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APS April Meeting 2018

EP3: Effective Practices for Physics Programs Guide – What It Is and Why You Should Care

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AAPT PHYSICS EDUCATION

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Accreditation

All departments and programs undergo periodic review

How many would like your program to undergo accreditation?

ABET offers to accredit ***all*** natural science disciplines (ANSAC: Applied and **Natural** Science Accreditation Comm.)

ABET ACCREDITATION FOR NATURAL SCIENCE PROGRAMS

JOIN THE CONVERSATION

ABET accreditation has long been the global standard for programs in applied science, computing, engineering, and engineering technology. And recently programs that fall outside of these four main areas have shown interest in becoming ABET-accredited.

During this half-day, three-part session you will explore the value of ABET accreditation, and specifically the value that it could bring to the natural sciences. Presenters from ABET as well as industry and programs in physics, geology, biology, and chemistry will share their perspectives and describe how

Design Goals

Who is it for?

- Physics department chairpersons
- Program and Administrative leaders
- Programs performing a review and Program reviewers
- Faculty in programs facing challenges; faculty interested in improving their programs
- **Key:** flexible, not prescriptive; mindful of local contexts

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Outcomes of the EP3 Guide

Help department chairs (& other program leaders)

- Bring together known literature of effective practices
- Collect practices recognized by the community as effective when there is insufficient evidence-based literature
- Encourage discussions in departments on continuous improvement of physics programs using evidence
- External program assessment and review; to improve usefulness of assessment
- Collect information for departments to use in advocating for resources to improve their program
- Engage PER community on departmental needs

Today

Our goals for today are:

- Become aware of this potentially transformative initiative
- Get a sense of the forces driving the effort
- Understand the task force's vision, goals & forthcoming activities
- Appreciate that outcomes are being designed to help programs and not to hinder or constrain programs
- Know who to contact with questions and input

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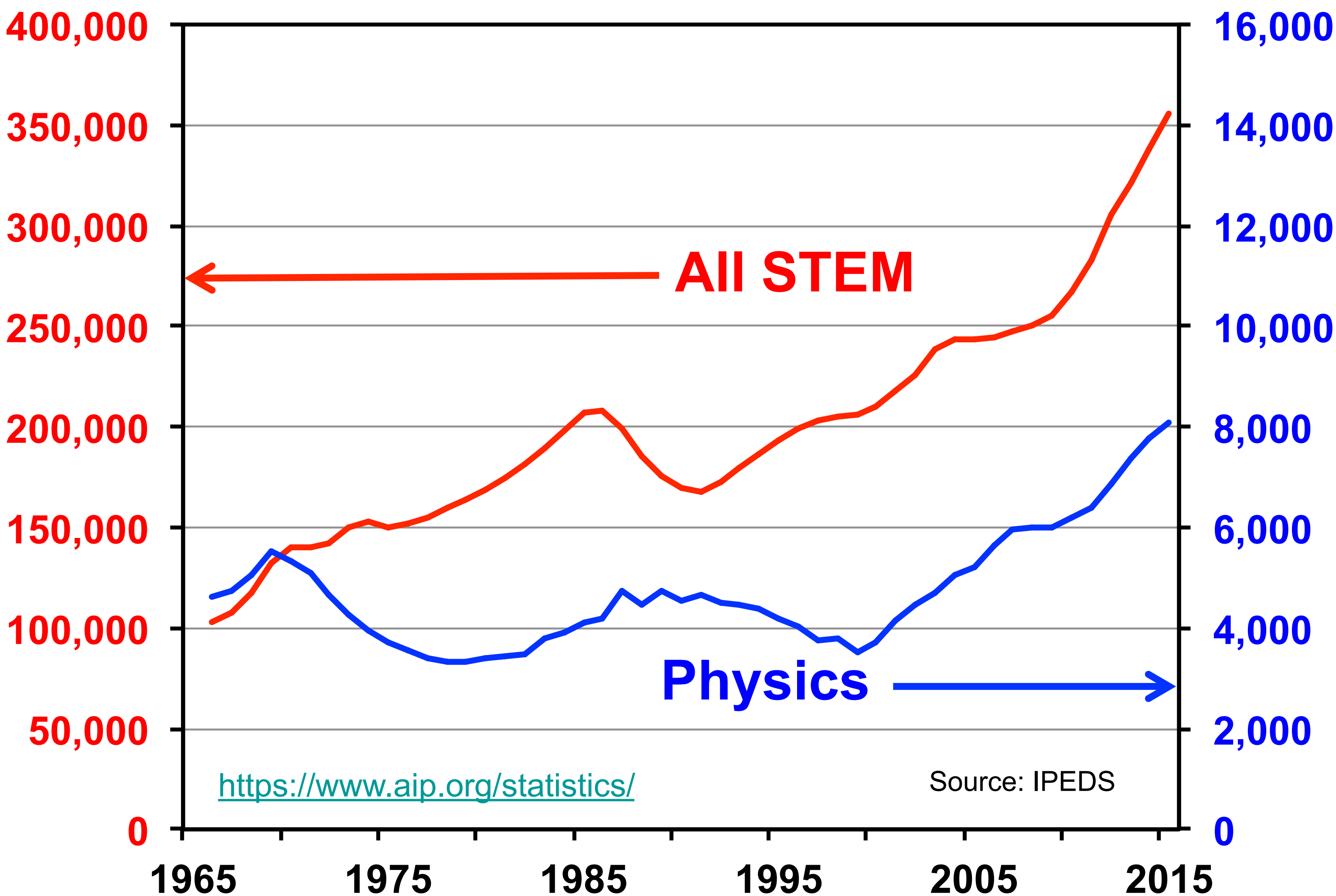
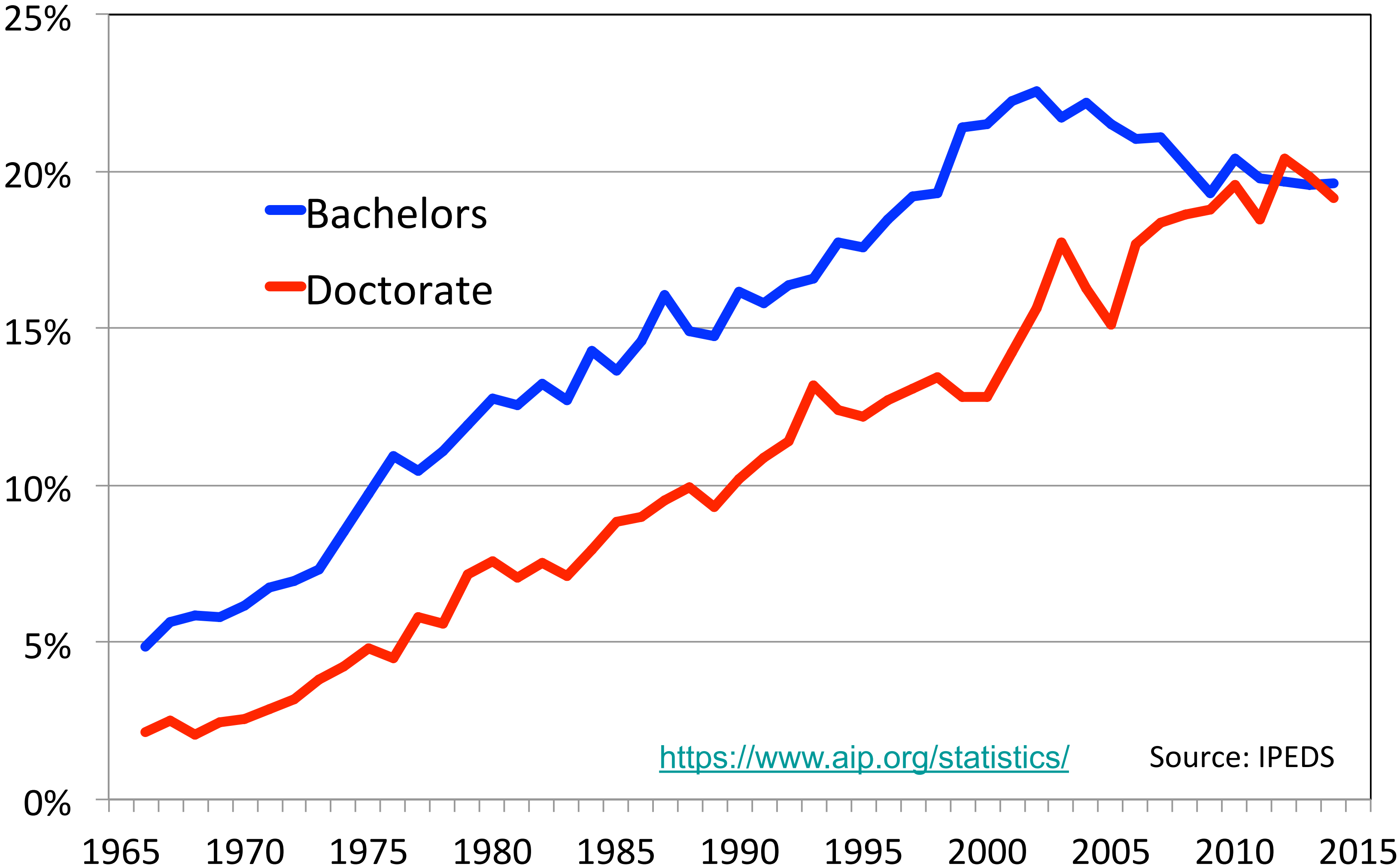
Physics / STEM Bachelor Degrees



Percentage of Women in Physics



Physics Bachelor Degrees Awarded to Underrepresented Minorities

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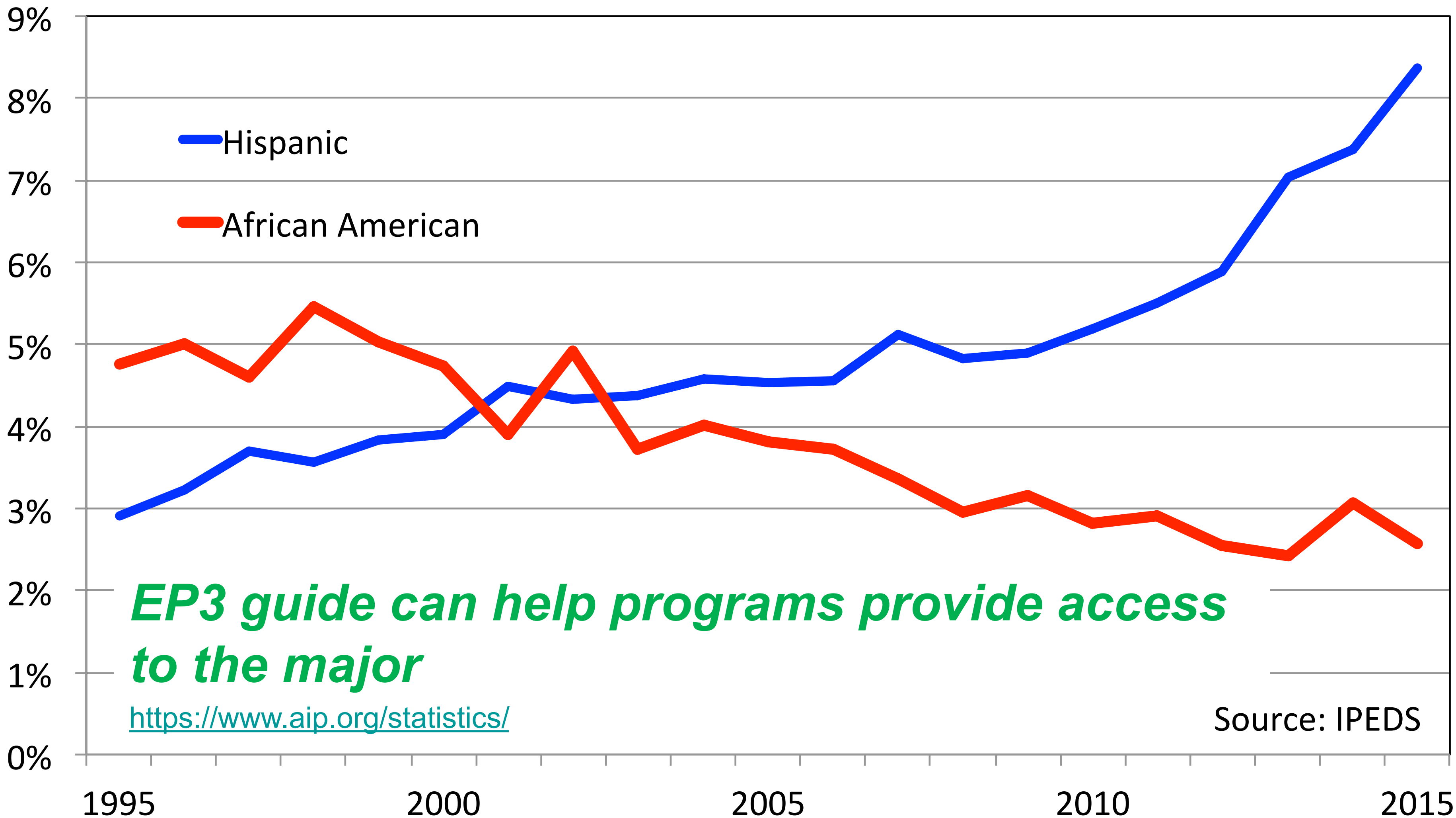

EP3 guide can help programs provide access to the major

https://www.aip.org/statistics/

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What is ..

the percentage of high school physics teachers who have a physics degree?

a. 80%
b. 70%
c. 60%
d. Less than 50%

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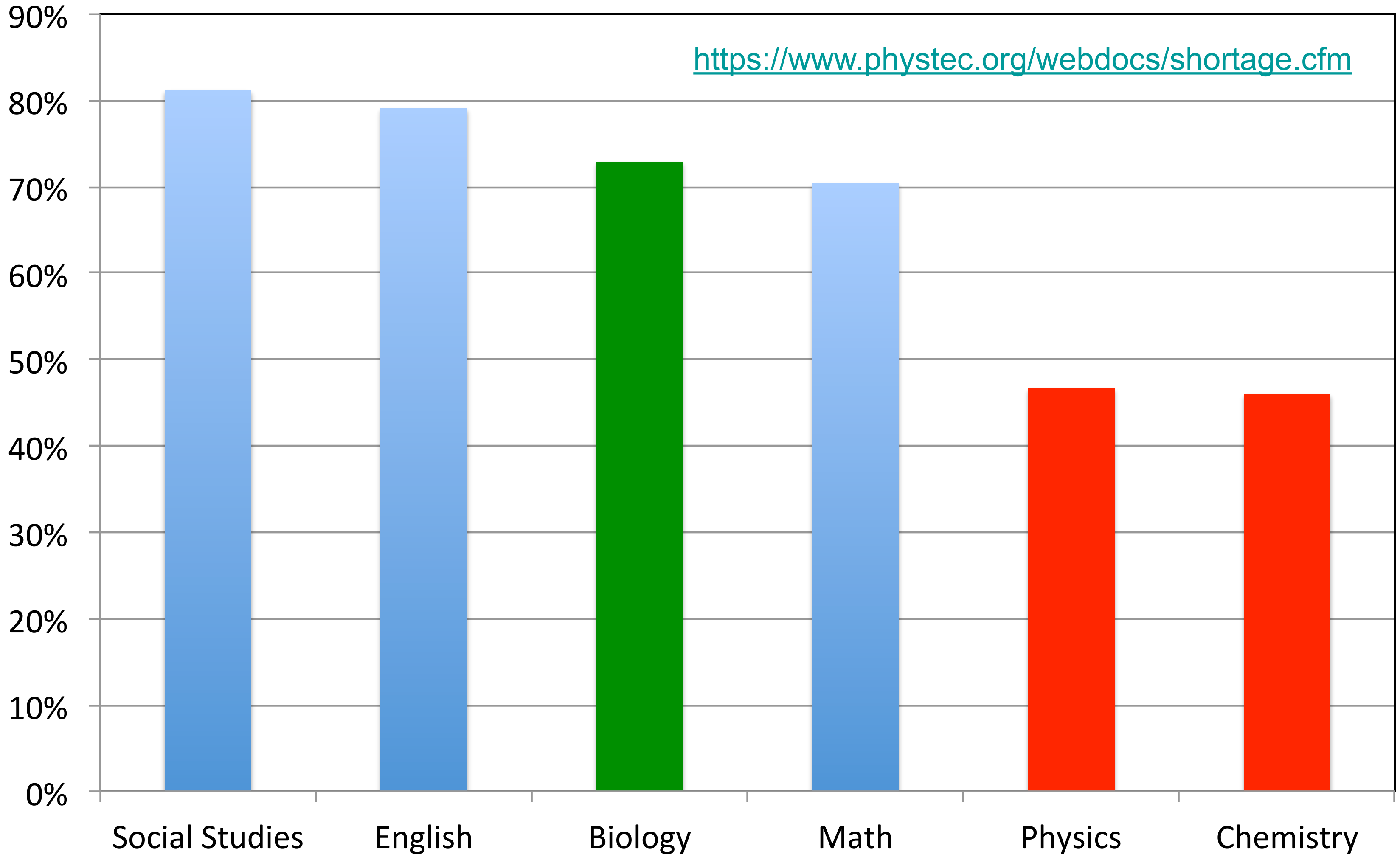
Physics Teacher Education Coalition

High school classes taught by teacher with degree in the field



Source: Schools and Staffing Survey

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What do these institutions have in common?

- Elizabeth City State University*
- Midwestern State University
- Prairie View A&M University*
- Southern Oregon University
- Tennessee State University*
- Texas Southern University
- University of Northern Iowa
- University of Southern Maine

*HBCU

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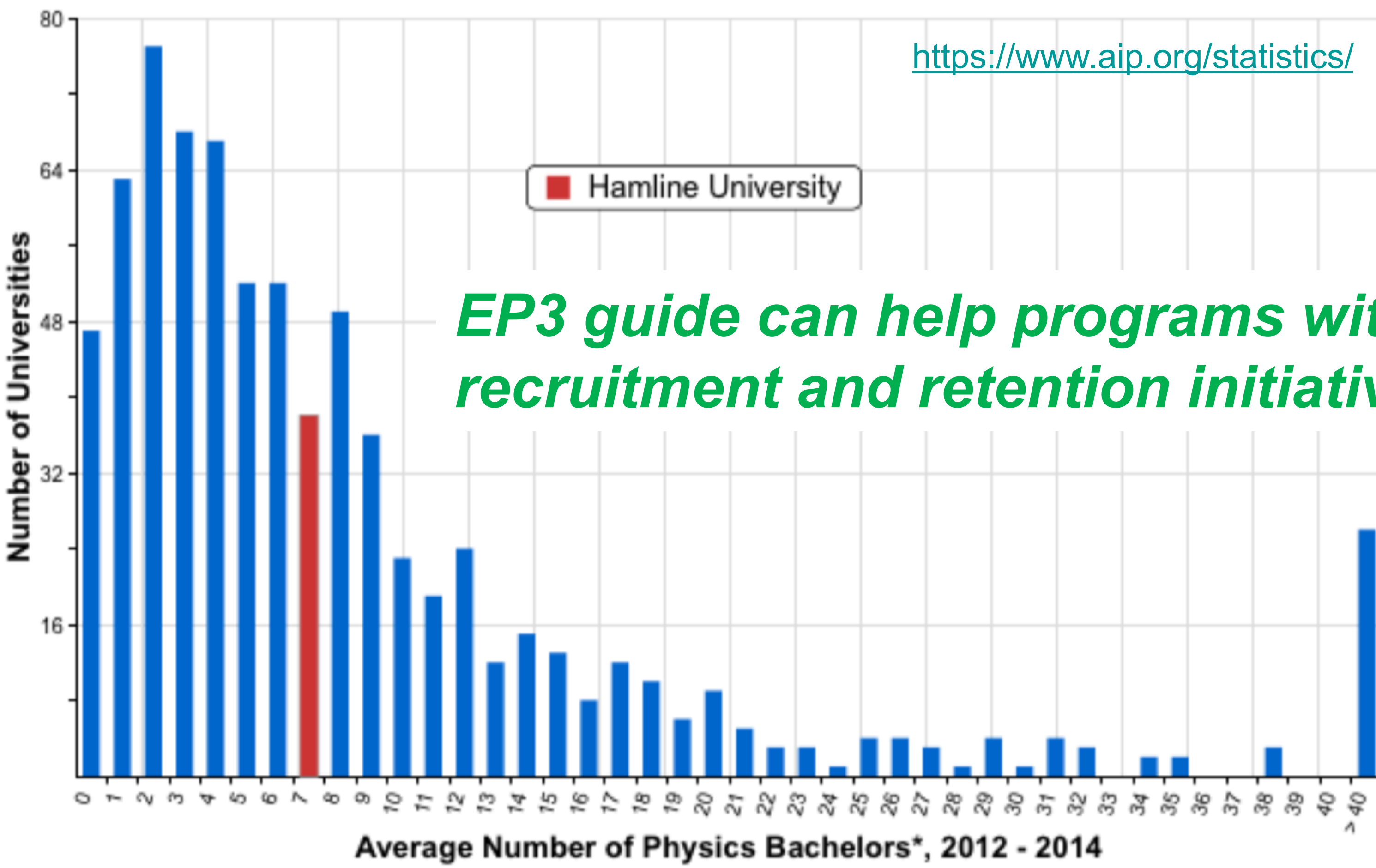
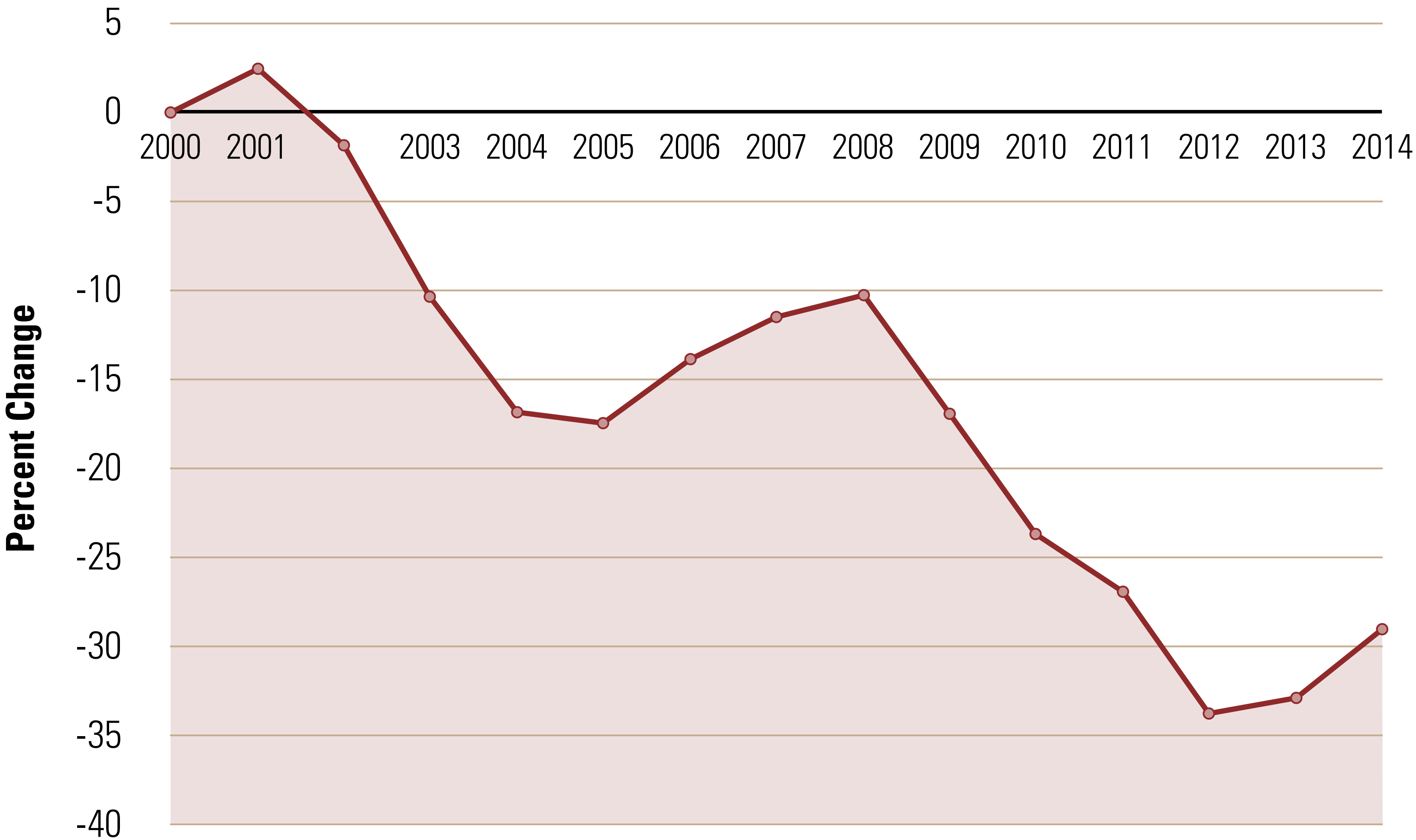
Physics Bachelor Degrees



EP3 guide can help programs with recruitment and retention initiatives.

www.aps.org/programs/education/statistics/compare.cfm

Change in Public Funding of Higher Education in the US



Source: The Lincoln Project: Public Research Universities - Recommitting to Lincoln's Vision: An Educational Compact for the 21st Century (Amer. Acad. of Arts & Sciences)

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Regional Accreditation

Regional Accrediting Bodies:

NWCCU
NORTHWEST COMMISSION ON COLLEGES AND UNIVERSITIES

WASC

CHEA Council for

EP3 guide can help with assessment, program review, <u>and</u> make the process meaningful.

HIGHER LEARNING COMMISSION

SACS COC

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Interactive Education: Read this Article

EP3 guide can help faculty implement evidence-based instructional strategies.

PNAS

Active learning increases student performance in science, engineering, and mathematics

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Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning ($n = 158$ studies), and that the odds ratio for failing was 1.95 under traditional lecturing ($n = 67$ studies). These results indicate that average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning. Heterogeneity analyses indicated that both results hold across the STEM disciplines, that active learning increases scores on concept inventories more than on course examinations, and that active learning appears effective across all class sizes—although the greatest effects are in small ($n \leq 50$) classes. Trim and fill analyses and fail-safe n calculations suggest that the results are not due to

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (*SI Materials and Methods*), and evaluated student performance using two outcome variables: (*i*) scores on identical or formally equivalent examinations, concept inventories, or other assessments; or (*ii*) failure rates, usually measured as the percentage of students receiving a D or F grade or withdrawing from the course in question (DFW rate).

The analysis, then, focused on two related questions. Does active learning boost examination scores? Does it lower failure rates?

Results

The overall mean effect size for performance on identical or equivalent examinations, concept inventories, and other assess-

PSYCHOLOGICAL AND COGNITIVE SCIENCES

Brief Timeline

STB*: Requests to APS to do what ACS does: Program Certification

2012: APS leadership asks Committee on Education (COE) to investigate

2013: Working group formed to investigate

2014: Survey of physics chairs, report written

2015: COE discusses, makes recommendation to APS Council
ABET announces intention to accredit all fields of natural science

2015: APS Council charges COE to form task force (BPUPP: "Best Practices for Undergraduate Physics Programs")

2016: COE begins process, drafts preliminary documents, recruits task force

2016: Task force begins meeting

2017: Applied for funding, beginning drafts & discussions on underlying issues, determination of content & structure of guide, development

2018: Guide development and dissemination begins in earnest

*Since Time Began

APS Council Charge for the Task Force

1. **Develop a guide for self-assessment of undergraduate physics programs founded on documented best practices linked to measurable outcomes**

   The guide should provide a physics-community-based resource to assist programs in developing a culture of continuous self-improvement, in keeping with their individual mission, context, and institutional type. The guide should include considerations of curricula, pedagogy, advising, mentoring, recruitment and retention, research and internship opportunities, diversity, scientific skill development, career/workforce preparation, staffing, resources, and faculty professional development.

2. **Recommend a plan for ongoing review and improvement of this guide under the oversight of the APS Committee on Education**

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Task Force Membership

Co-Chair: David Craig, Le Moyne College & Oregon State University

Co-Chair: Michael Jackson, Millersville University of Pennsylvania

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- Courtney Lannert, Smith College and UMass Amherst
- Ramon Lopez, University of Texas at Arlington
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www.aps.org/bpupp

Structure of the Online EP3 Guide

Chapters:

- Introduction: how to navigate and use the guide
- Assessment of Student Learning: developing a useful and efficient culture of assessment
- Departmental Leadership
- Effective Practices (~25 “sections”)
- Program Review:
  - Guide to reviewers
  - Preparing for a review
- Ancillary material: sample program learning outcomes, assessment plans, *etc.*

Tentative Section List

- Capstone experiences
- **Career preparation**
- Communications skills
- Computational skills
- Departmental climate
- Equity, diversity, and inclusion
- Ethics
- *Learning spaces and facilities*
- Faculty development
- Implementing research-based instructional practices
- Individualized degree tracks
- Institutional partnerships: dual-degree physics / engineering programs
- Internships
- Introductory Physics for Life Sciences
- Introductory STEM major courses
- Laboratory / experimental skills
- **Learning assistants**
- Mentoring / advising
- Non-STEM major courses
- Online education
- Community Engagement and Outreach
- *Recruiting*
- *Retention*
- ***Teacher preparation programs***
- **Undergraduate research**
- Upper-level physics courses

Example Online Section:

http://apps3.aps.org/bpupp/

High School Physics Teacher Preparation

Description

Physics programs are encouraged to implement, document, publicize, and support pathways to recruit and educate future high school teachers. This includes creating an environment within the program that promotes high school teaching as a valid and desirable career option for students.

⊕ Benefits to the Program

Effective Practices

1. Implement a teacher preparation pathway

⊕ Establish a degree track for high school teacher education within the major

1. In programs with one track, modify the existing degree to allow certification requirements
2. In programs with multiple tracks, design a teaching track to allow students to smoothly transition among degree options (should be perceived as on par with other career options)
3. Collaborate with School of Education or its equivalent to accurately communicate required components for licensure (curriculum, field experiences, testing, etc.) to students
4. Design the program (individually or with other science departments) in collaboration with the College of Education to meet licensure requirements
5. Learn from existing models, e.g., PhysTEC and UTeach employ practices and strategies for recruiting, preparing, and supporting teachers that begin within the physics program
6. Be mindful not to add extra expense or time to graduation

⊕ Understand alternate pathways to teacher certification

⊕ Support recent graduates during their transition into the classroom

What the EP3 Guide Is

- Collection of community knowledge and evidence-based practices
- Authored, reviewed, approved by physics community
- *Living* document (not static), with stewardship by APS COE
- Primarily online
- Ethics and diversity included throughout
- Effort to implement evidence-based pedagogy
- Transform mandatory assessment into useful exercise
- Suggestions on how to improve all aspects of a program
- Opportunity to extend reach of education research

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What the EP3 Guide is <u>NOT</u>

The EP3 guide is **<u>NOT</u>**

- Accreditation
- Program certification
- Mandate to conform
- ‘To-do’ list departments are required to complete
- **Finished (yet)**

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EP3 Guide's Forthcoming Timeline

17/18: Initial drafts; external input on drafting sections; external section reviews by invited department chairs and experts in the field; NSF proposals; establish processes for soliciting section authors and reviewers with diverse points of view in the community; completion of one section

2018: Limited release of first sections; feedback from community; primary push to develop guide sections and solicit feedback (1 completed, 3 received from authors, 3 in development)

2019: Begin workshops on use of guide; training of departmental reviewers

19/20: Release of entire (1st edition) of guide; continued workshops

20/21: First review by COE to update/improve content, updating of review procedures to ensure fidelity of design principles

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References

SPIN-UP 2002 (enrollment):

aps.org/programs/education/undergrad/faculty/spinup/

T-TEP 2012 (teacher education):

phystec.org/webdocs/TaskForce.cfm

Phys21 2016 (careers):

compadre.org/phys21/

Vision and Change 2011 (biology):

visionandchange.org

Active learning:

Scott Freeman, et al., “Active learning increases student performance in science, engineering, and mathematics,” PNAS **111** (23), 8410-8415 (2014).

PTEPA (assessment):

Physics Teacher Education Program Analysis: phystec.org/thriving

Contact?

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This material is based upon work supported by the National Science Foundation under Grant Nos. 1738311, 1747563
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.