

APS April Meeting

13 April 2008

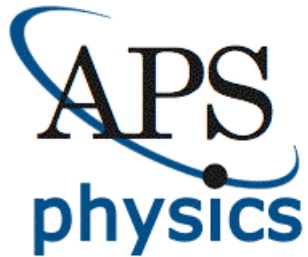
St. Louis, MO

Statistics and Rationale for the Doubling Initiative

Theodore Hodapp

American Physical Society

Director of Education and Diversity

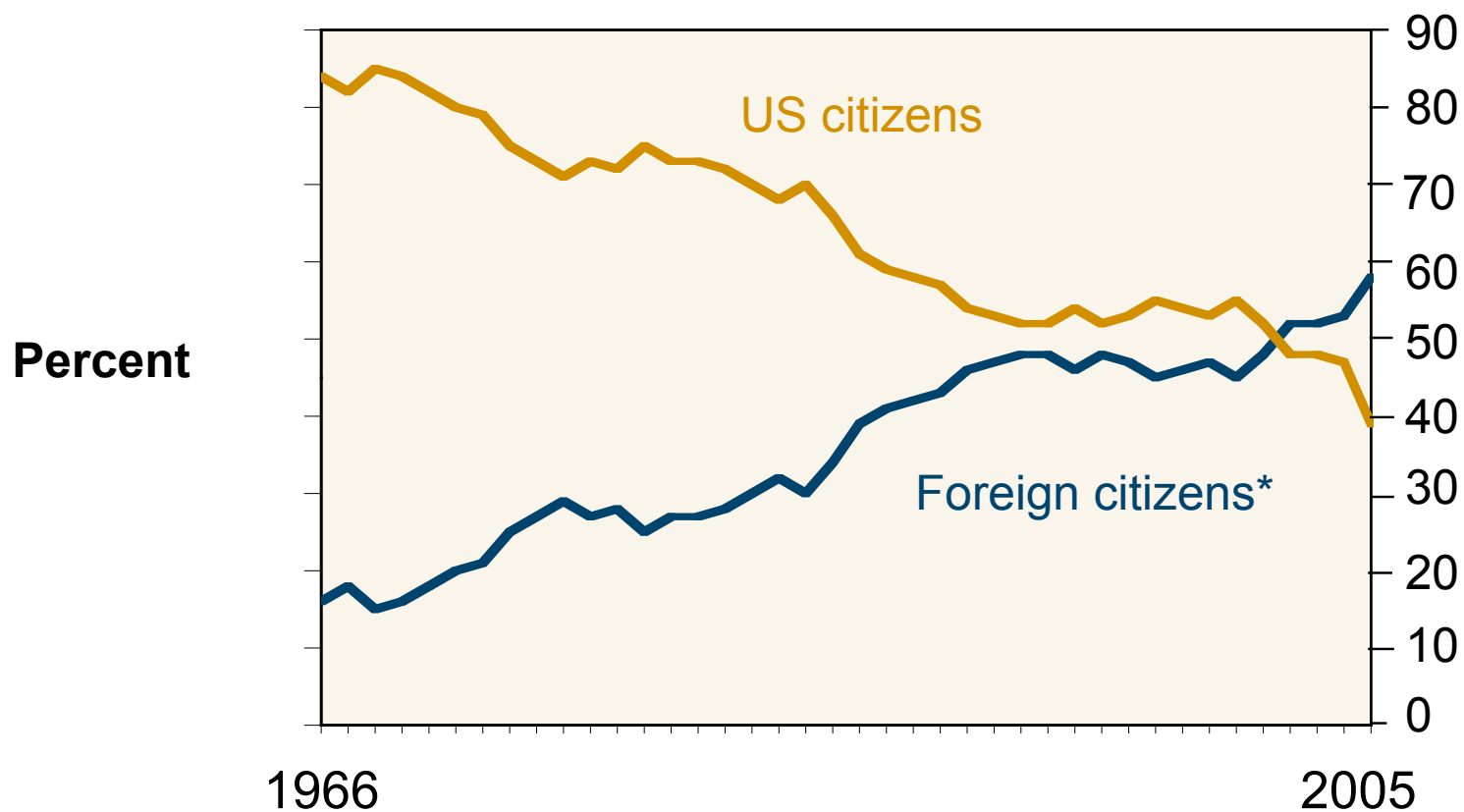


APS / AAPT Statement on Doubling

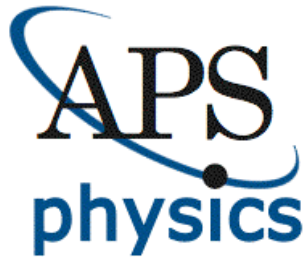
We advocate doubling the number of bachelor degrees in physics to address critical national needs including K-12 education, economic competitiveness, energy, security, and an informed electorate

- An essential area of increase is in the number of highly-qualified high school physics teachers
- An essential area of increase is in the fraction of both women and under-represented minorities who major in physics

Citizenship of Physics PhDs, 1966 - 2005



Sources: NSF(1966-1991), AIP (1992-2005)

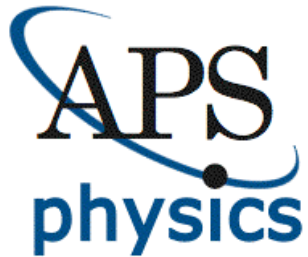


Calls to Action

- 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.*



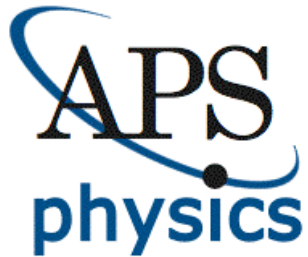
Other Statements

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



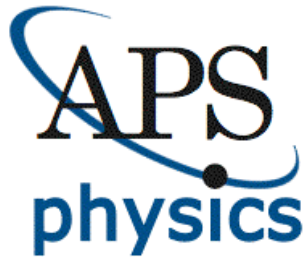
Teacher Shortages

U.S. Department of Education estimates that an **additional 2.2 million teachers** will be needed over the next decade, exceeding the annual production rate of new teachers.

More specifically, “hard-to-staff” schools in **high-poverty urban and rural districts will require more than 700,000 new teachers** in the next 10 years.

Many states also have identified specific subject-area shortages that exist across their schools in topics such as **math and science.**

Education Commission of the States
<http://www.ecs.org/clearinghouse/61/61/6161.htm>



Workforce Needs

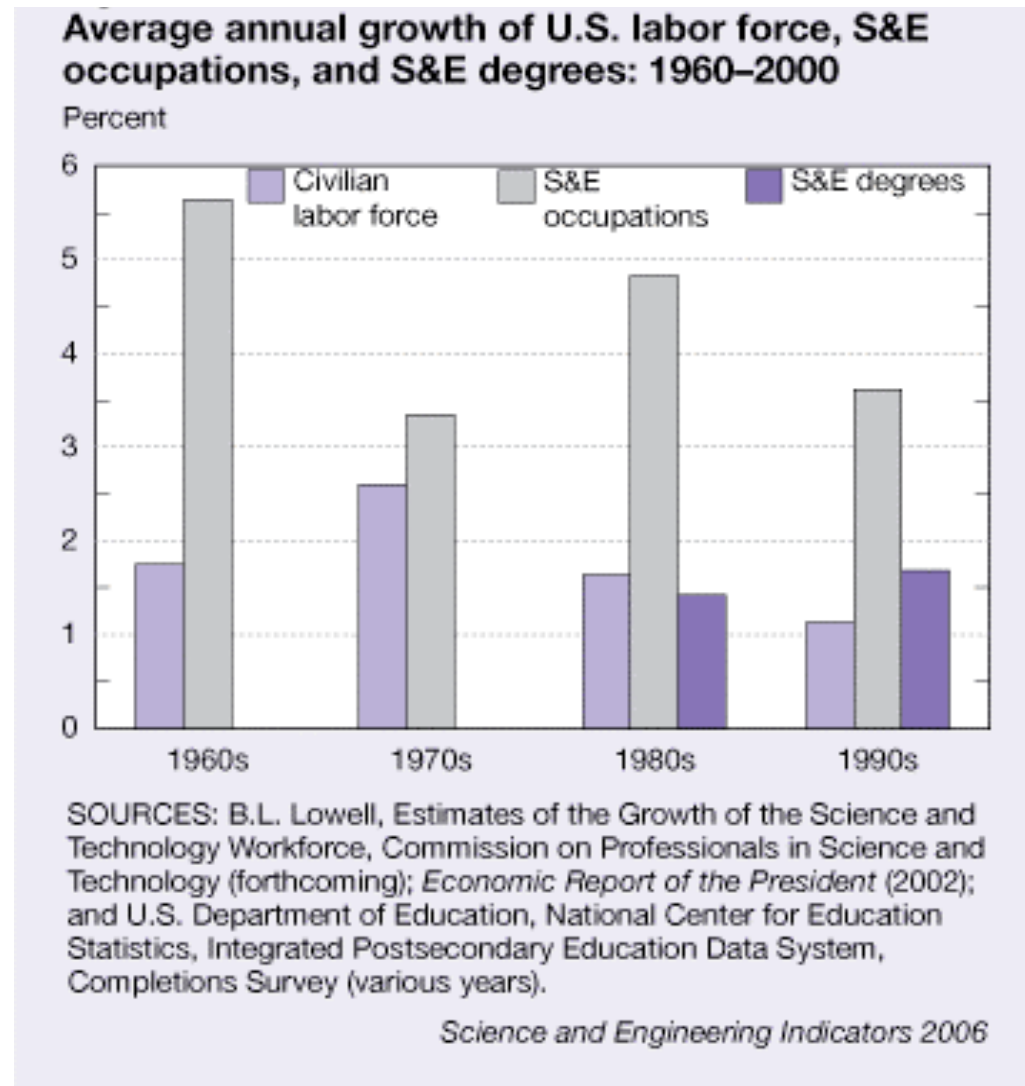
Nuclear Industry

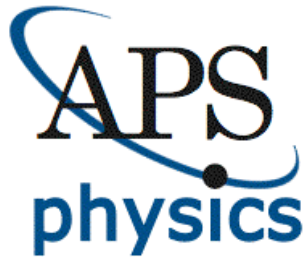
- 104 Commercial nuclear generating units currently operating
- 10% US electrical generating capacity
- No new licenses since 1996
- 8 license applications submitted since Nov 2007
- 33 units expected by 2010

Medical Physics

- ~3200 jobs in medical physics (most in radiation oncology [78%] and medical imaging [16%])
- ~300 new positions/year more than current capacity

Workforce Growth





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	4.32

Physics 4.31

Mental Retardation (Spec. Ed.)	4.23
Learning Disability (Spec. Ed.)	4.22

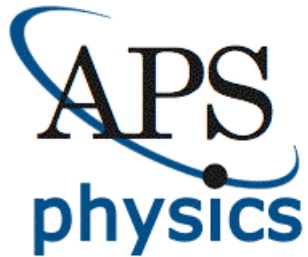
Mathematics Education 4.21

Fields with Some Shortage (4.20 - 3.41)

Visually Impaired	4.20
-------------------	------

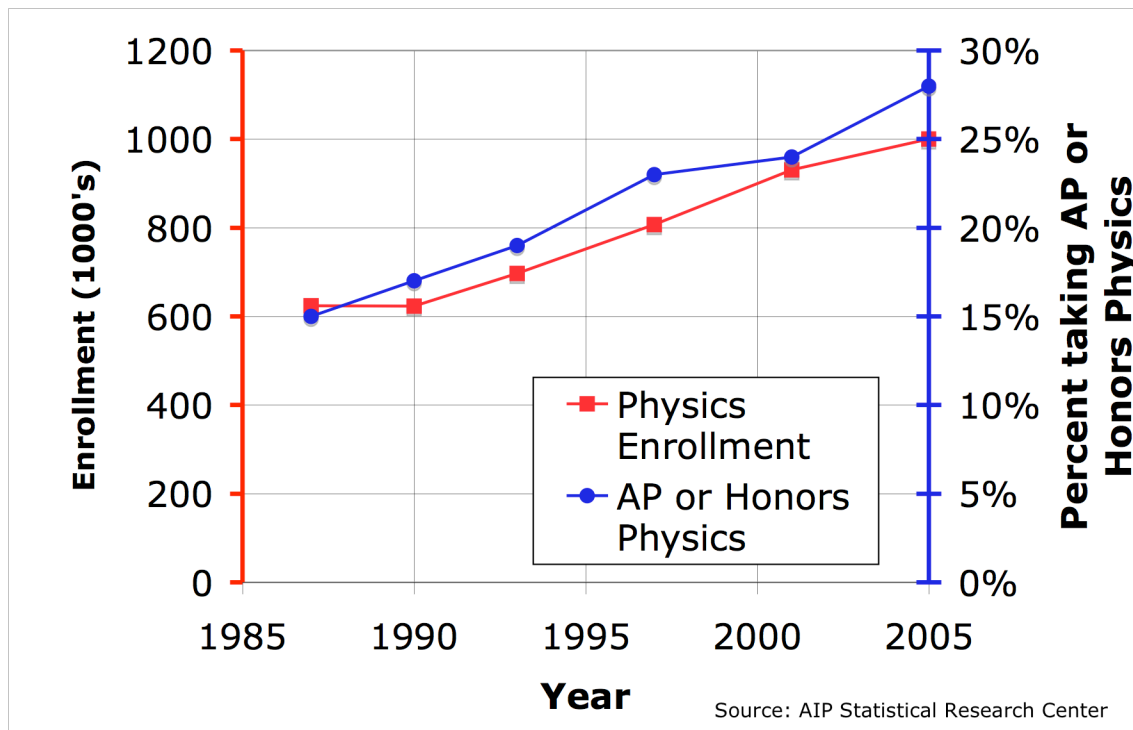
Chemistry 4.16

2004 AAEE (*American Association of Employment in Education*)
Educator Supply and Demand in the United States Report



Demographics of High School Physics Teachers

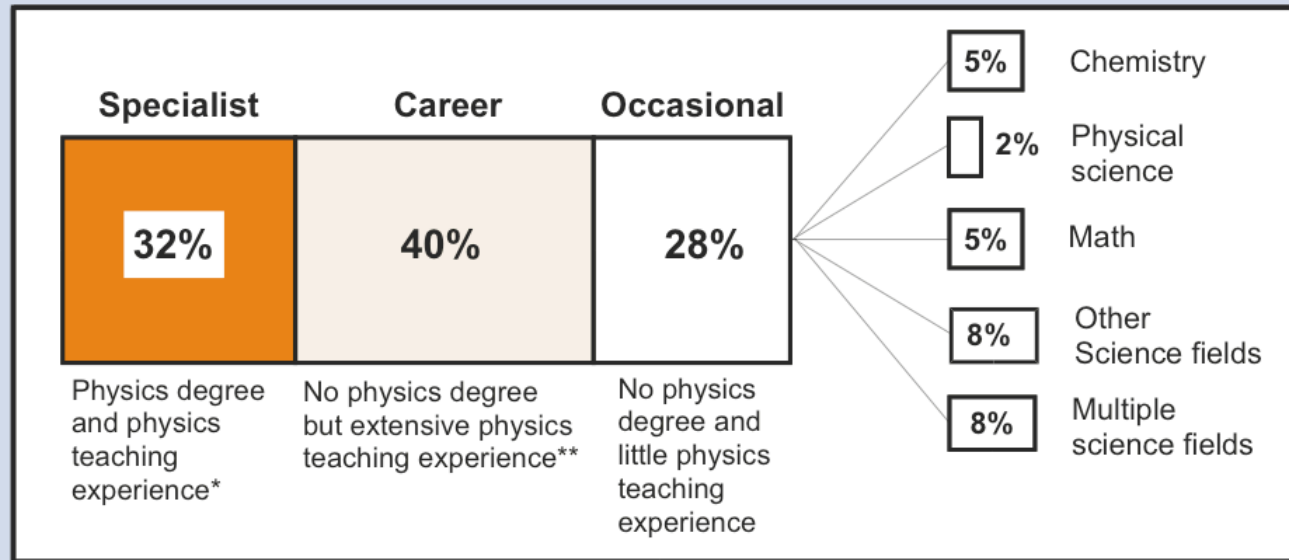
- 21,300 Physics Teachers Nationwide
- 1,200 new physics teachers each year
- ~400 of these have physics major or minor



- Number taking physics growing by 1% per year

Preparation of High School Physics Teachers

Teacher Specialization: Academic Training and Experience



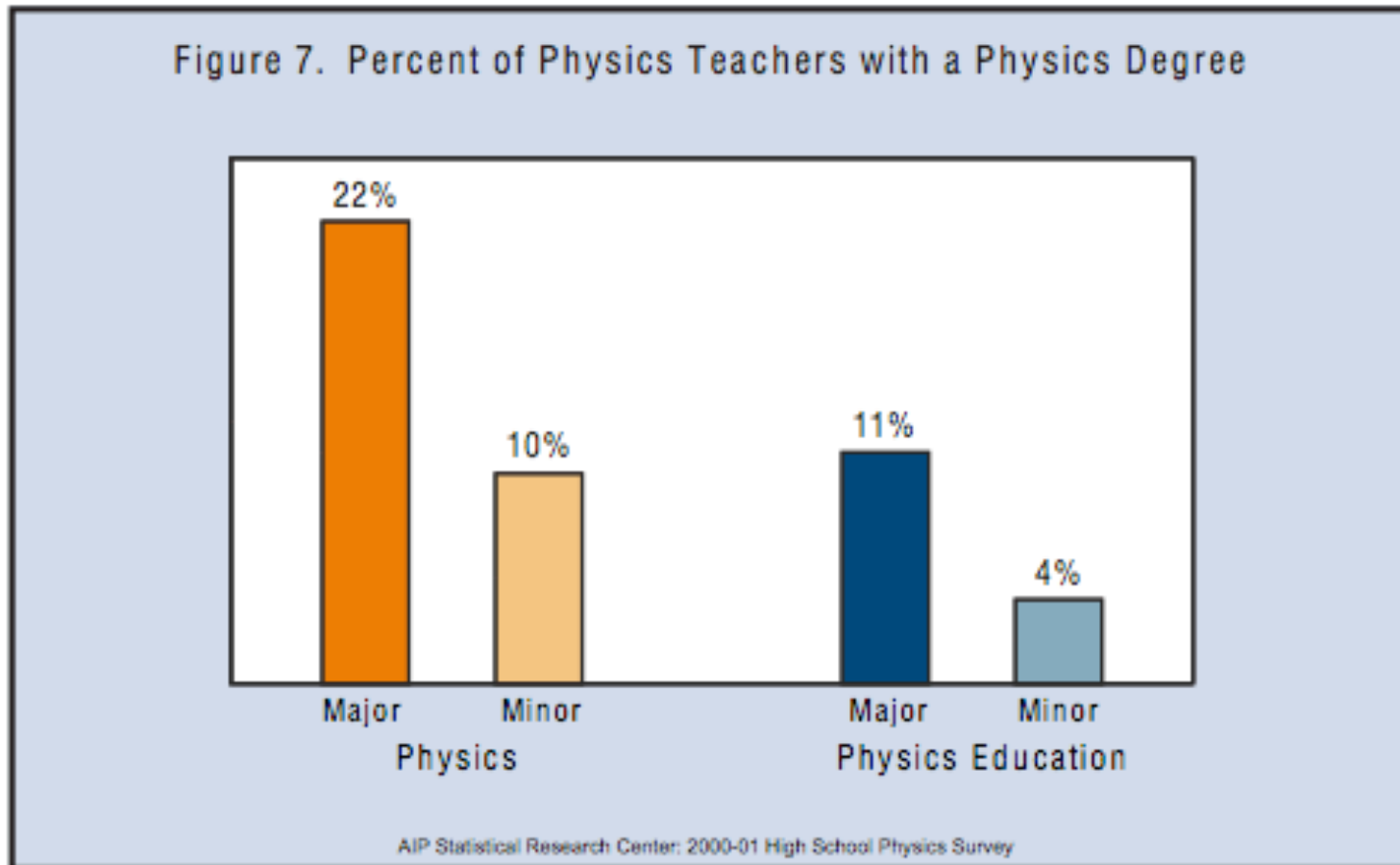
*Teachers with physics degrees but insufficient physics teaching experience are excluded from this figure (3%).

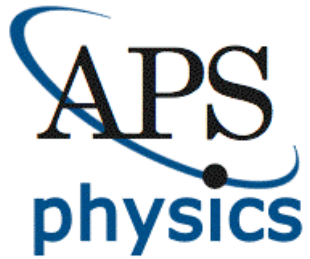
**Career physics teachers include those who have taught physics as much as, or more than, any other subject, or have taught it for ten or more years. The distribution of highest degree earned by career teachers was spread evenly across the sciences, with 29% in math/engineering, 25% chemistry, 22% biology, and 14% in other science fields.

AIP Statistical Research Center: 2000-01 High School Physics Survey

One third of **all** STEM teachers have no STEM degree
www.APS.org

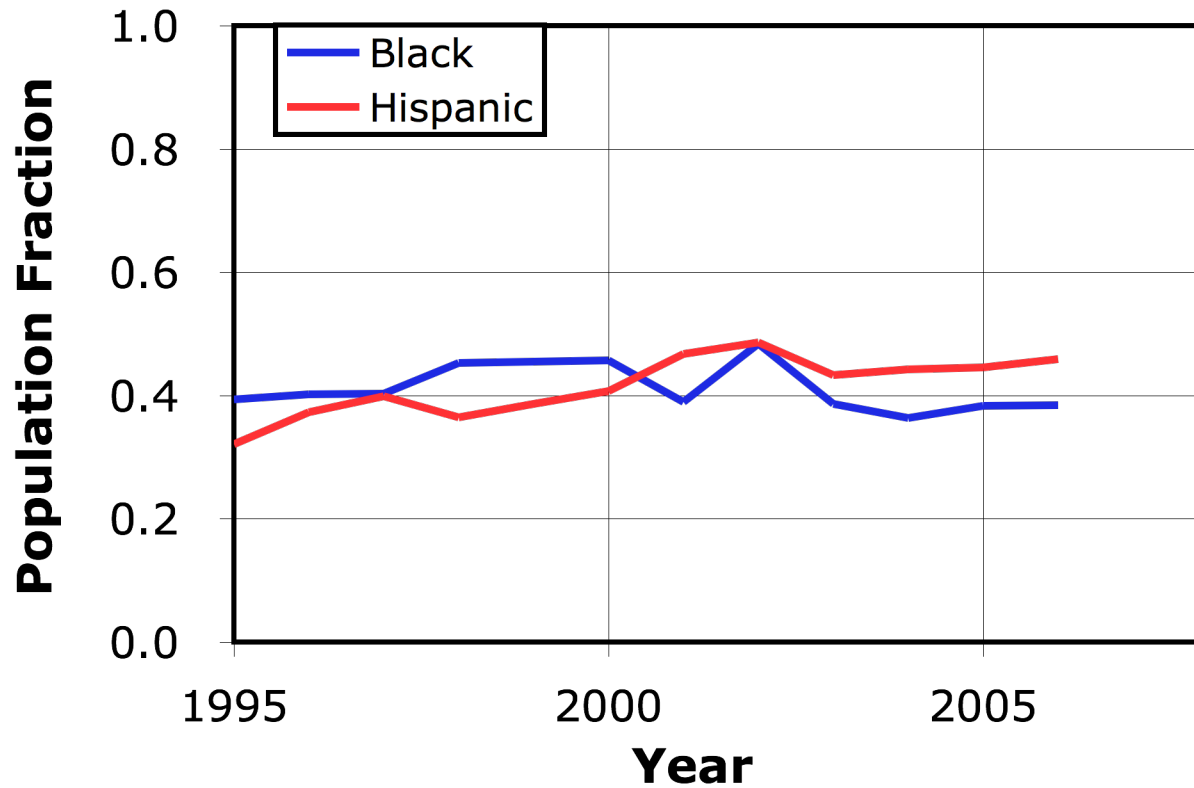
Physics Teacher Education





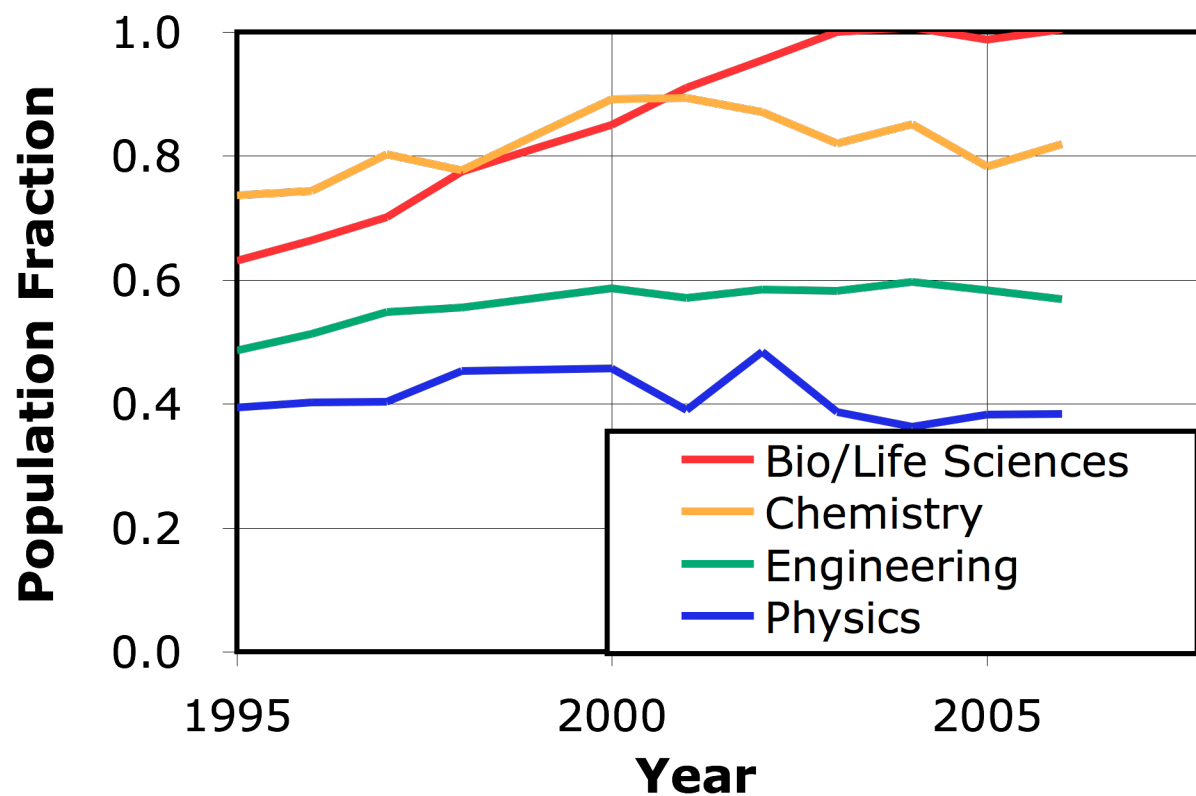
Minority Bachelor Degrees

Minority Representation in Physics: Bachelor Degrees



Source: National Center for Education Statistics

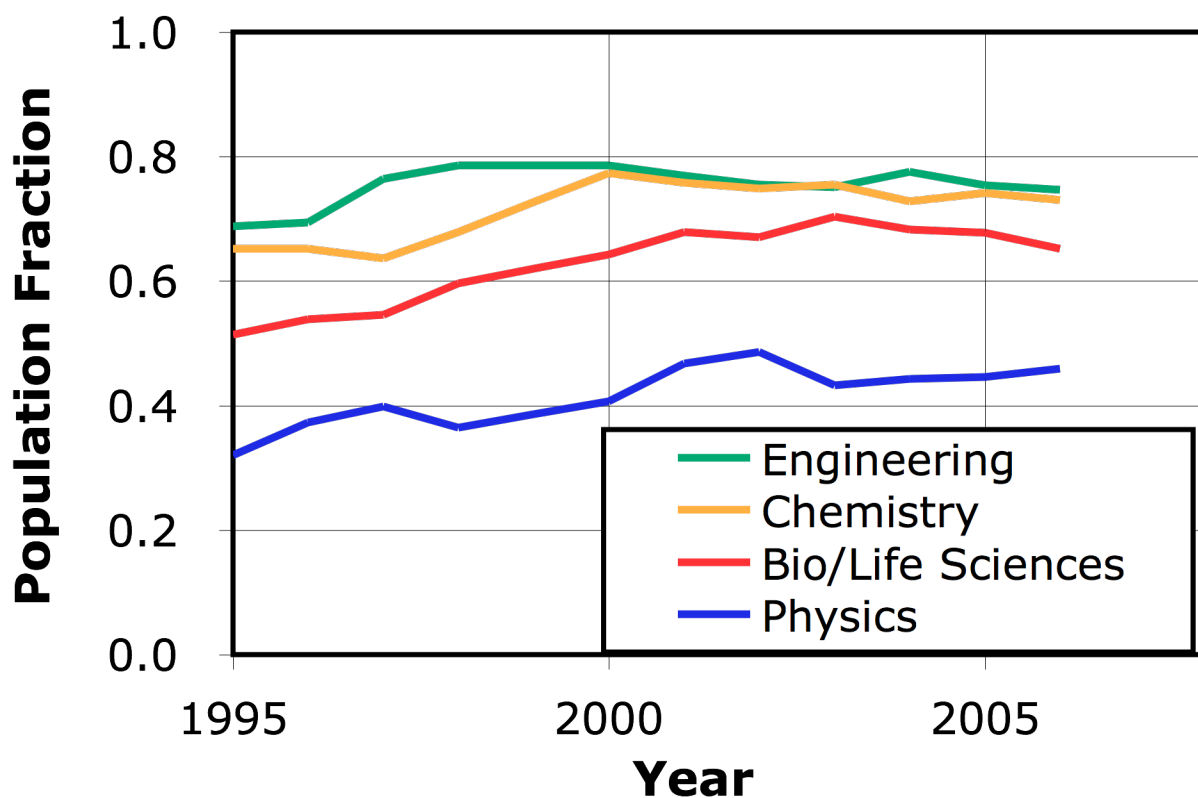
Black Bachelor Degrees: STEM Fields



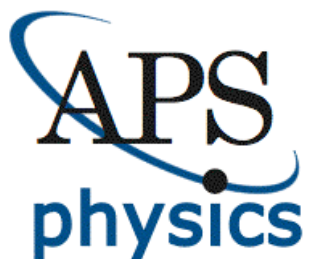
Source: National Center for Education Statistics

Hispanic Americans

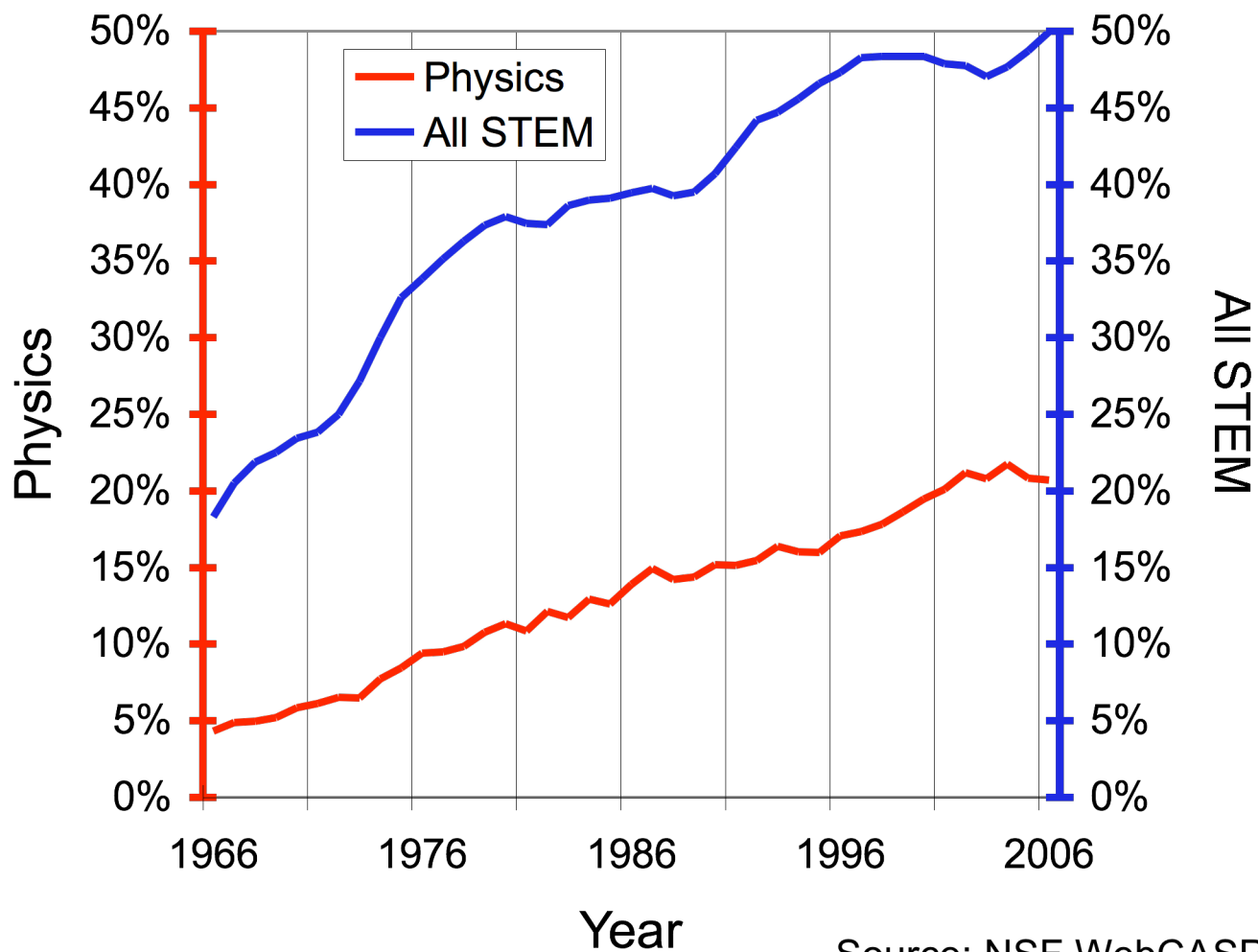
Hispanic Bachelor Degrees: STEM Fields



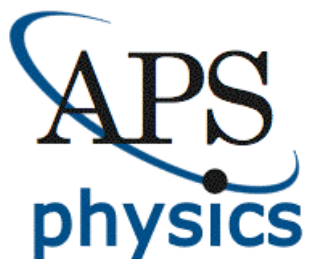
Source: National Center for Education Statistics



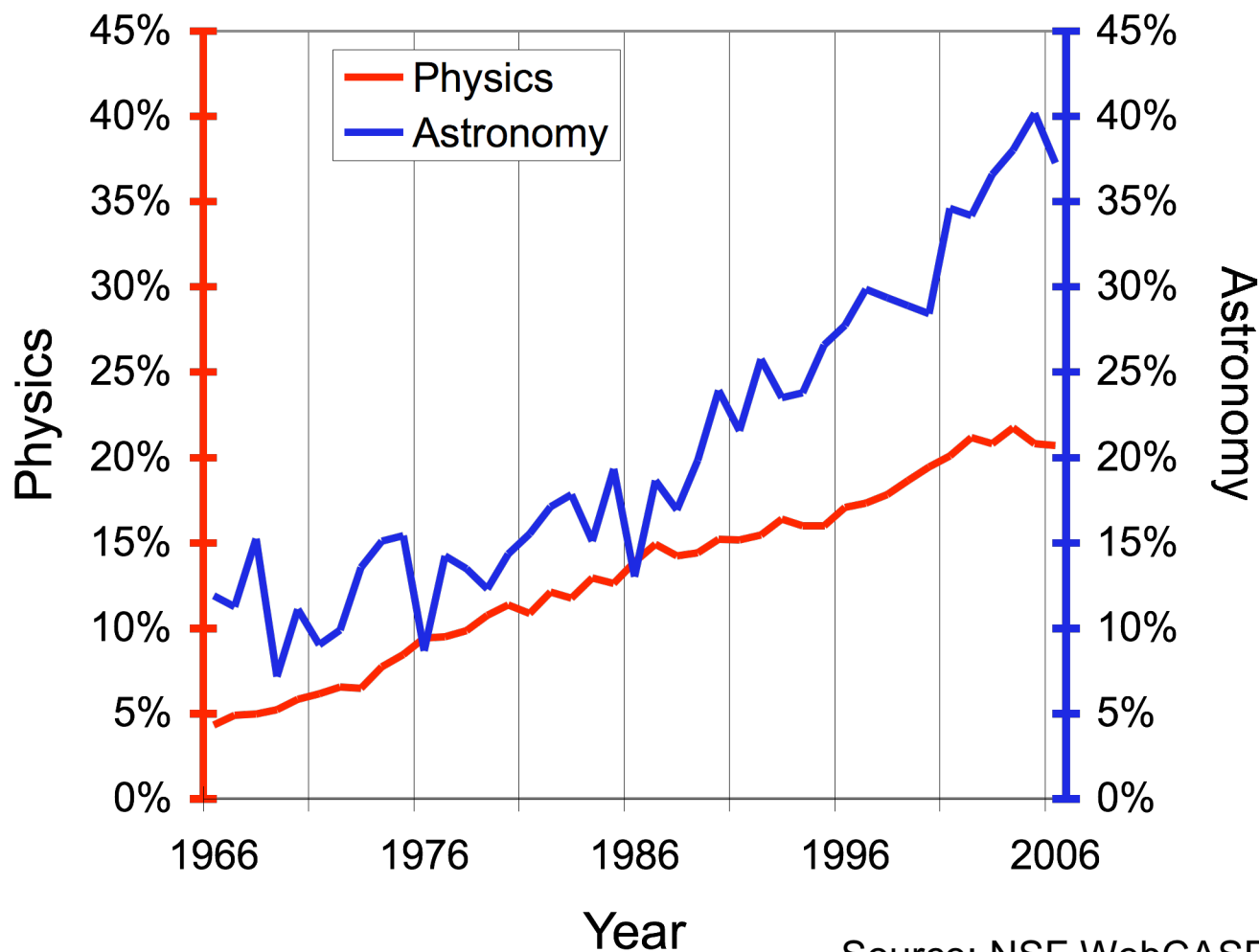
Female Fraction of Bachelor Degrees



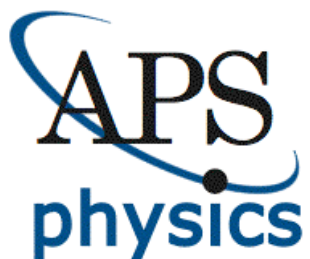
Source: NSF WebCASPAR



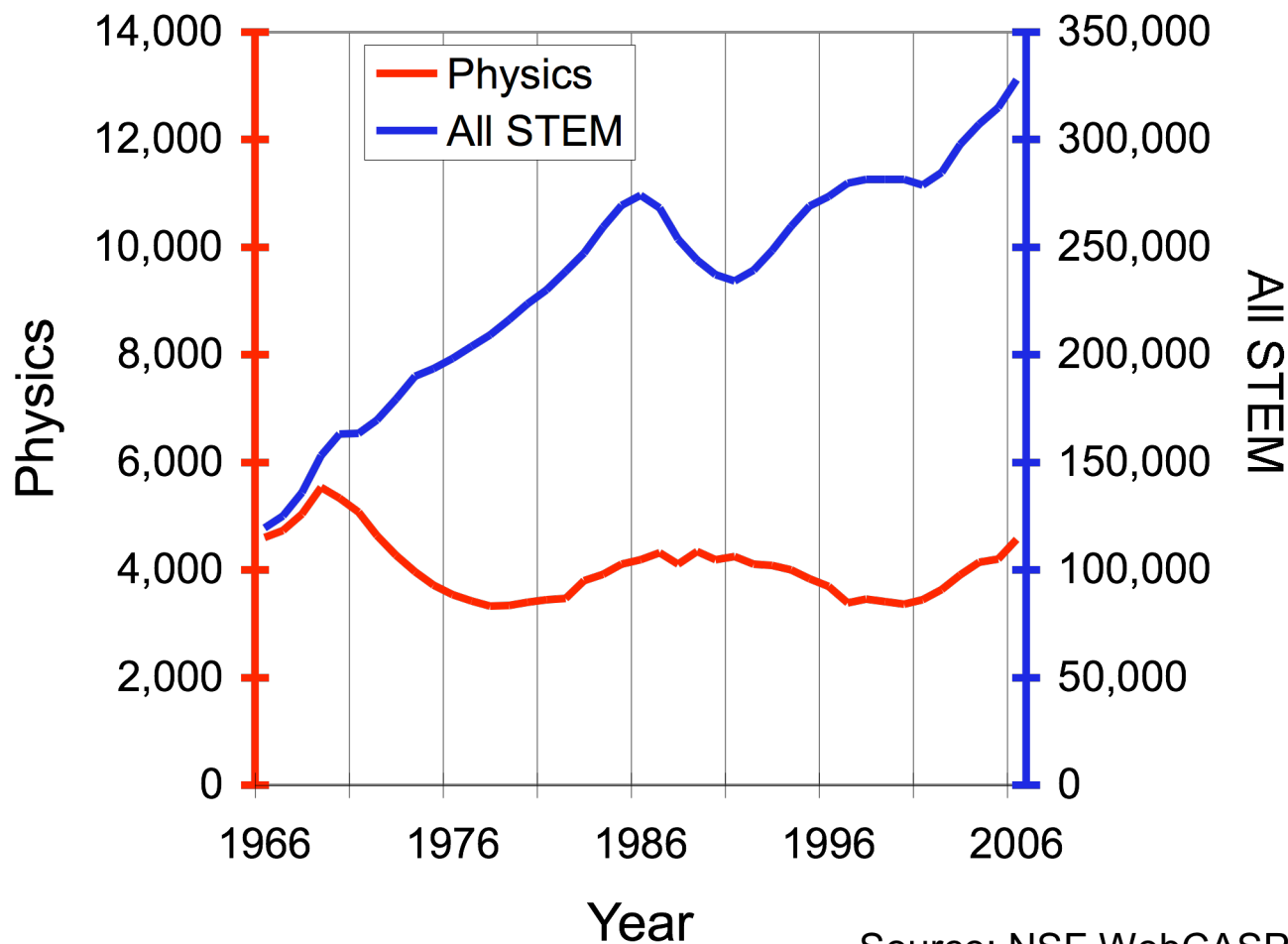
Women in Physics / Astronomy



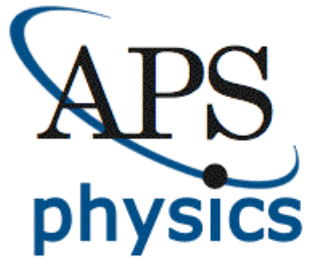
Source: NSF WebCASPAR



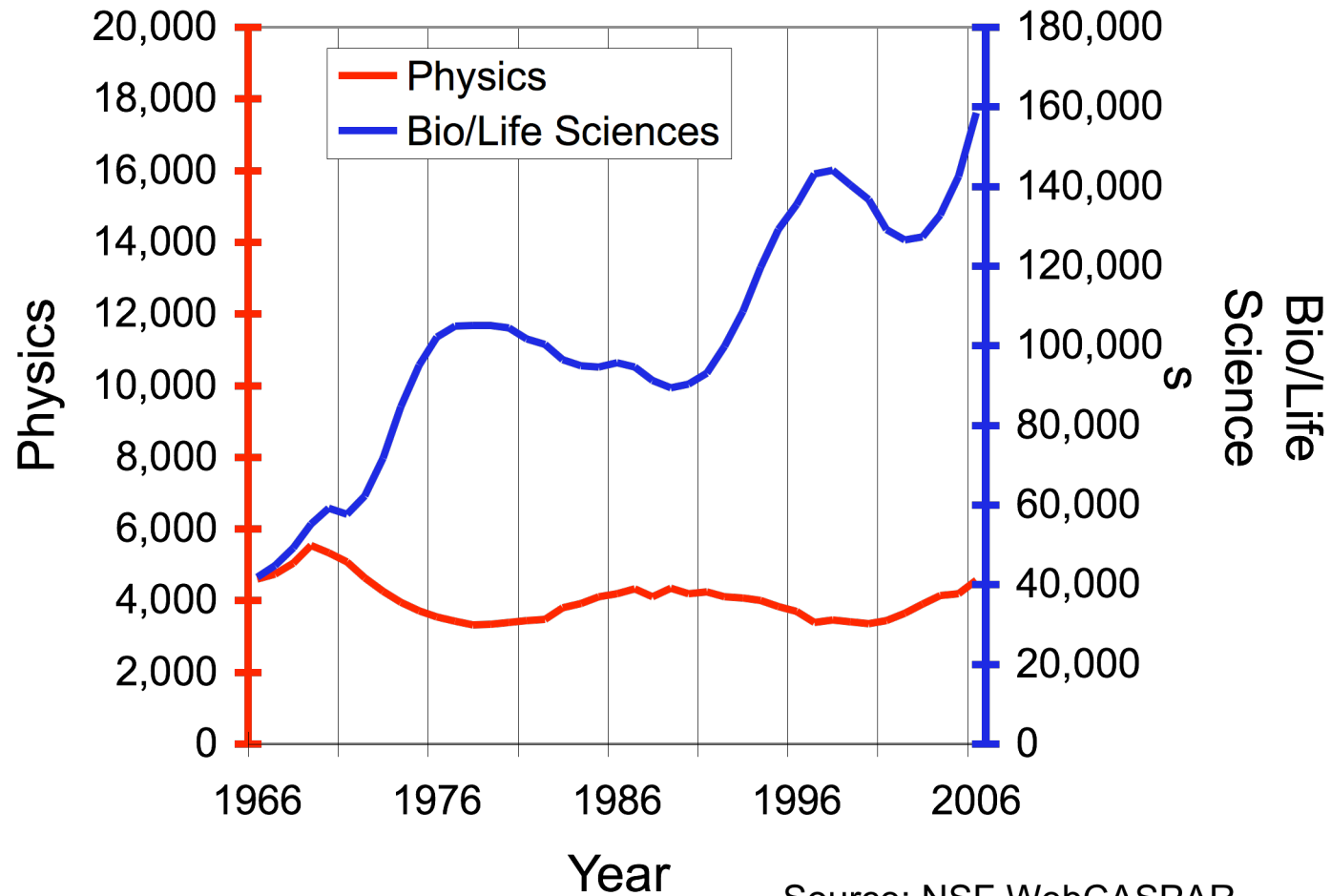
Physics / STEM Bachelor Degrees



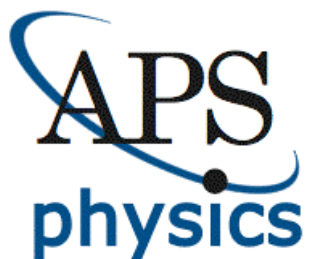
Source: NSF WebCASPAR



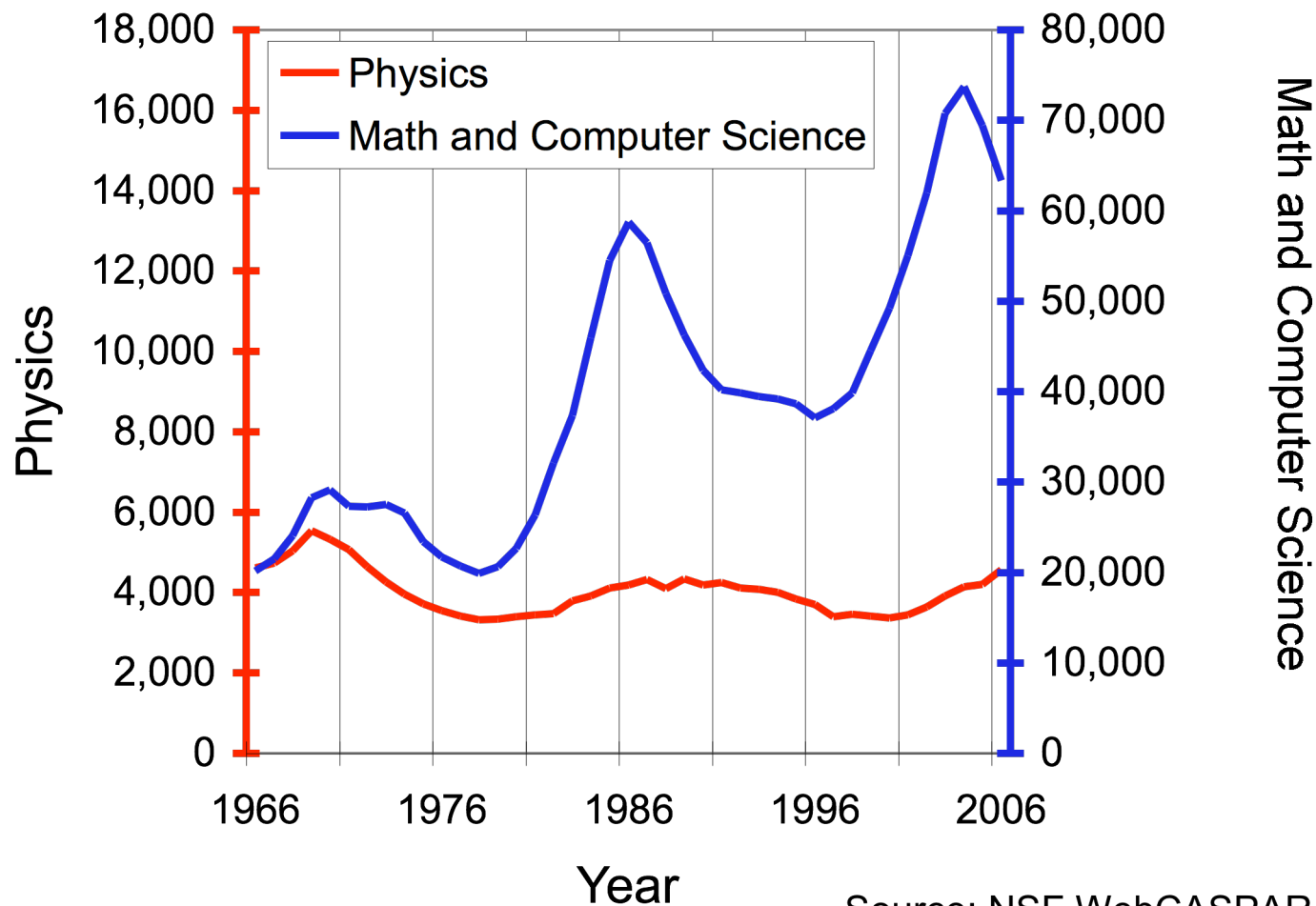
Physics / Biology Bachelor Degrees



Source: NSF WebCASPAR

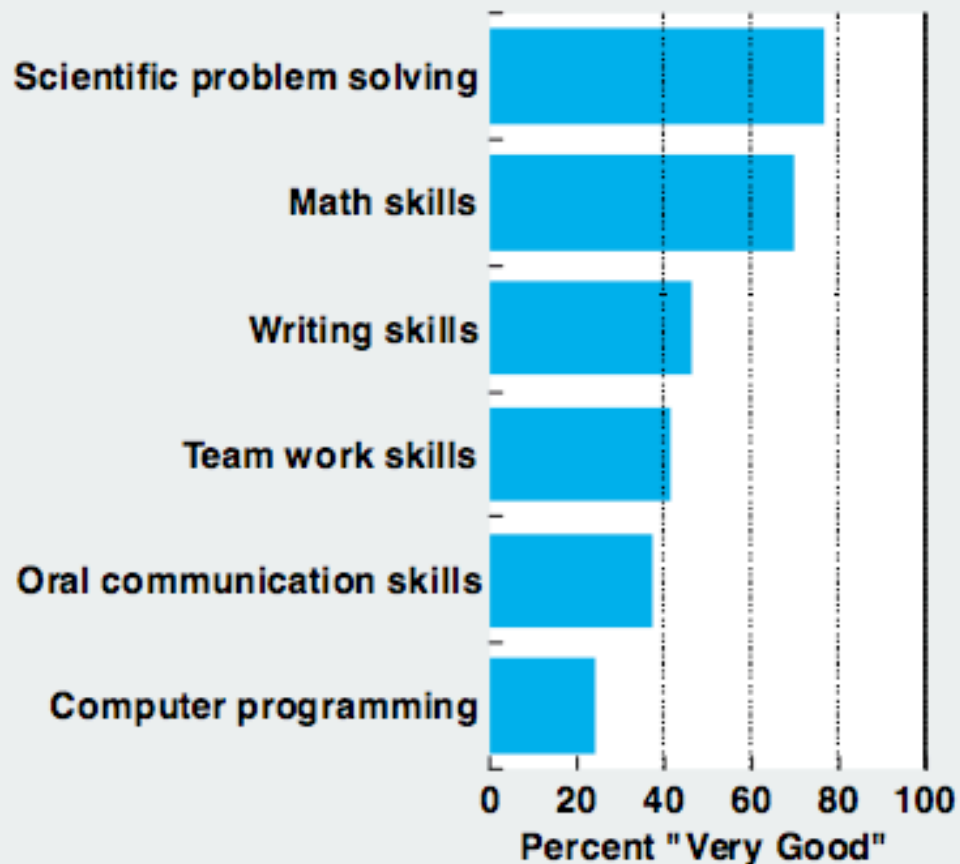


Physics / Math & CS Bachelor Degrees



Source: NSF WebCASPAR

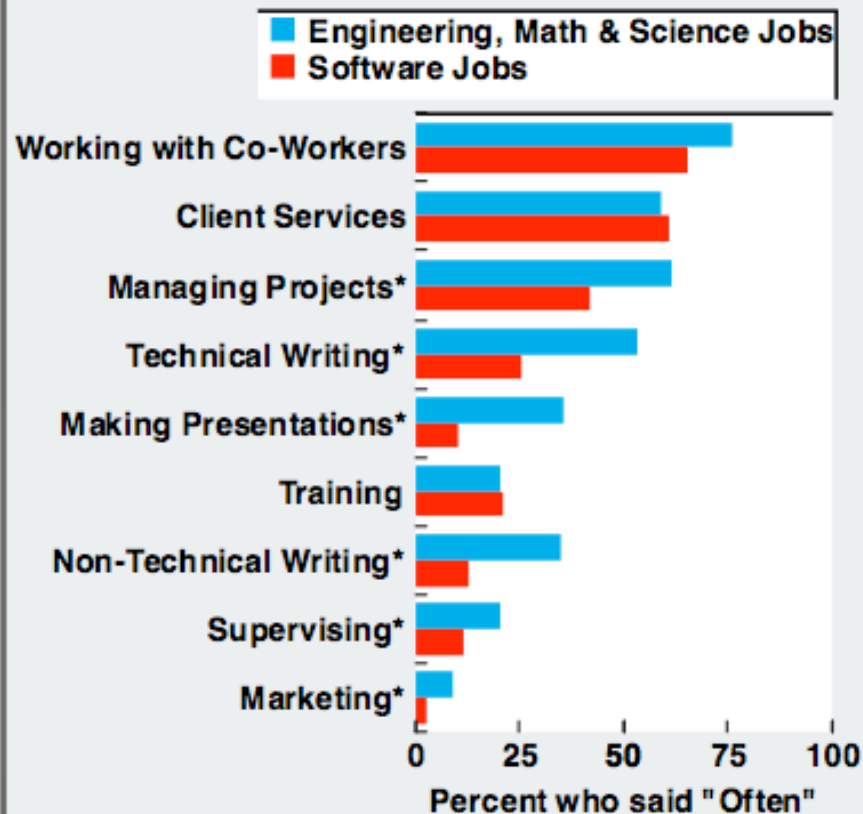
Figure 4. Rating of Physics Bachelors' Education 5 to 8 Years After Graduation



These data reflect the percentage who chose 4 or 5 on a 5-point scale where 1 = terrible and 5 = excellent. Based on physics bachelors with no additional degrees who are not primarily students.

AIP Statistical Research Center, 1998-99 Bachelors Plus Five Study

Figure 3. Time Spent on Job Activities by Physics Bachelors 5 to 8 Years After Graduation

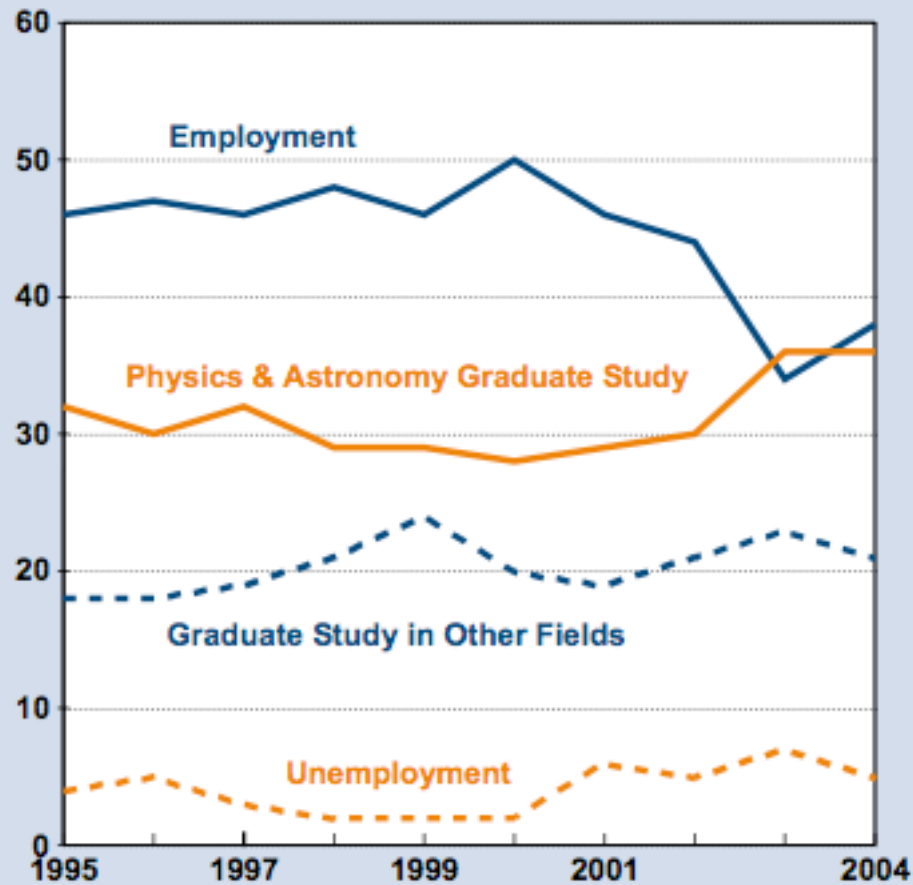


These data reflect the percentage who chose 4 or 5 on a 5-point scale where 1 = none and 5 = extensive. Based on physics bachelors with no additional degrees who are not teachers or primarily students.

*Differences between the two fields of employment are significant at $\alpha \leq .05$.

AIP Statistical Research Center, 1998-99 Bachelors Plus Five Study

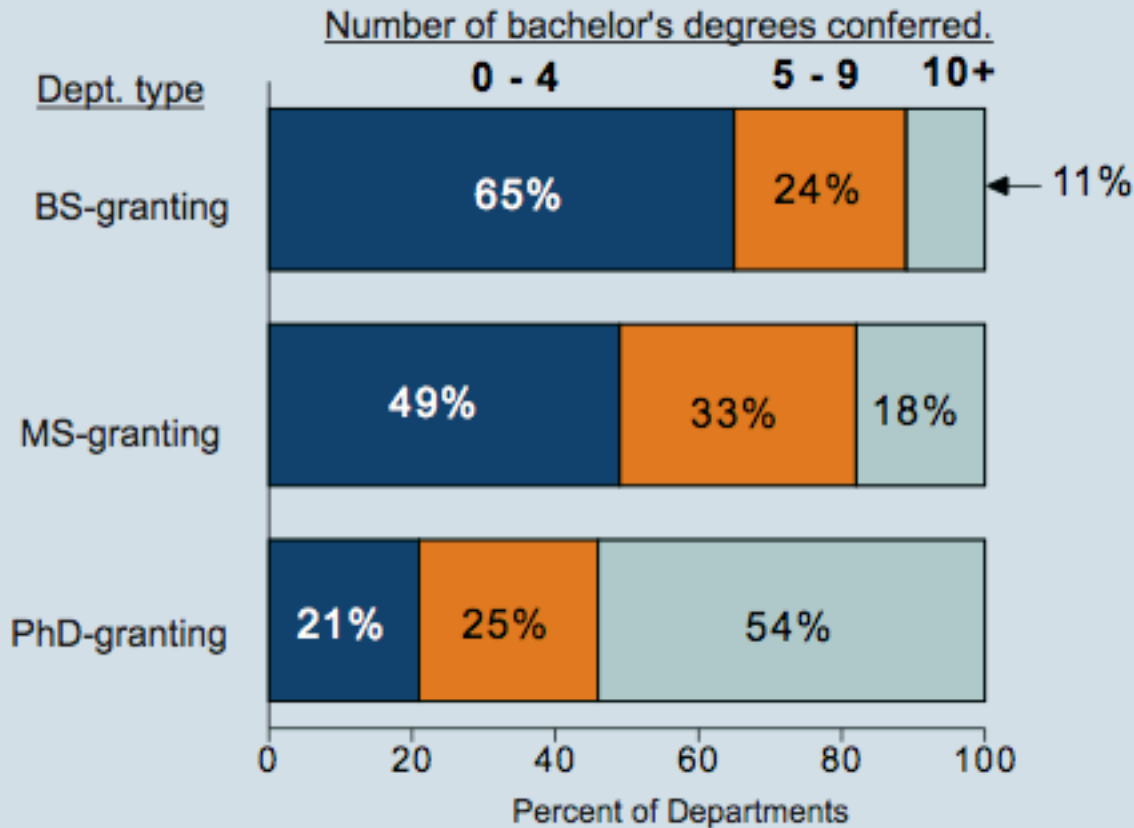
Figure 2. Trends in initial outcomes of physics bachelor's, classes of 1995-2004.



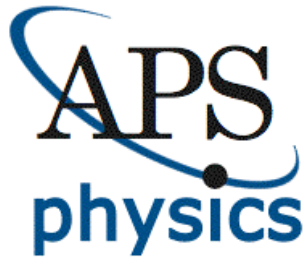
AIP Statistical Research Center, Initial Employment Report.

Where are BS Degrees Produced?

Figure 9. Size of undergraduate program by highest physics degree offered, class of 2005.



AIP Statistical Research Center, Enrollments and Degrees Report.



How to Respond / Act?

- Read the SPIN-UP
(www.aapt.org/Projects/ntfup.cfm)
 - Construct flexible degree programs for majors
 - Put best people into introductory courses
 - Provide student study spaces / SPS chapter
- Form a Doubling Committee
- Speak with colleagues from places with large gains
- Join PTEC and improve teacher preparation
- Attend NSBP/NSHP meetings
- Attend to department “culture”
- Market the degree

Table 8. PhD-granting departments averaging 20 or more physics bachelor's degrees per year, classes of 2003, 2004 and 2005.

	Annual Average		Annual Average
U of California-Berkeley	77	Cornell U (NY)	28
U of Washington	71	Ohio State U	28
Mass Inst of Technology	68	U of California-Davis	28
Brigham Young U (UT)	55	U of Minnesota-Minneapolis	27
U of Illinois-Urbana/Champaign	44	Pennsylvania State U	26
U of California-Los Angeles	41	U of Michigan-Ann Arbor	26
U of California-Santa Barbara	36	Carnegie Mellon U (PA)	25
U of Texas-Austin	36	Rensselaer Polytech Institute (NY)	25
U of Arizona	35	U of Wisconsin, Madison	25
U of California-San Diego	34	Georgia Inst of Technology	24
Rutgers U-New Brunswick (NJ)	34	Purdue U-West Lafayette (IN)	24
U of Maryland-College Park	33	U of Florida	24
Colorado School of Mines	32	U of Utah	24
U of Virginia	32	Portland State U (OR)	21
U of California-Santa Cruz	31	Stanford U (CA)	21
California Inst of Technology	30	Boston U (MA)	20
Cornell U-Applied (NY)	29	U of California-Davis Applied	20
U of Chicago (IL)	29		

Note: List includes only those departments who contributed degree data for all 3 years.
AIP Statistical Research Center, Enrollments and Degrees Report.

Table 6. Bachelor's-granting departments averaging 10 or more physics bachelor's degrees per year, classes of 2003, 2004 and 2005.

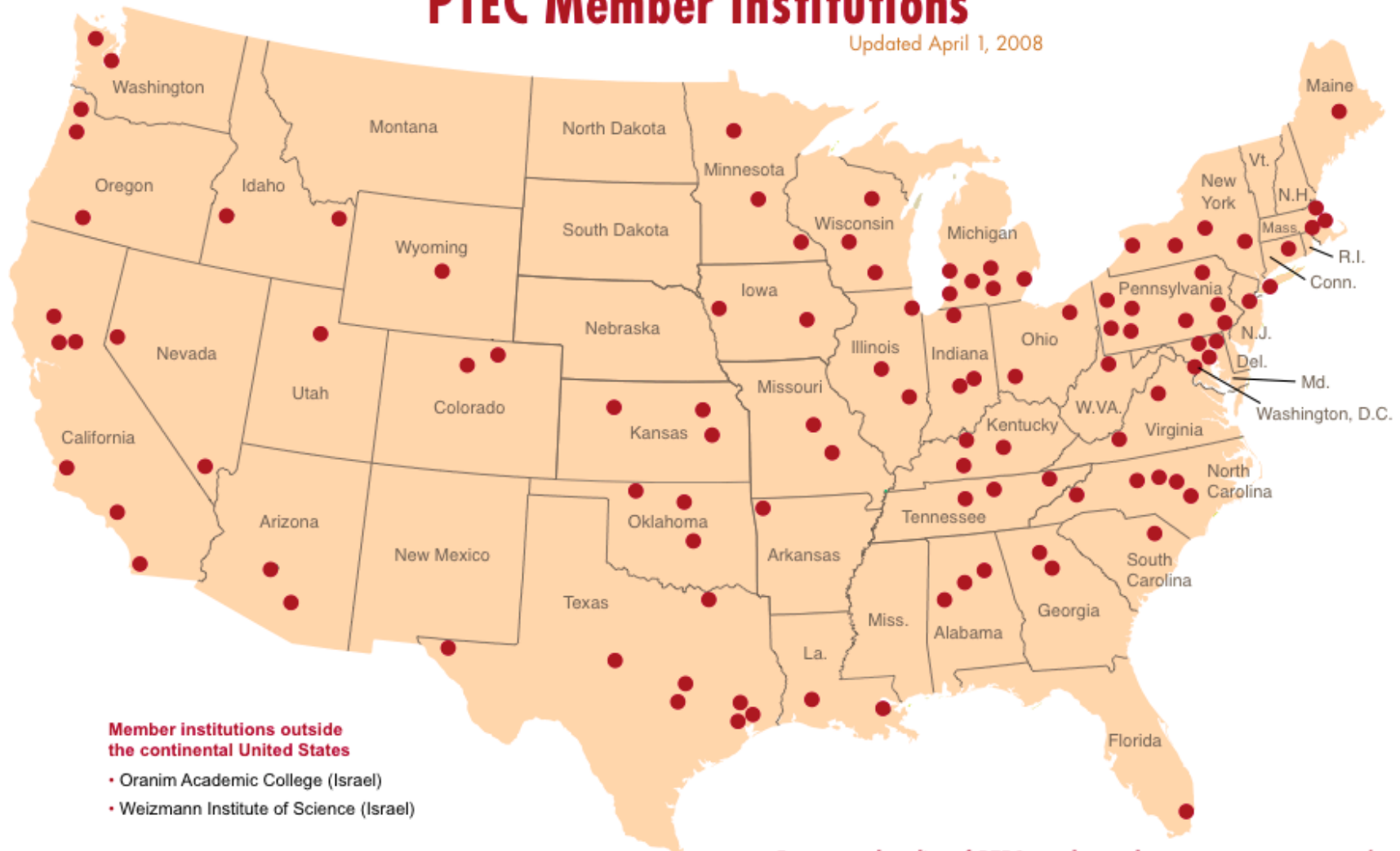
	Annual Average		Annual Average
CA Poly St U-San Luis Obispo	24	Saint Olaf College (MN)	12
US Air Force Academy (CO)	23	The College of New Jersey	12
Harvey Mudd College (CA)	22	U of Northern Colorado	12
College of Charleston (SC)	19	Augustana College (IL)	11
Illinois State U	19	Colorado College	11
U of Wisconsin-La Crosse	19	James Madison U (VA)	11
SUNY College-Geneseo (NY)	18	Middlebury College (VT)	11
Williams College (MA)	18	Sonoma State U (CA)	11
Reed College (OR)	17	Whitman College (WA)	11
Gustavus Adolphus Coll (MN)	16	Benedict College (SC)	10
Bates College (ME)	15	Colby College (ME)	10
Carleton College (MN)	15	Furman U (SC)	10
Bethel College (MN)	13	Grove City College (PA)	10
Dickinson College (PA)	13	Kalamazoo College (MI)	10
US Military Academy (NY)	13	U of Puget Sound (WA)	10
Bowdoin College (ME)	12	U of Wisconsin-River Falls	10
Grinnell College (IA)	12	Xavier U (LA)	10
Oberlin College (OH)	12		

Note: List includes only those departments who contributed degree data for all 3 years.

AIP Statistical Research Center, Enrollments and Degrees Report.

PTEC Member Institutions

Updated April 1, 2008

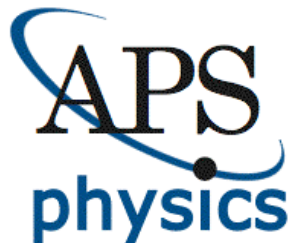


For a complete list of PTEC members, please see www.ptec.org/programs.

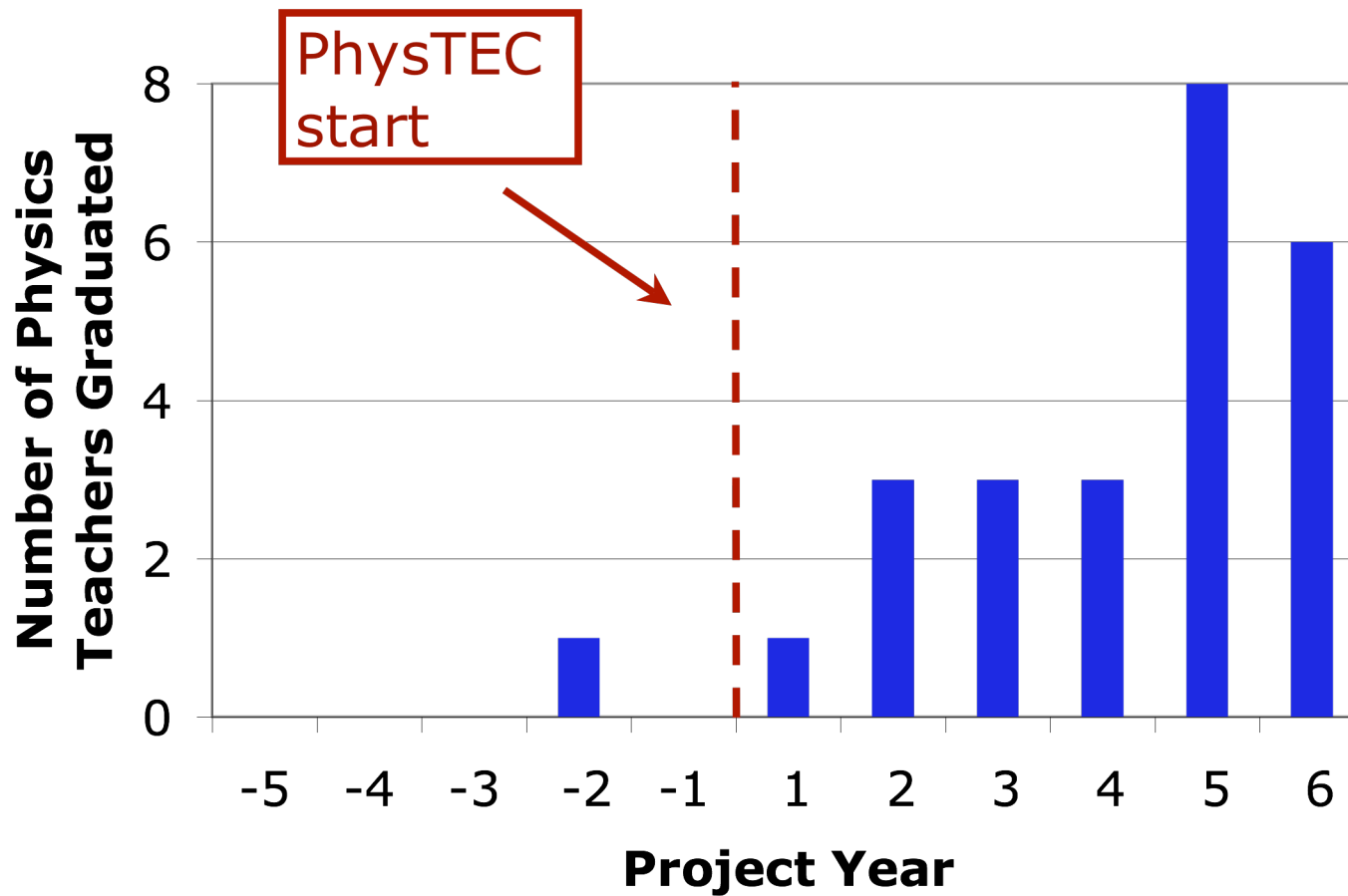


Physics Teacher Education Coalition

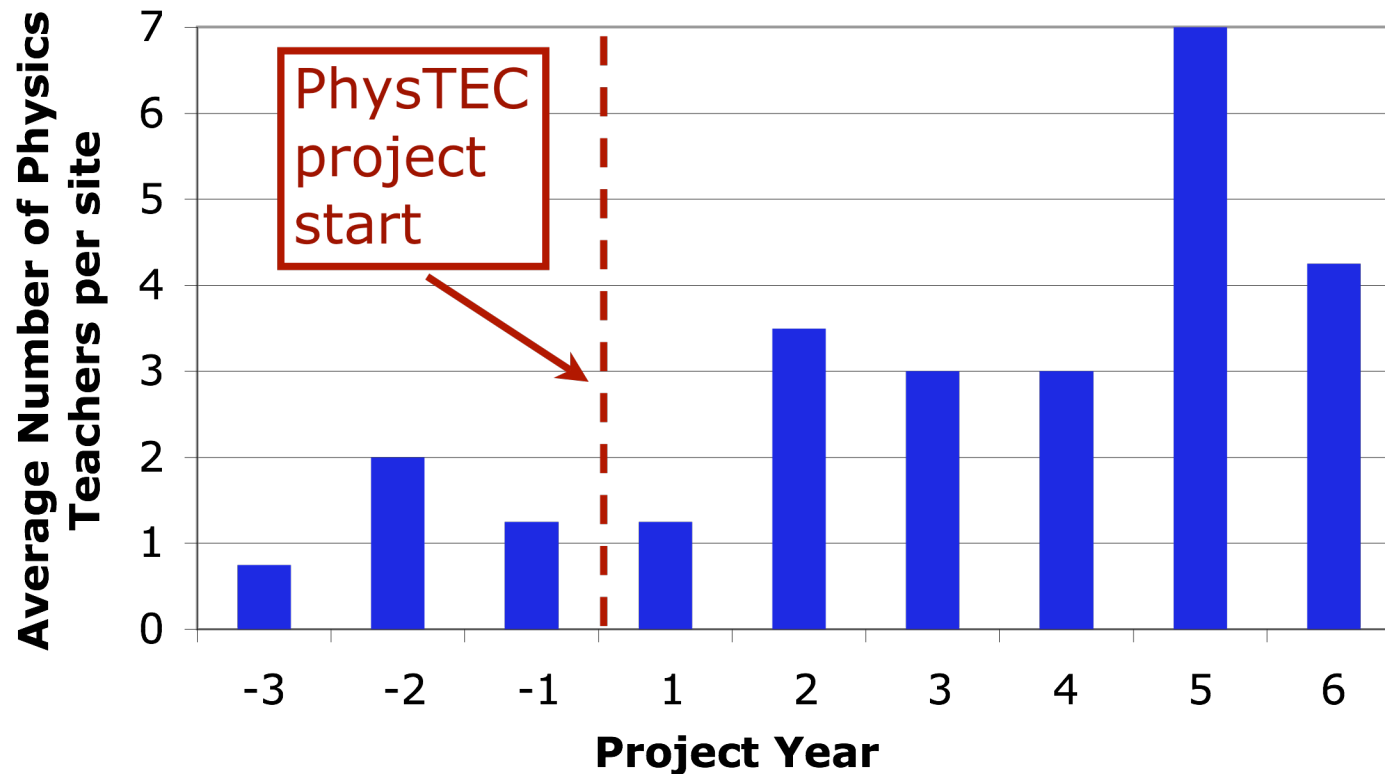
- **PhysTEC:** Significant support for a limited number of institutions to demonstrate model programs of physics and physical science teacher education
- **PTEC:** National coalition of colleges and universities dedicated to improving physics teacher education



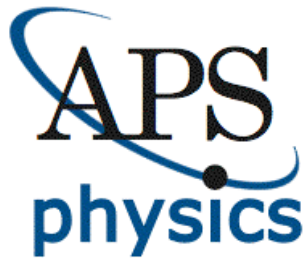
The University of Arkansas Success Story



Increased Production of Physics Teachers at PhysTEC Sites*



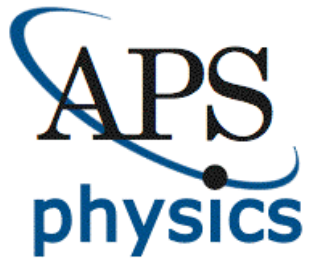
*Includes the 5 sites committed to increasing physics teacher production which began 2004 or earlier



Why do Minorities Start/Stay in Physics

Table 4. Main factor that led NSBP / NSHP student participants to their choice of career goal, 2004.

	Overall %	Undergrad Males %	Undergrad Females %	Grad Males %	Grad Females %
Challenging or interesting work	42	52	31	37	50
Chance to give something back to the community	41	33	46	45	45
Salary and benefits	8	9	9	10	0
Respect people have for this type of work	5	3	11	2	5
Other	4	3	3	6	0



Department Culture

Table 5. Factors that have helped NSBP/NSHP student participants persist in their studies, 2004.

	Top Factor %	Among Top 3 %
Love of subject matter	36	63
Support from minority faculty members	18	40
Support from other minority students	16	45
Family support	9	42
Support from non-minority faculty members	6	30
Career prospects	4	30
Support from minority professional societies	4	17
Support from other non-minority students	4	12
Support from non-minority professional societies	-	7
Other	2	5

Five Nice



A card with a warm-toned photograph of a group of young women smiling and hugging. The text "SOCIAL CONNECTION" is overlaid in a bold, sans-serif font. To the left is a circular logo with "BASIC INSTINCTS" around the top and "NICE" in a yellow box at the bottom. Below the card is a row of seven yellow dots.



A card with a blue-toned photograph of a person in a dark jacket performing a skateboard trick. The text "ACCOMPLISHMENT" is overlaid in a bold, sans-serif font. To the left is a circular logo with "BASIC INSTINCTS" around the top and "NICE" in a yellow box at the bottom. Below the card is a row of seven yellow dots.



A card with a red-toned photograph of a person in a red hoodie and cap striking a pose. The text "PERSONAL EXPRESSION" is overlaid in a bold, sans-serif font. To the left is a circular logo with "BASIC INSTINCTS" around the top and "NICE" in a yellow box at the bottom. Below the card is a row of seven yellow dots.



A card with a purple-toned photograph of a large crowd of people at a concert or festival. The text "BELONGING" is overlaid in a bold, sans-serif font. To the left is a circular logo with "BASIC INSTINCTS" around the top and "NICE" in a yellow box at the bottom. Below the card is a row of seven yellow dots.



A card with a brown-toned photograph of two people on a beach, one appearing to be in a state of distress or being helped. The text "FREEDOM" is overlaid in a bold, sans-serif font. To the left is a circular logo with "BASIC INSTINCTS" around the top and "NICE" in a yellow box at the bottom. Below the card is a row of seven yellow dots.

Five
Naughty

BASIC INSTINCTS
REBELLION
NAUGHTY



BASIC INSTINCTS
RISK TAKING
NAUGHTY




BASIC INSTINCTS
SEXUALITY
NAUGHTY



BASIC INSTINCTS
CYNICISM
NAUGHTY



BASIC INSTINCTS
TRIBALISM
NAUGHTY





...inaction has downsides too

