Physics chairs meeting (7-9 June)
- REU site leaders
- Prof. skills development workshops
- Graduate education conference
- Advocating for physics education
- Childcare at meetings
- Mentoring seminar materials
- Ethics case studies
Percentage of Women in Physics

- High School
- College Entrance
- BS (degree)
- PhD (degree)
- Assistant Professor
Percentage of Women in Physics

Sources: NCES/IPEDS, AIP-SRC, HERI
Percentage of Women in Physics

Source: National Center for Education Statistics and APS
Undergraduate Physics Degrees Awarded to Women

Physics / STEM Bachelor Degrees

Source: IPEDS
Hispanic American Bachelor Degrees

US College-Age Hispanic Population

Source: National Center for Education Statistics, US Census, and APS
African American Bachelor Degrees

US College-Age Black Population

- Biology
- Chemistry
- Math & Stats
- Engineering
- Physics
- Earth Sciences

Source: National Center for Education Statistics, US Census, and APS

www.aps.org

©2017, American Physical Society; Email: hodapp@aps.org
Underrepresented Minority (URM) Physics degrees

Only ~30 students!

Source: National Center for Education Statistics, US Census, and APS
APS Bridge Program: Key Features

- **Recruit** students through graduate (unaccepted), undergraduate programs *(promising but uncompetitive, or unsure)*

- **Establish** Bridge Sites (6):
  - Year 1: Advanced undergraduate or grad courses, introduction to grad-level research, active mentoring, progress monitoring, social integration into grad school *(Project funds)*
  - Year 2: Take 1st year grad courses, apply to PhD program, research underway *(Department funds)*

- **Place** additional students at Partnership Institutions (23):
  - 65 graduate programs looked at “other” applications (2017), recruited additional students; No direct support, some travel
  - “COM approved” Partnership Institutions; national recognition of program

- **Monitor** student/site progress
- **Research**
- **Disseminate / Advocate**
Member and Partner Institutions

**Member Institutions**
- 125 in 38 states

**Partnership Institutions**
- 32 in 18 states
  - 24 PhD
  - 8 MS
Institution Involvement

• **Member Institution** (any institution, 125)
  Free; receive information / updates; reduced fees for APS-BP conferences

• **Partnership Site** (graduate only, 32)
  APS COM approval process; recommended site for Bridge Fellows (and others) to attend; demonstrate effective practices in graduate student support

• **Bridge Site** (graduate only, 6)
  Receive significant funding from APS; build sustainable program; prepare 2+ students each year for graduate study; significant institutional commitment

---

**APS Bridge Partnership Sites**

*Bowling Green State University
*California State University Long Beach
*California State University, Los Angeles
Columbia University
Delaware State University
*DePaul University
Embry-Riddle Aeronautical University
Fisk-Vanderbilt
Florida International University
Florida State University
Illinois Institute of Technology
Indiana University
MIT
North Dakota State University
Ohio State University
Princeton University
*Texas State University
*Towson University
University of Central Florida
University of Chicago
University of Cincinnati
University of Connecticut
University of Hawai‘i at Manoa
*University of Houston Clear Lake
University of Michigan
University of North Carolina at Chapel Hill
University of Rochester
University of South Florida
University of Texas at Arlington
University of Texas, San Antonio
University of Virginia
*Wright State University
Bridge Program Achievements

Bridge Program Physics PhDs

- 23% Women (20%)
- 93% URM (6%)
  - 64% Hispanic
  - 24% African American
  - 5% Native
- 88% Retention (60%)

National Achievement Gap

Students

- Left Program
- Placed/Retained
- Project Funding

2013 2014 2015 2016 2017
Where did the 48 students go (2017)?

- Bowling Green State University
- CSU Long Beach (2)
- CSU Los Angeles (5)
- Delaware State University (2)
- DePaul University
- Fisk-Vanderbilt University (3)
- Florida State University (6)
- Indiana University (2)
- Ohio State University (3)
- Texas A&M University, Commerce
- Texas State University
- University of Central Florida (5)
- University of Cincinnati (3)
- University of Connecticut
- University of Houston, Clear Lake (3)
- University of Kansas (2)
- University of Massachusetts Dartmouth
- University of Minnesota Duluth
- University of North Carolina, Chapel Hill
- University of Rochester
- University of South Florida (2)
- University of Virginia
Physics GRE: Impact of Cutoff Scores

Fraction (White)

Fraction (Hispanic)

Fraction (Black)

Fraction (Asian)

0.09 (Black)

0.34 (Hispanic)

0.61 (Asian)

0.44 (White)

650
Mission: To increase the number of underrepresented ethnic and racial minorities who complete a physics BS degree

Program components:

• Pair undergraduates with local faculty mentors
• Email prompts
• Workshops/PD
• BEAM fund
• Annual meeting

Sign up now!

• [www.aps.org/nmc](http://www.aps.org/nmc)
• Email: NMC@aps.org
• Focus on professional development, networking, understanding pathways
• Attendance more than tripled since APS became involved in 2012
• Very good URM attendance
• Departments using CUWiP as retention event for 1st year students
• Support from NSF, DOE
• 11 sites for 2018, plus 1 in Canada
• Directed research efforts to improve messaging to women sees positive changes
• National leadership group; Current chair: Pearl Sandick, Utah; Overseen by CSWP
• Site applications due 1 November for 2019 conferences
High school classes taught by teacher with degree in the field

Source: Schools and Staffing Survey
### Demand for new teachers

#### Top 5 education fields (greatest demand)
- Spec. Ed. – Severe/Profound Disability: 4.57
- Spec. Ed. – Emotional/Behavioral Disorders: 4.54
- **Physics**: 4.51
- Spec. Ed. – Visually Impaired: 4.50
- Spec. Ed. – Hearing Impaired: 4.45

#### Bottom 5 education fields (least demand)
- Pre-K education: 3.06
- Intermediate education: 3.00
- English/Language Arts: 2.97
- Kindergarten/Primary Education: 2.77
- Health education: 2.72

Numbers of new physics teachers educated

- **1081 Institutions (72%)**

Source: Title II
PhysTEC Member Institutions

[Map of the United States showing locations of PhysTEC Member Institutions and Supported Sites]
PhysTEC Supported Sites

• 46 PhysTEC Sites educate 1 in 8 physics teachers with a degree
• Comprehensive Sites nearly tripled their numbers of physics teachers
• Retention rates for new PhysTEC teachers are over 70% after 5 years

Key Components
• Recruiting
• Course reform
• Early teaching experiences
• Mentoring and induction
• Learning Assistants
• Teacher in Residence
• Champion
• Collaboration
• Institutional commitment
• Assessment
What would it take to solve the problem?

New physics teachers hired each year (1400 total)

- 600 with major/minor in physics or physics education
- 800 without deep content knowledge

Need 800 more new physics teachers / year

Source: AIP Statistical Research Center
• Recommendations to recruit more physics, chemistry, math and computer science majors to teaching

• Surveyed 8,000 STEM majors and recent graduates, including over 1,200 physics majors

• Partnered with the American Chemical Society, the Computing Research Association, and the Math Teacher Education Partnership
“How interested are you in being a middle or high school teacher?”

- **Physics**: 28% Not at all interested, 12% Slightly interested, 6% Somewhat interested, 2% Quite a bit interested
- **CS**: 23% Not at all interested, 9% Slightly interested, 3% Somewhat interested, 1% Quite a bit interested
- **Math**: 21% Not at all interested, 10% Slightly interested, 6% Somewhat interested, 17% Quite a bit interested
- **Chemistry**: 25% Not at all interested, 9% Slightly interested, 4% Somewhat interested, 3% Quite a bit interested

www.PhysTEC.org  ©2017, American Physical Society; Email: hodapp@aps.org
“Middle or high school teaching is discussed as a career option in my major department.”
“Middle or high school teaching is discussed as a career option in my major department.”
Student misperceptions

• Teacher salaries are ~$20k higher than what students think, on average

• 40% of STEM majors listed uncontrollable or uninterested students as a significant worry about teaching, whereas less than 8% of actual teachers reported this as a concern

• See report for more:
  
  www.aps.org/policy/reports/popa-reports
“Physics teacher candidates are in your program: They just need the opportunity to discover how rewarding teaching can be.”
– Alma Robinson, Virginia Tech

“I’ve been generally surprised how many physics students were interested once they knew that teaching is an option.”
– Brian Thoms, Georgia State

Zachary Kovach,
La Joya Community High School
Planned Project Activities

- Funding new “Comprehensive” sites (5); Spring 2018 RFP
- Funding “Recruiting” sites (10)
- PhysTEC “Fellows” (first cohort just identified)
- Report Card to document national need
- PhysTEC meeting (8-10 Feb 2018)
- Workshops on “Learning Assistants”
- Recruiting kit
- Online physics methods course
- Recognition of top producers: “5+ Club”
- Recognition of top teachers: PhysTEC teacher of the year
Quick Tips from Successful Sites

- Identify and support a faculty “Champion”
- Advertise your department’s education track
- Host an informal departmental event for students interested in teaching
- Ensure all undergrad advisors are knowledgeable about teacher education
- Tell all intro classes whom students interested in teaching should contact
- Track number of physics teachers graduating from your program each year
- Ask your students if they have considered teaching
- Invite a high school physics teacher to give a talk in the physics dept.
- Invite a recent physics teacher grad from your dept. to meet students
- Go to lunch with education faculty member
- Survey your students to ask who has ever considered high school teaching
- Know your local high school teachers, and make sure they know you
- Learn about Learning Assistants
Next Steps...

- Replicate Bridge Program in chemistry, math, astronomy, geosciences (apsbridgeprogram.org)
- Mentoring / tracking students into careers / postdoc positions
- National Mentoring Community (aps.org/nmc) expansion
- New BEAM (Bringing Emergency Aid to Mentees) fund available
- Bridge Program / NMC Meeting: **19-21 Oct 2018**: Stanford/Google
- PhysTEC meeting: **8-10 Feb 2018**, College Park, MD (phystec.org)
- PhysTEC solicitation for new sites starts Spring 2018
- CUWiP: **12-14 Jan 2018** (each year on MLK wknd) (aps.org/cuwip)
- STEP UP 4 Women: Pilot phase now (stepup4women.org)

Happy Physicists ⇒ Great Physics
Email: hodapp@aps.org, Phone: 301-209-3263

This material is based upon work supported by the National Science Foundation under Grant Nos. 1143070, 1346627, 1720810, 0808790, 1707990

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.