

APS March Meeting

16 March 2009

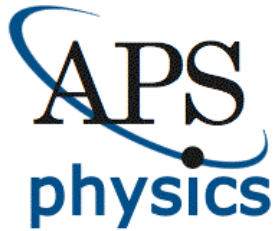
Pittsburgh, PA

*Why do we need 10,000 physics
majors?*

Theodore Hodapp

American Physical Society

Director of Education and Diversity

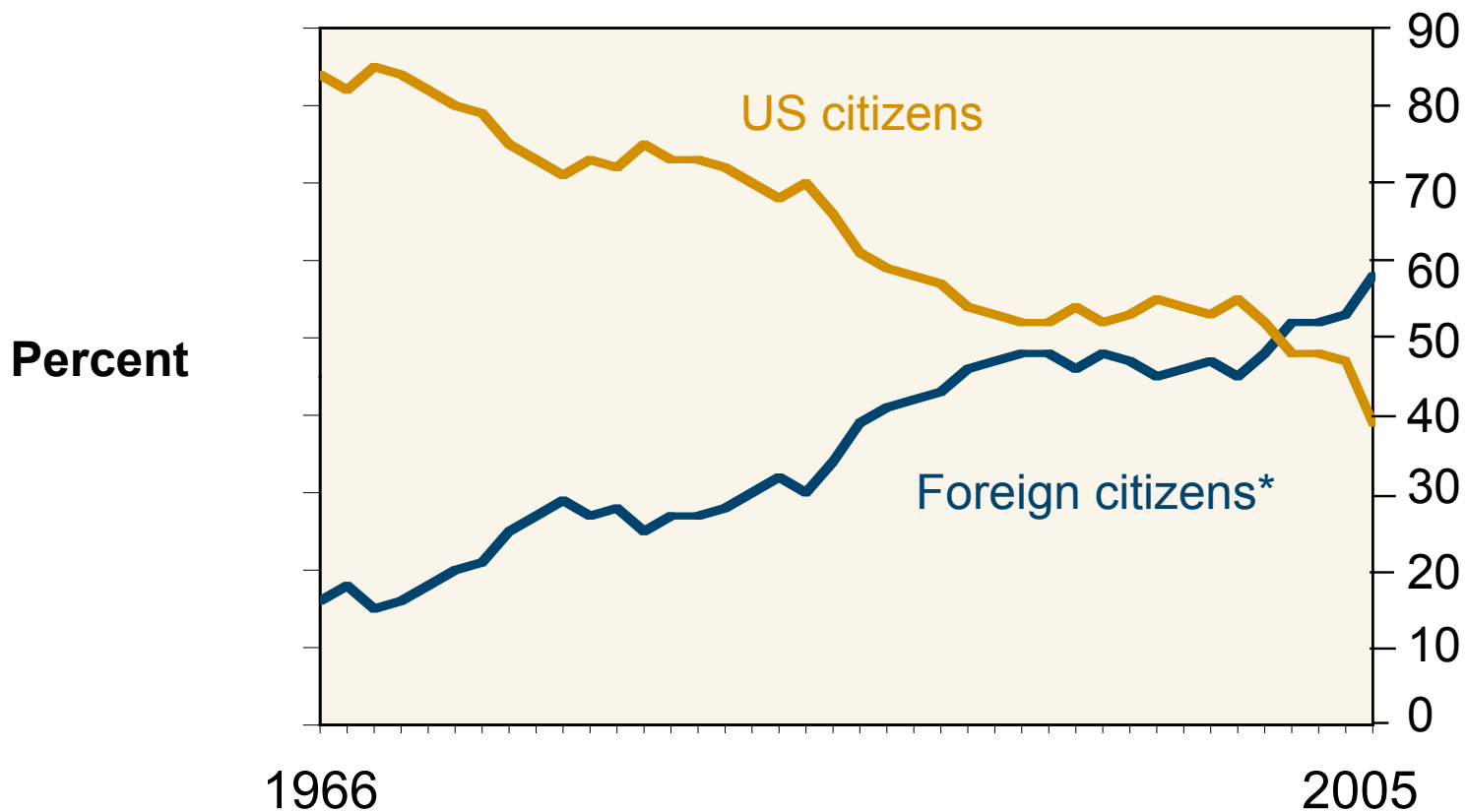


APS / AAPT Statement on Doubling

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

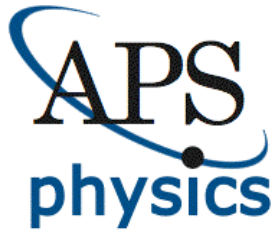


Sources: NSF(1966-1991), AIP (1992-2005)

- 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

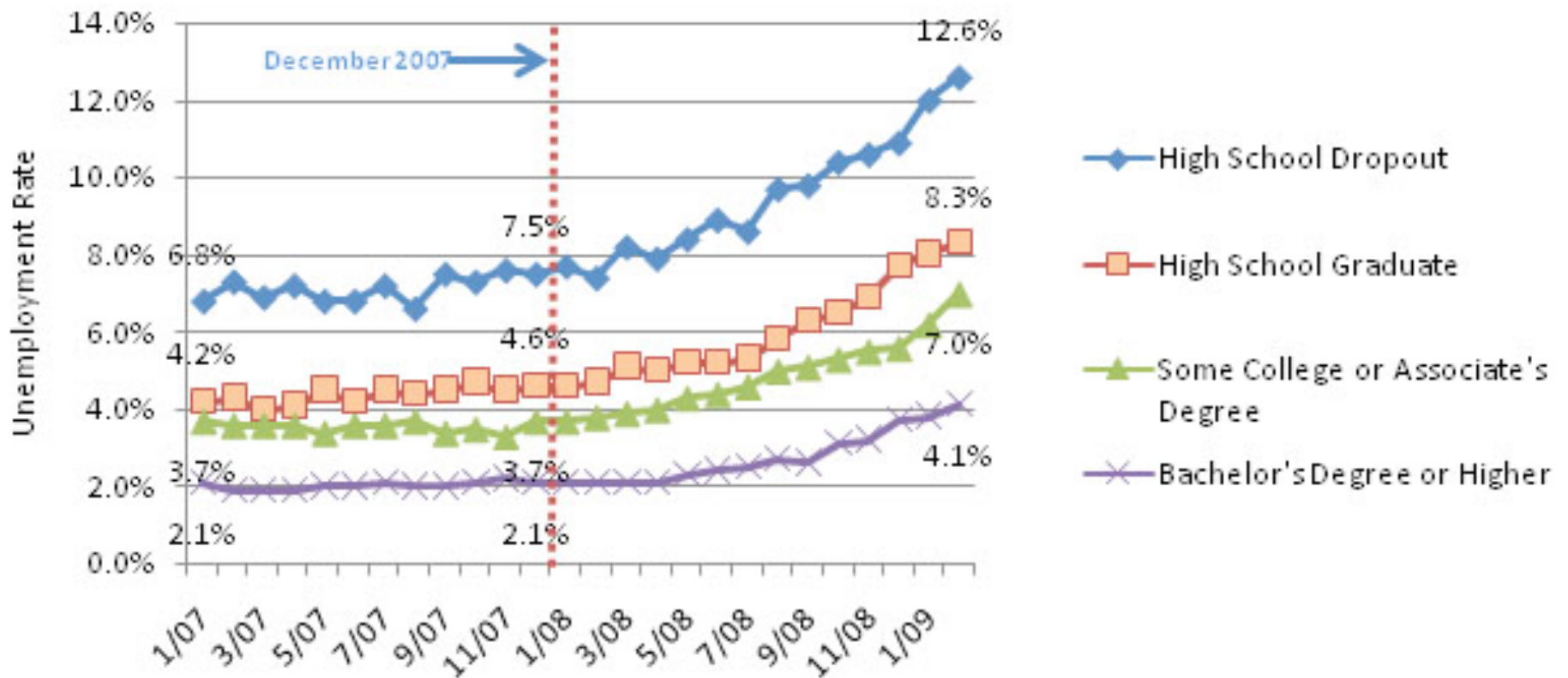
America COMPETES Act of 2007

- 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.

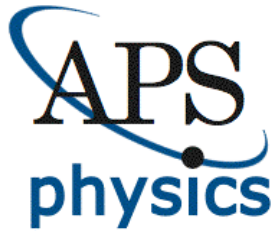
Tapping America's Potential: The Education for Innovation Initiative, Business Roundtable, July 2005

- Double the number of STEM graduates by the year 2015

Reasons (in case you needed another)



Source: Bureau of Labor Statistics



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

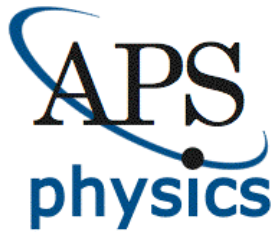
Mathematics Education **4.21**

Fields with Some Shortage (4.20 - 3.41)

Visually Impaired 4.20

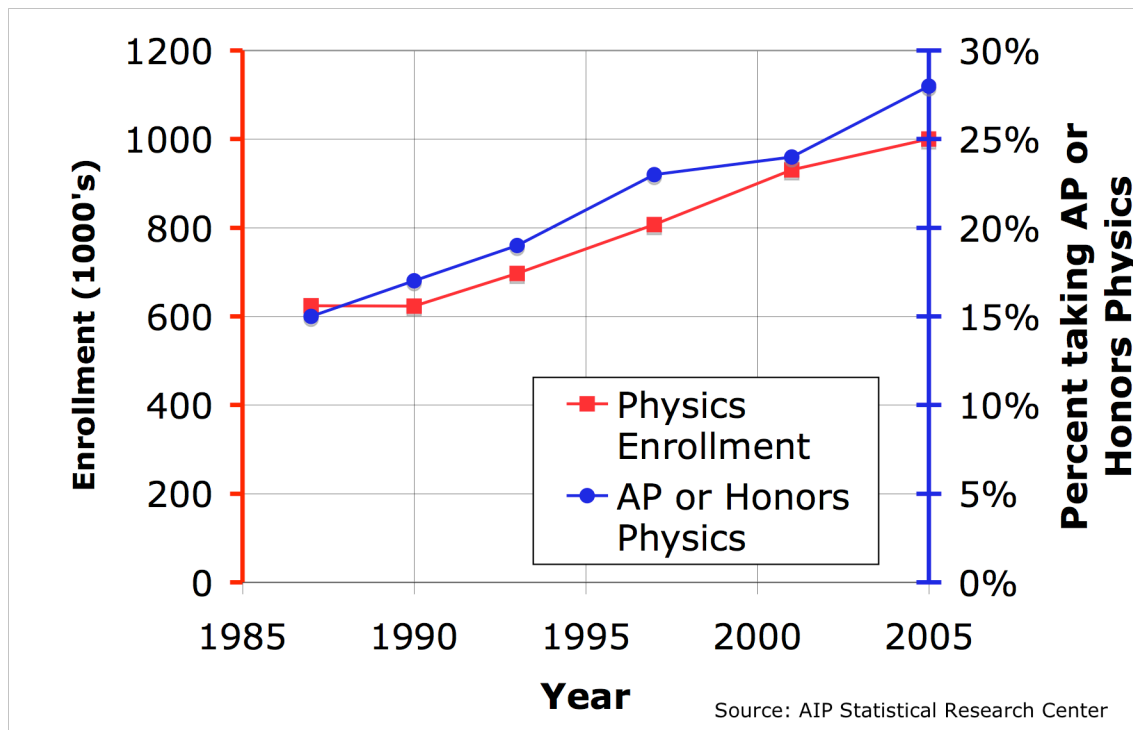
Chemistry **4.16**

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



Demographics of High School Physics Teachers

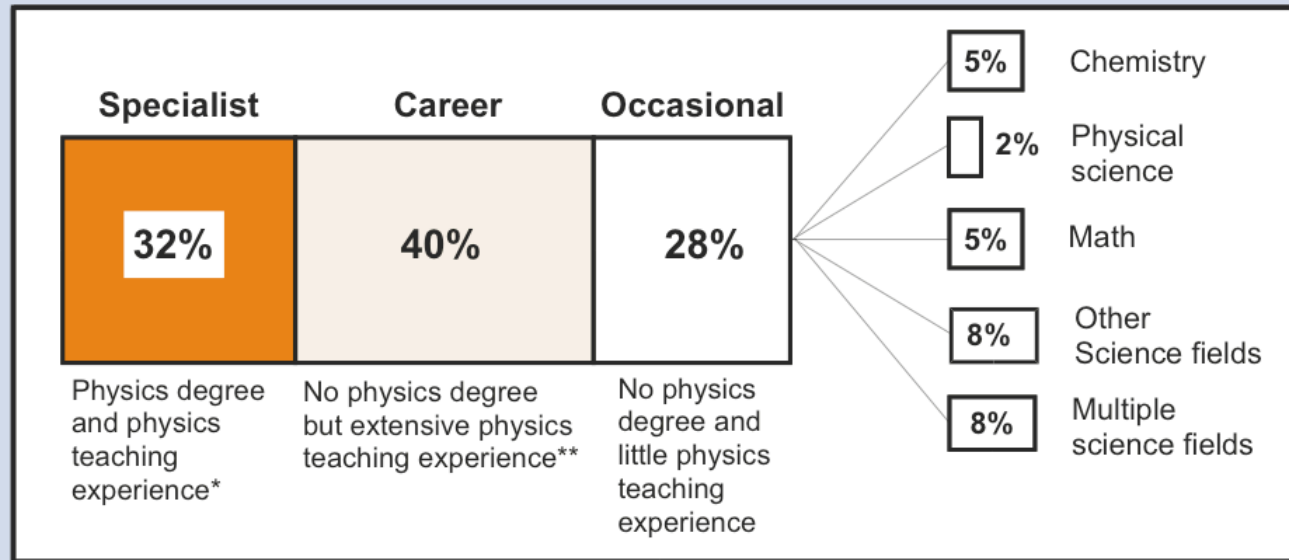
- 23,000 Physics Teachers Nationwide
- 1,200 new physics teachers each year
- ~400 of these have physics major or minor



- Number taking physics growing by 1% per year

Preparation of High School Physics Teachers

Teacher Specialization: Academic Training and Experience



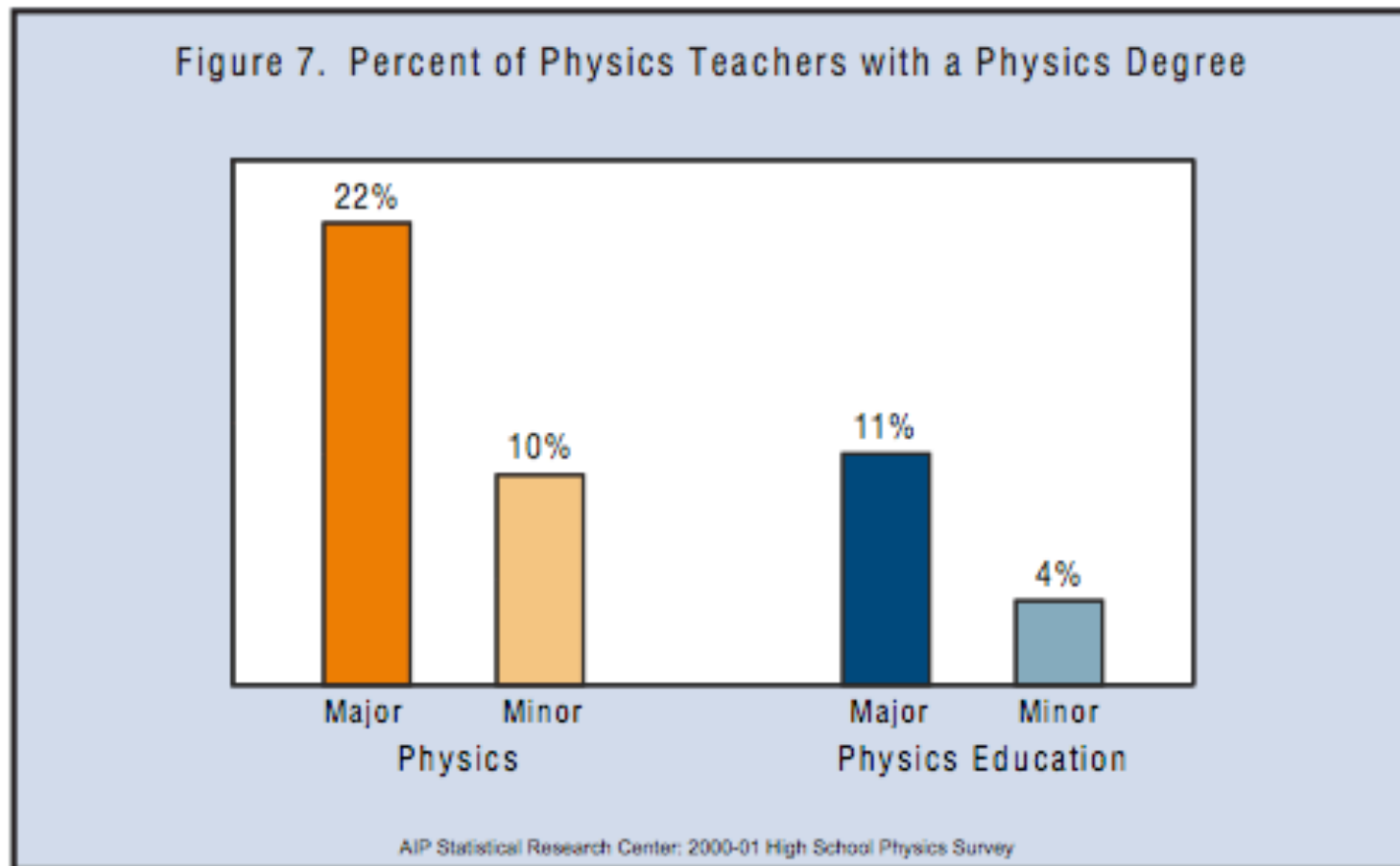
*Teachers with physics degrees but insufficient physics teaching experience are excluded from this figure (3%).

**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

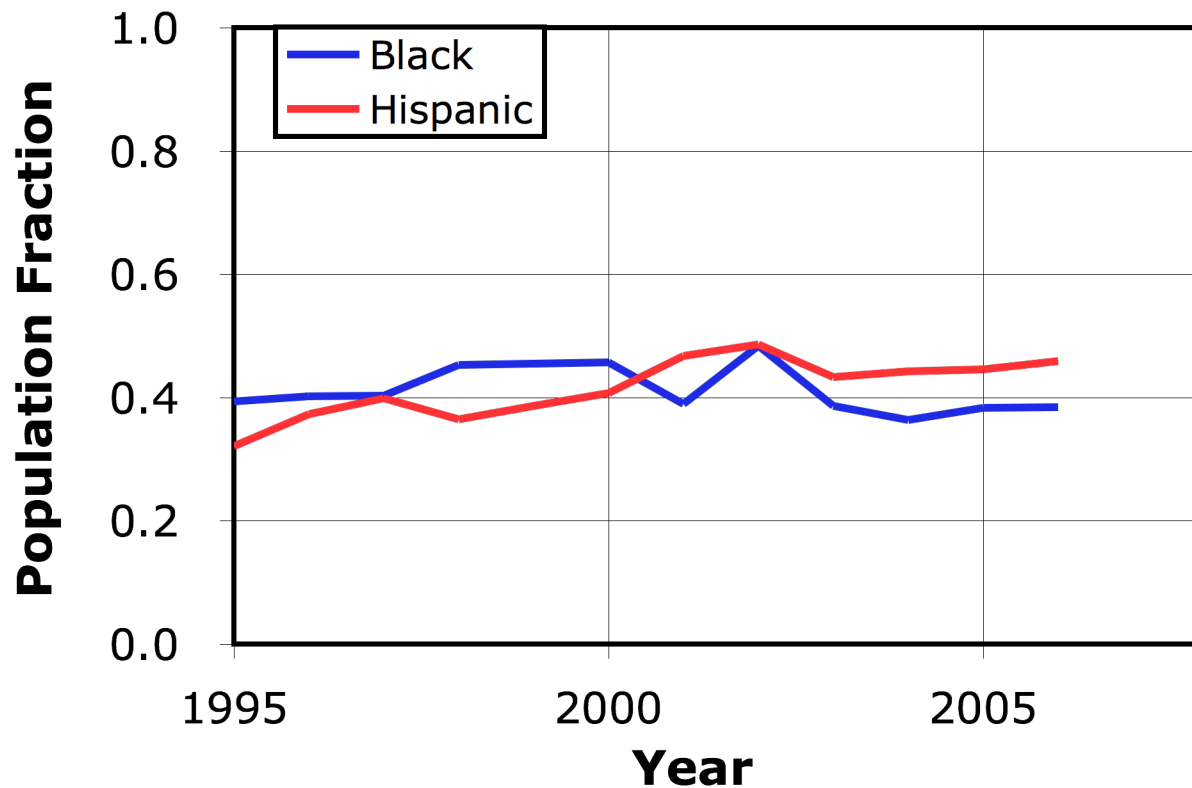
One third of **all** STEM teachers have no STEM degree
www.APS.org

Physics Teacher Education



Minority Bachelor Degrees

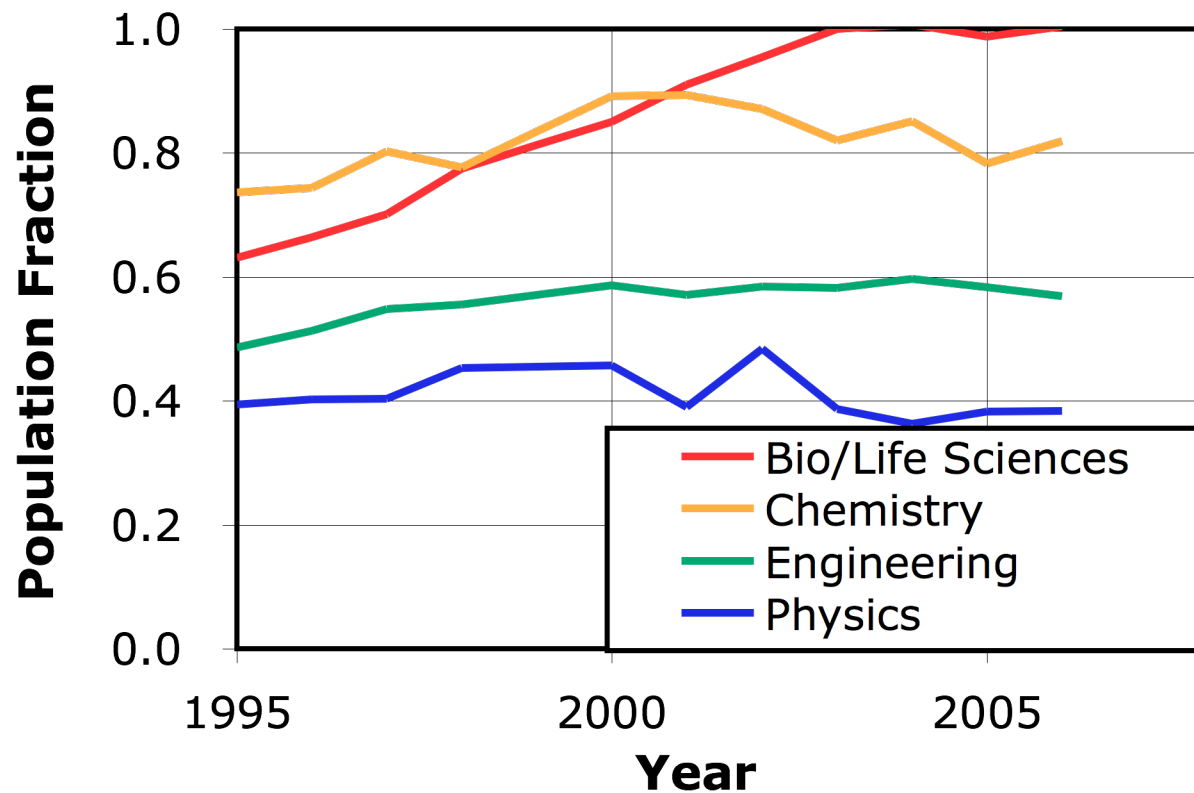
Minority Representation in Physics: Bachelor Degrees



Source: National Center for Education Statistics

African Americans

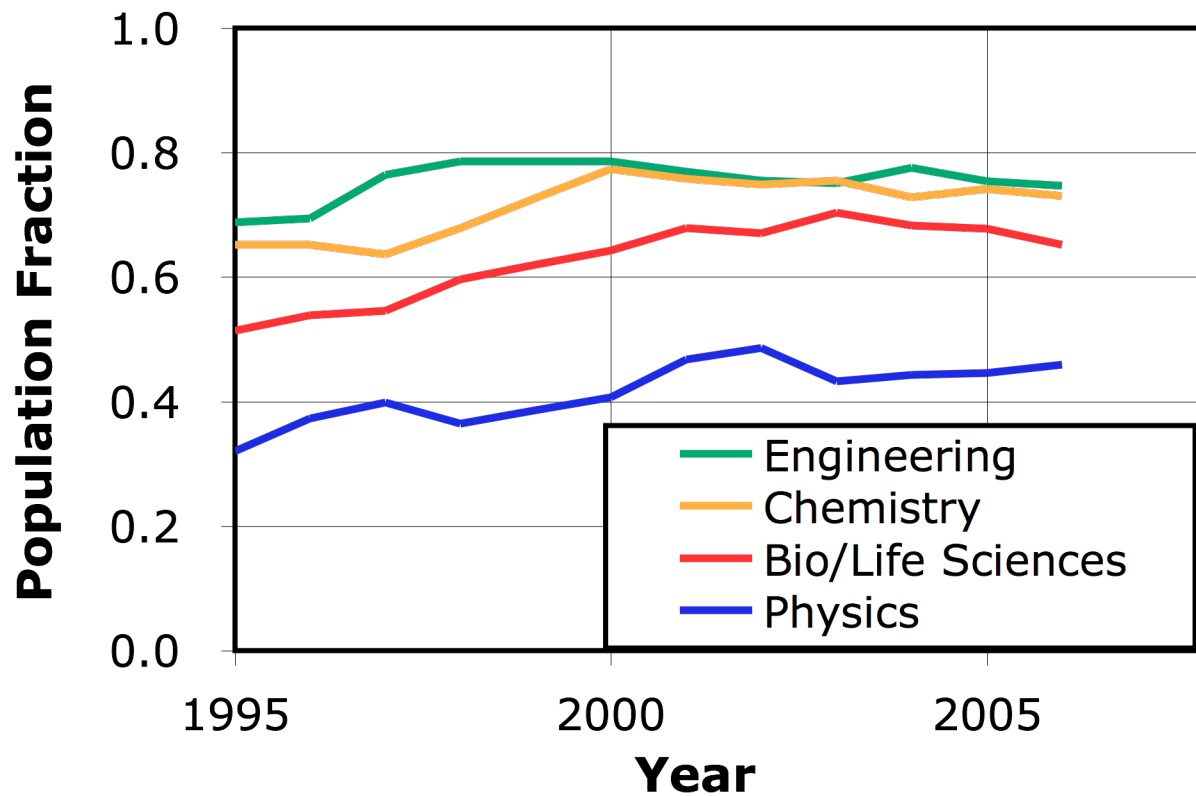
Black Bachelor Degrees: STEM Fields



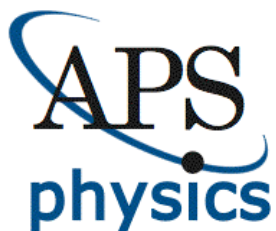
Source: National Center for Education Statistics

Hispanic Americans

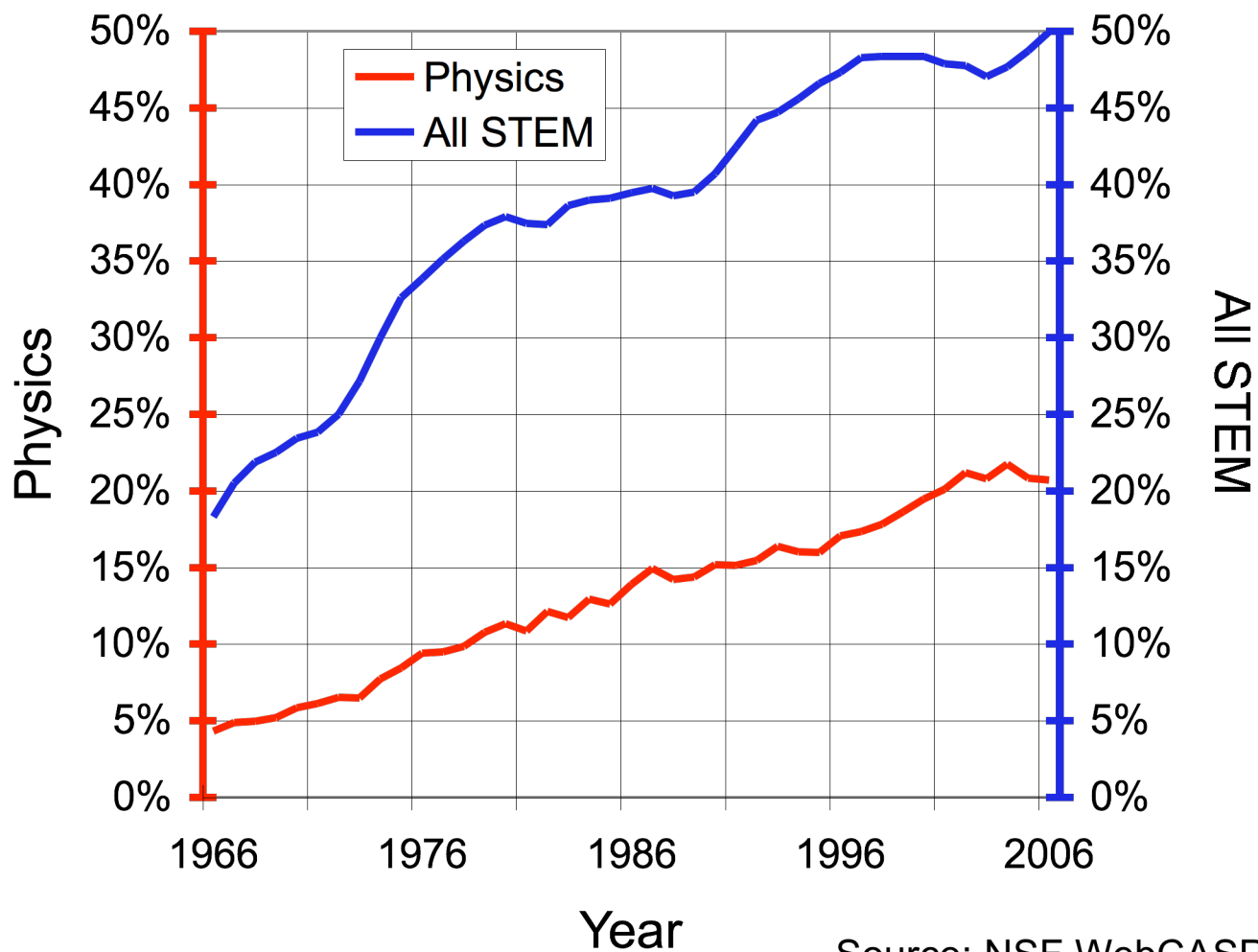
Hispanic Bachelor Degrees: STEM Fields



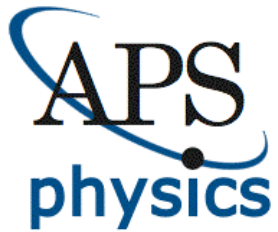
Source: National Center for Education Statistics



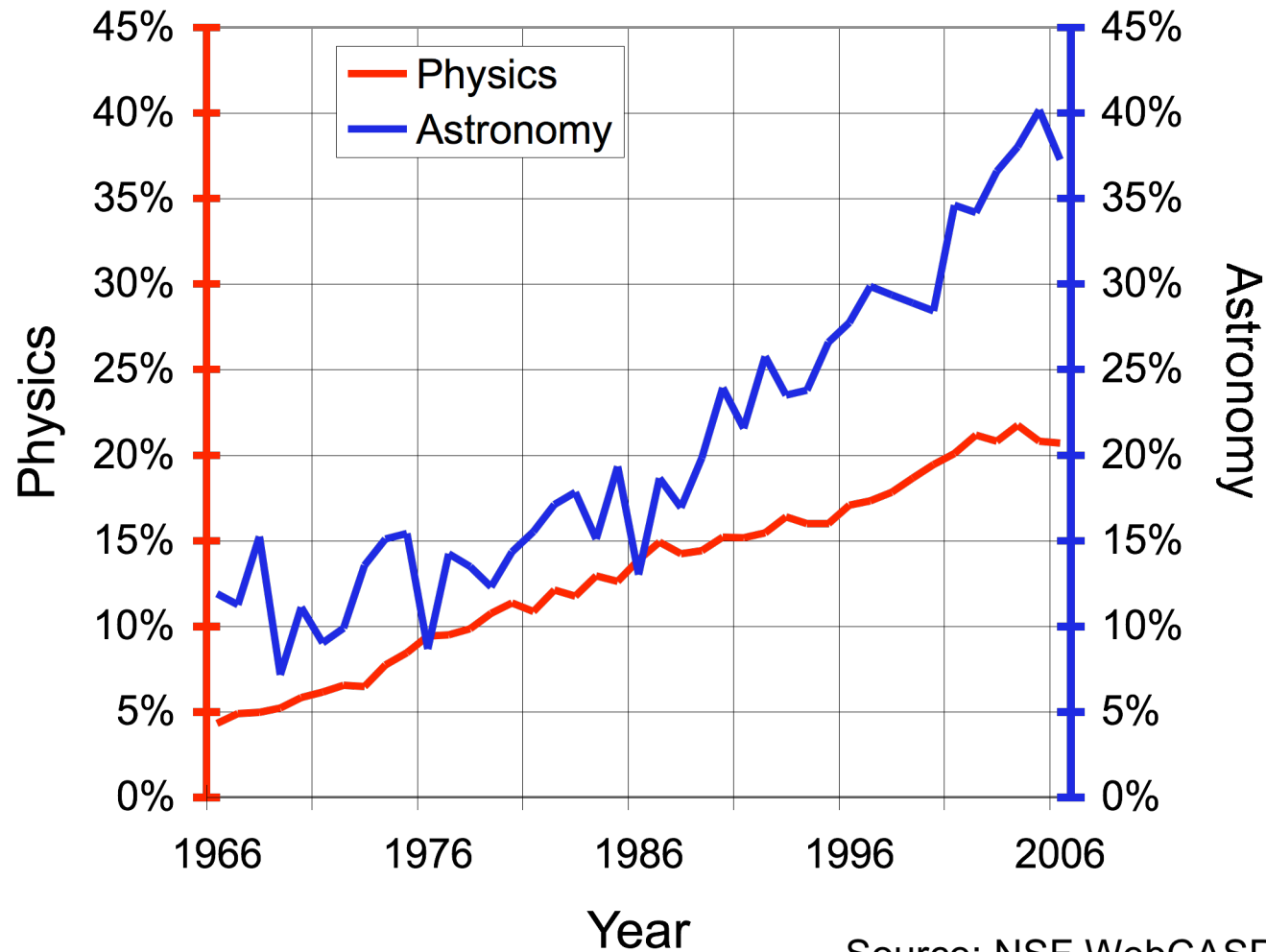
Female Fraction of Bachelor Degrees



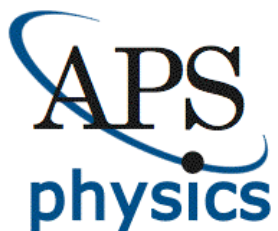
Source: NSF WebCASPAR



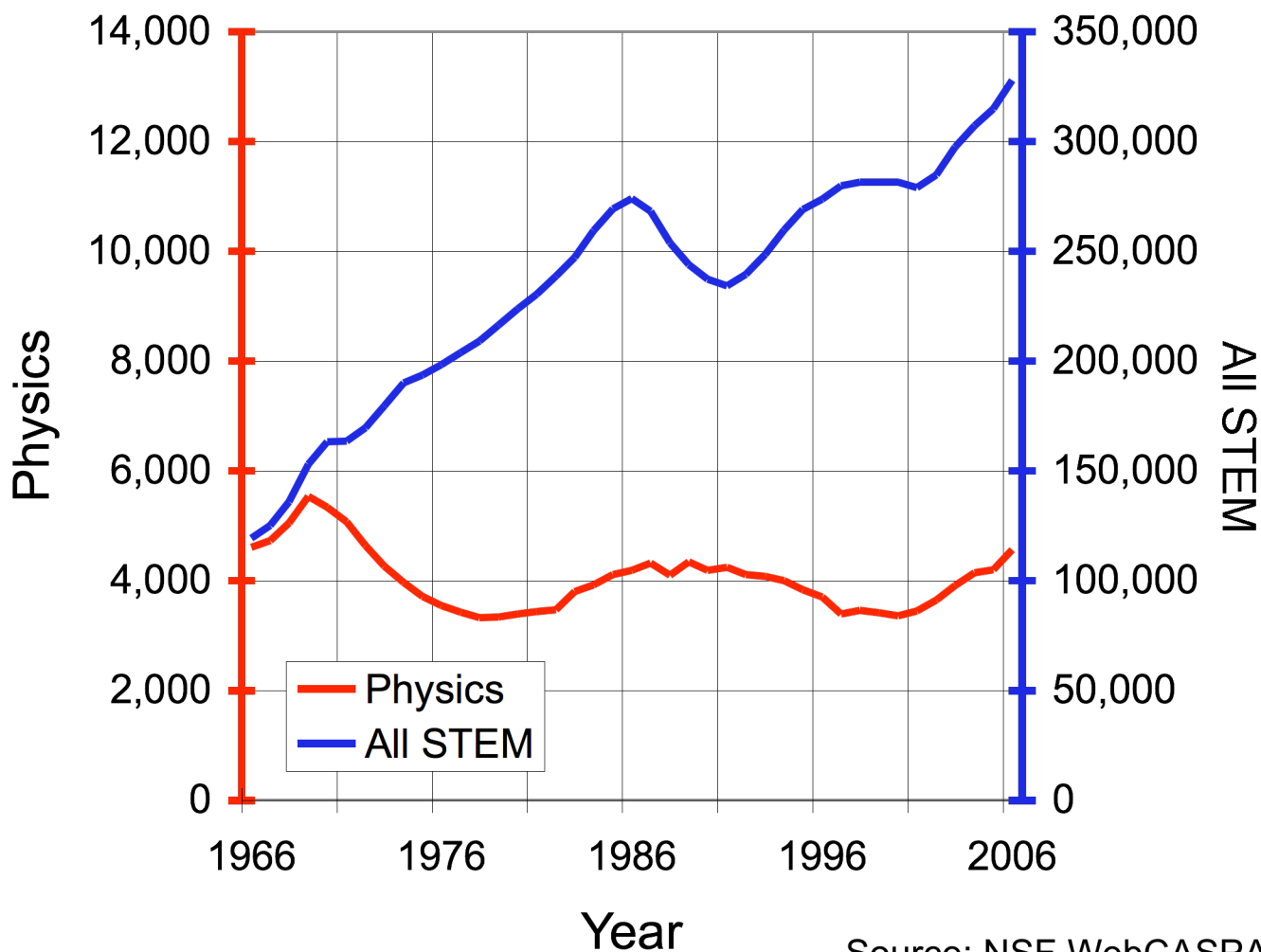
Women in Physics / Astronomy



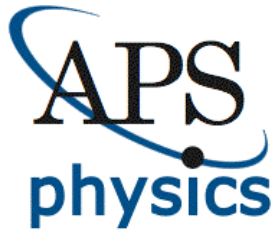
Source: NSF WebCASPAR



Physics / STEM Bachelor Degrees

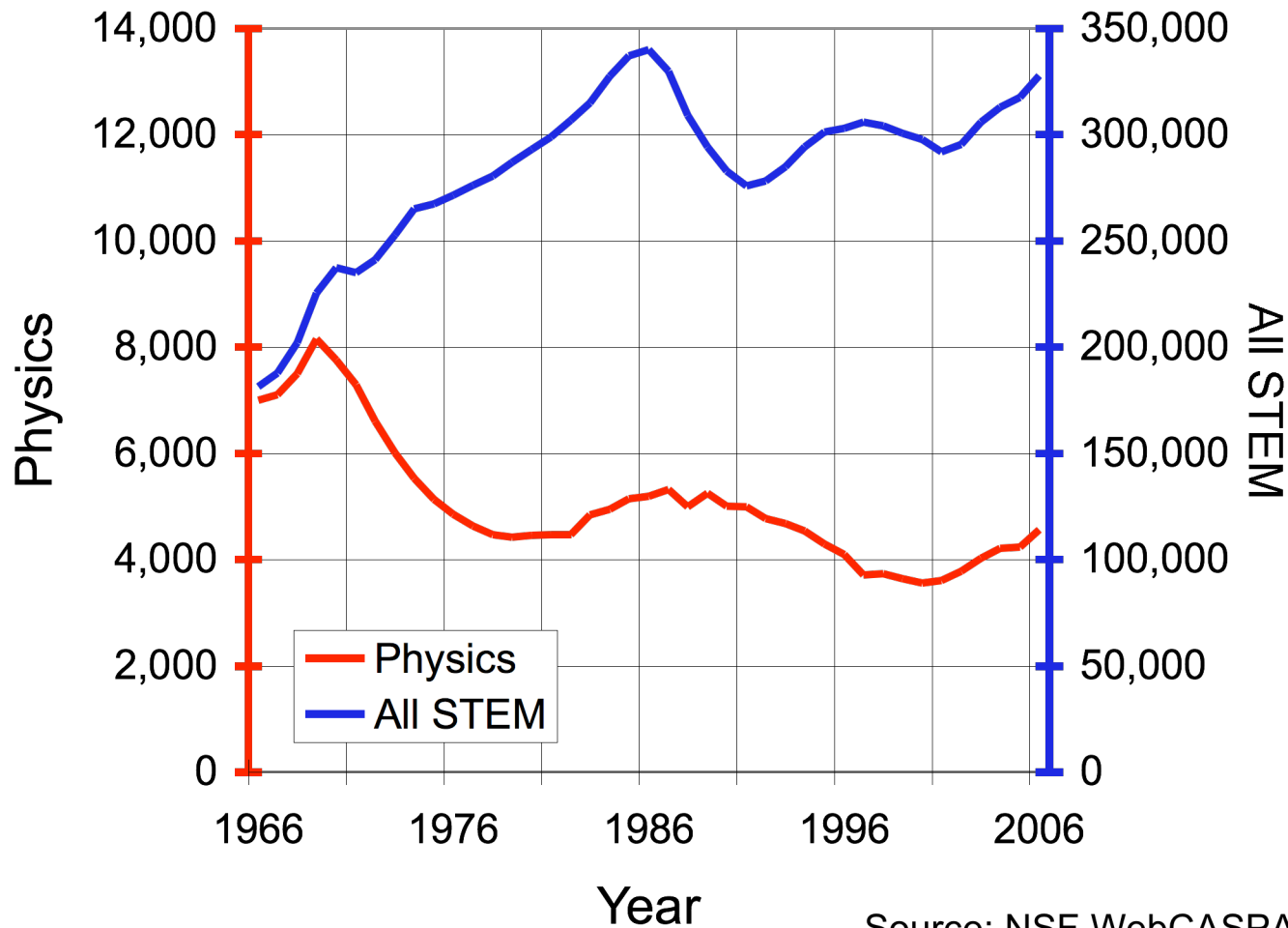


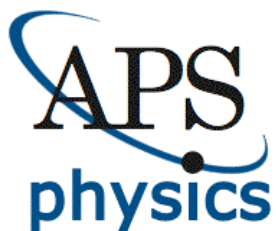
Source: NSF WebCASPAR



Physics / STEM Bachelor Degrees

Normalized to 2006 Population





Physics / Engineering Bachelor Degrees

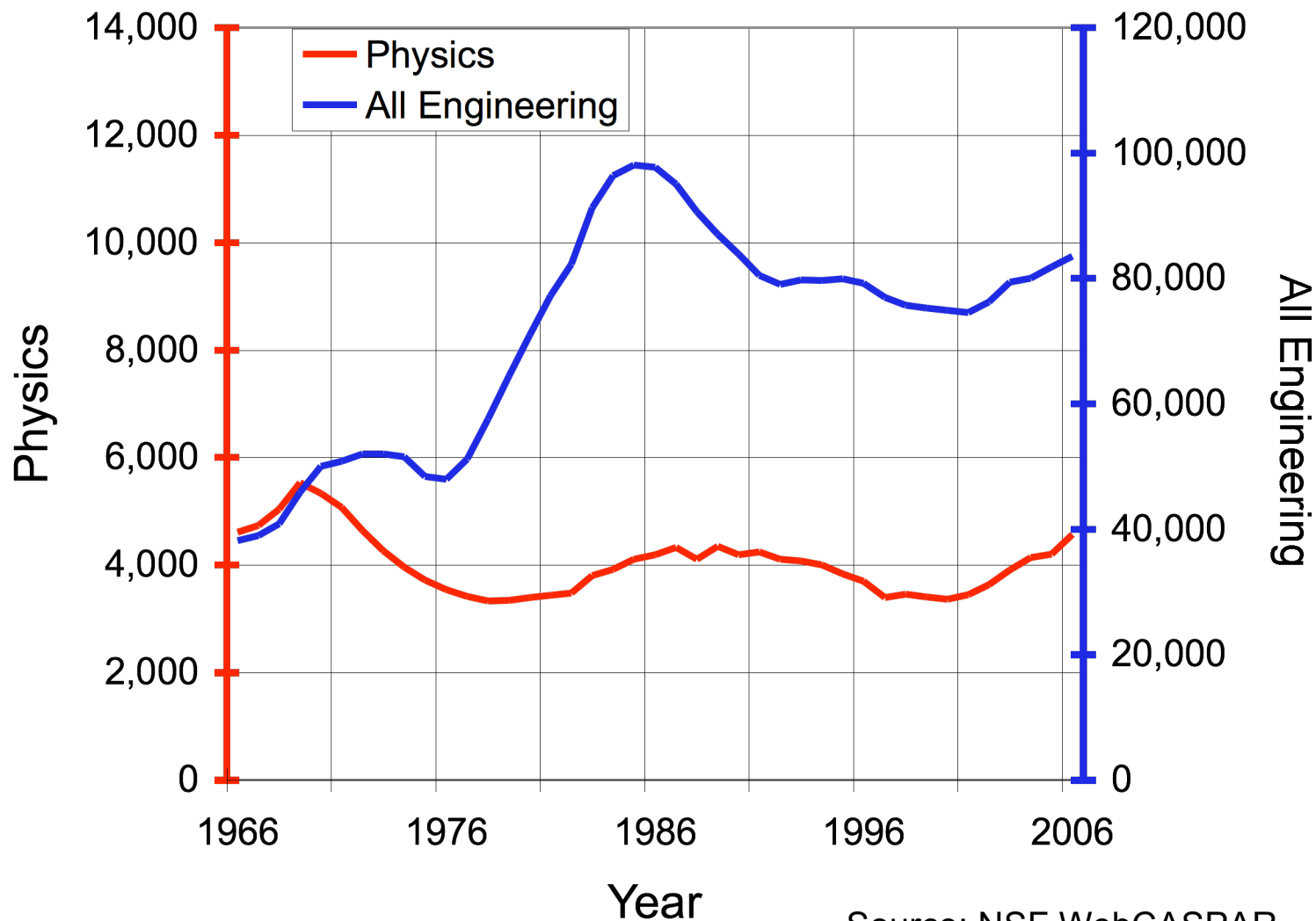
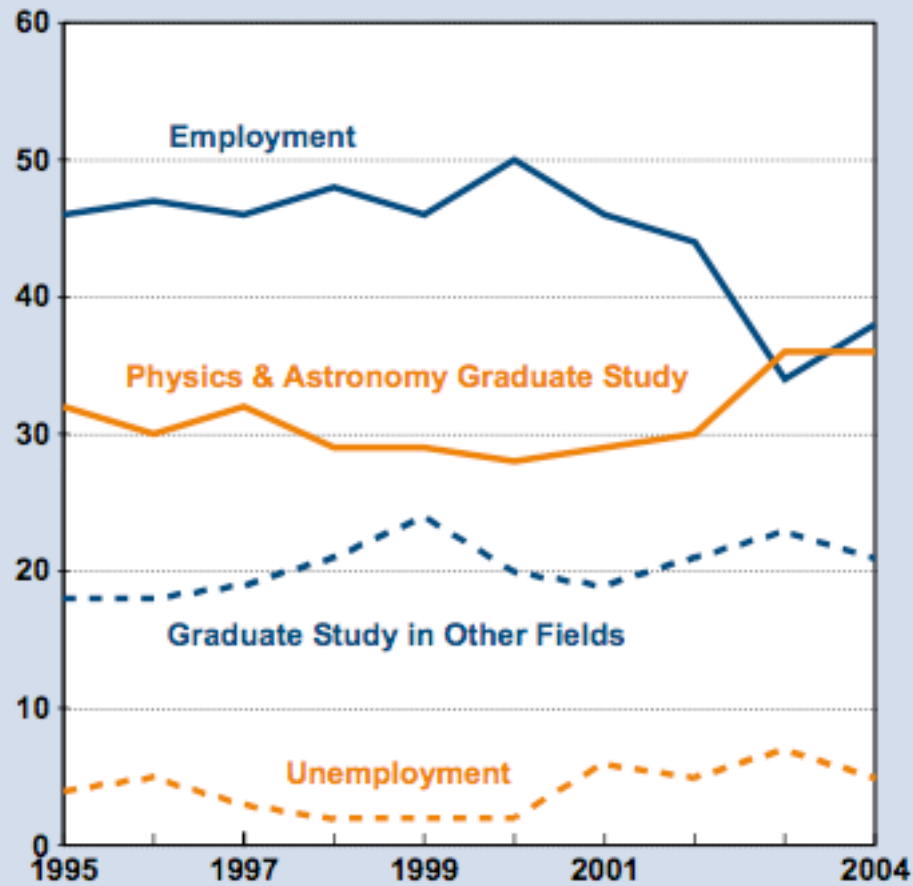
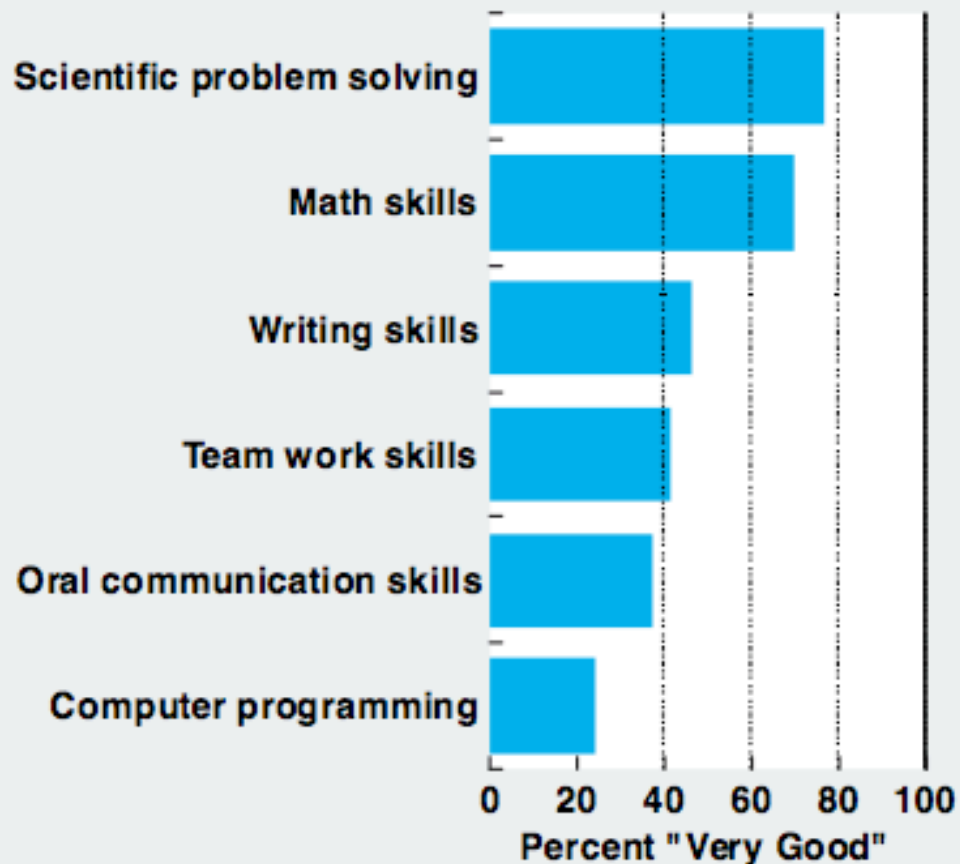


Figure 2. Trends in initial outcomes of physics bachelor's, classes of 1995-2004.



AIP Statistical Research Center, Initial Employment Report.

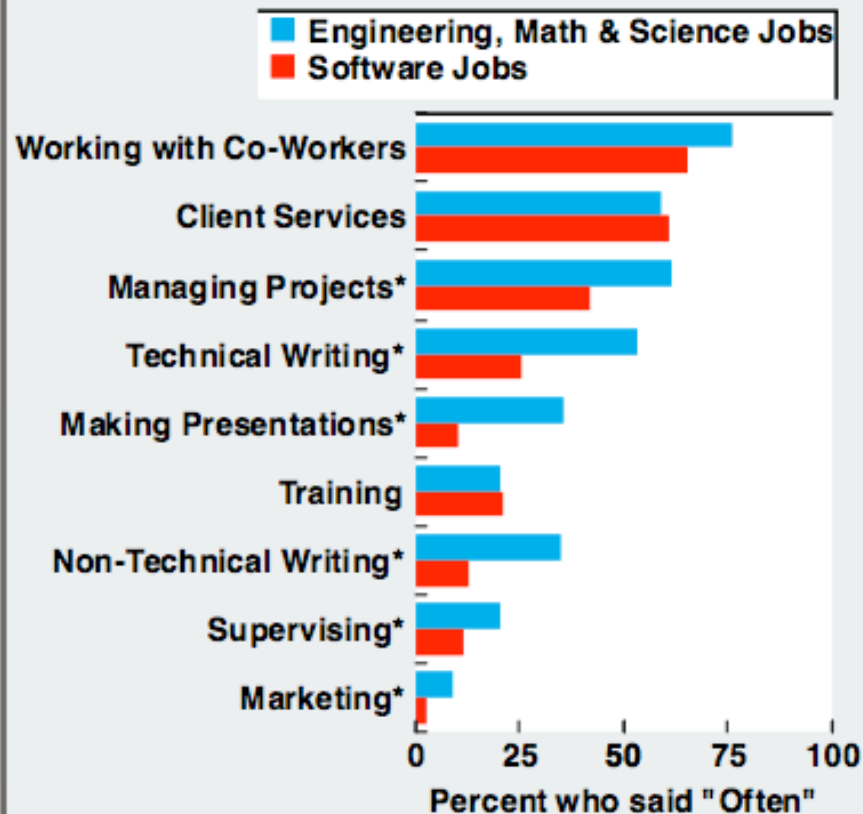
Figure 4. Rating of Physics Bachelors' Education 5 to 8 Years After Graduation



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

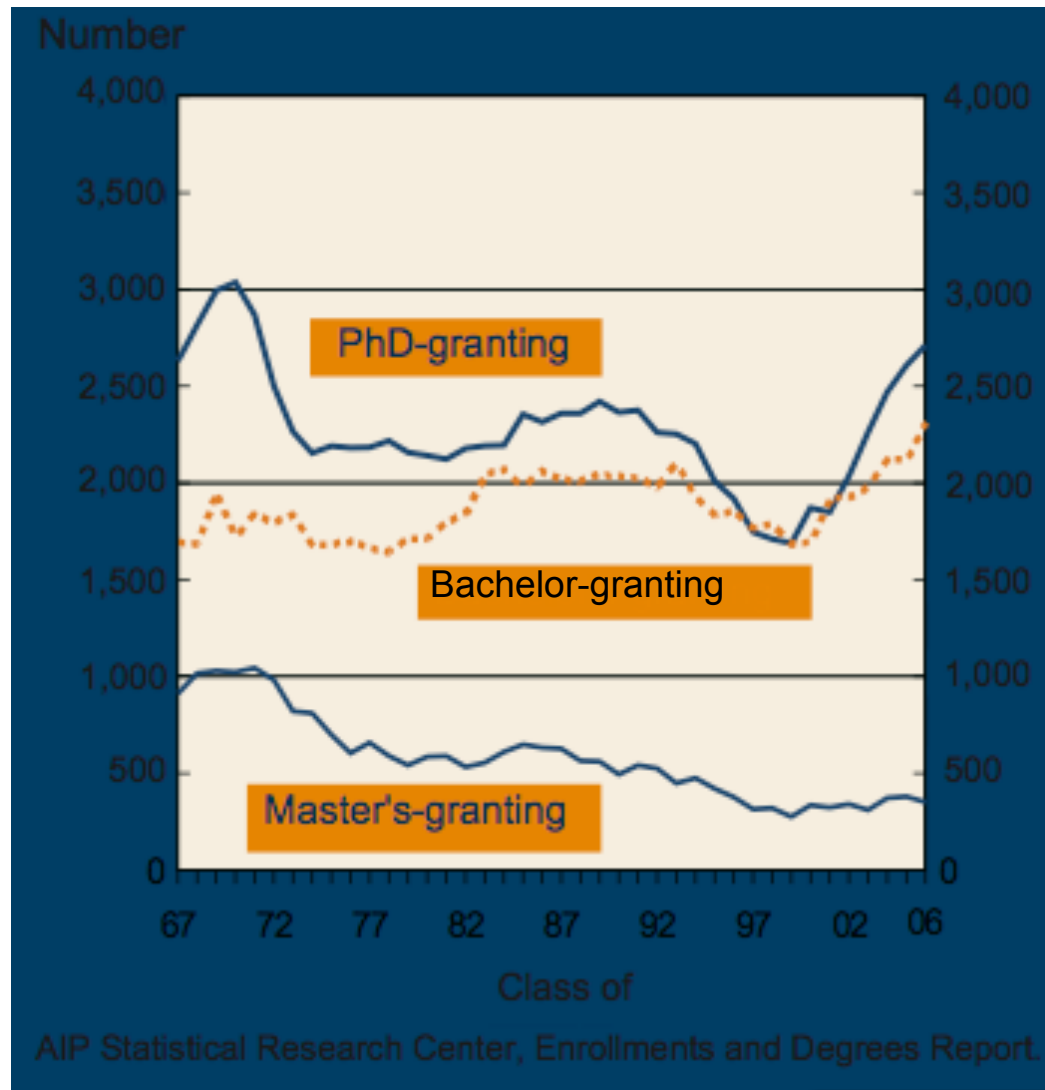


These data reflect the percentage who chose 4 or 5 on a 5-point scale where 1 = none and 5 = extensive. Based on physics bachelors with no additional degrees who are not teachers or primarily students.

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

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

Where are BS Degrees Produced?



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 2004, 2005 and 2006.

	Annual Average		Annual Average
U of California-Berkeley	78	Cornell U (NY)	29
Mass Inst of Technology	75	U of California-Davis Applied	29
U of Washington	70	Carnegie Mellon U (PA)	28
Brigham Young U (UT)	52	Cornell U-Applied (NY)	28
U of California-Los Angeles	46	U of Wisconsin, Madison	28
Colorado School of Mines	43	U of California-Davis	27
U of IL-Urbana/Champaign	43	Stanford U (CA)	26
U of Arizona	37	U of Florida	26
U of California-San Diego	37	U of Minnesota-Minneapolis	26
U of Virginia	37	Rensselaer Polytech Inst (NY)	25
U of Maryland-College Park	35	Boston U (MA)	24
U of Texas-Austin	35	Michigan State U	24
California Inst of Technology	34	Purdue U-West Lafayette (IN)	24
Rutgers U-New Brunswick (NJ)	33	Oregon State U	21
U of California-Santa Barbara	32	Portland State U (OR)	21
Pennsylvania State U	31	Princeton U (NJ)	21
U of California-Santa Cruz	31	U of Massachusetts, Amherst	21
U of Chicago (IL)	31	College of William & Mary (VA)	20
U of Michigan-Ann Arbor	31	Columbia U (NY)	20
Ohio State U	30	Georgia Inst of Technology	20
U of Utah	30	Yale U (CT)	20

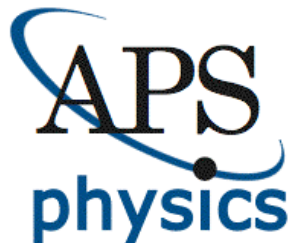
Table 6. Bachelor's-granting departments averaging 10 or more physics bachelor's degrees per year, classes of 2004, 2005 and 2006.

	Annual Average		Annual Average
CA Poly St U-San Luis Obispo	28	Bates College (ME)	11
Harvey Mudd College (CA)	25	Bucknell U (PA)	11
US Air Force Academy (CO)	21	Colorado College	11
Illinois State U	19	Furman U (SC)	11
SUNY College-Geneseo (NY)	19	Grove City College (PA)	11
Williams College (MA)	19	Murray State U (KY)	11
Reed College (OR)	18	US Military Academy (NY)	11
U of Wisconsin-La Crosse	16	U of Puget Sound (WA)	11
Xavier U (LA)	16	U of Wisconsin, Eau Claire	11
Carleton College (MN)	15	Whitman College (WA)	11
College of Charleston (SC)	15	Adelphi U (NY)	10
Gustavus Adolphus Coll (MN)	15	Augustana College (IL)	10
Saint Olaf College (MN)	15	Benedict College (SC)	10
Bethel College (MN)	14	Bowdoin College (ME)	10
Colby Coll (ME)	13	Coll of Richard Stockton (NJ)	10
Dickinson College (PA)	13	Fordham U (NY)	10
Grinnell College (IA)	13	Hampden-Sydney Coll (VA)	10
Oberlin College (OH)	13	Luther College (IA)	10
The College of New Jersey	13	Macalester College (MN)	10
U of Northern Colorado	13	Shippensburg U (PA)	10
James Madison U (VA)	12	Sonoma State U (CA)	10
Occidental College (CA)	12	Swarthmore College (PA)	10
Taylor U (IN)	12	U of Wisconsin-River Falls	10

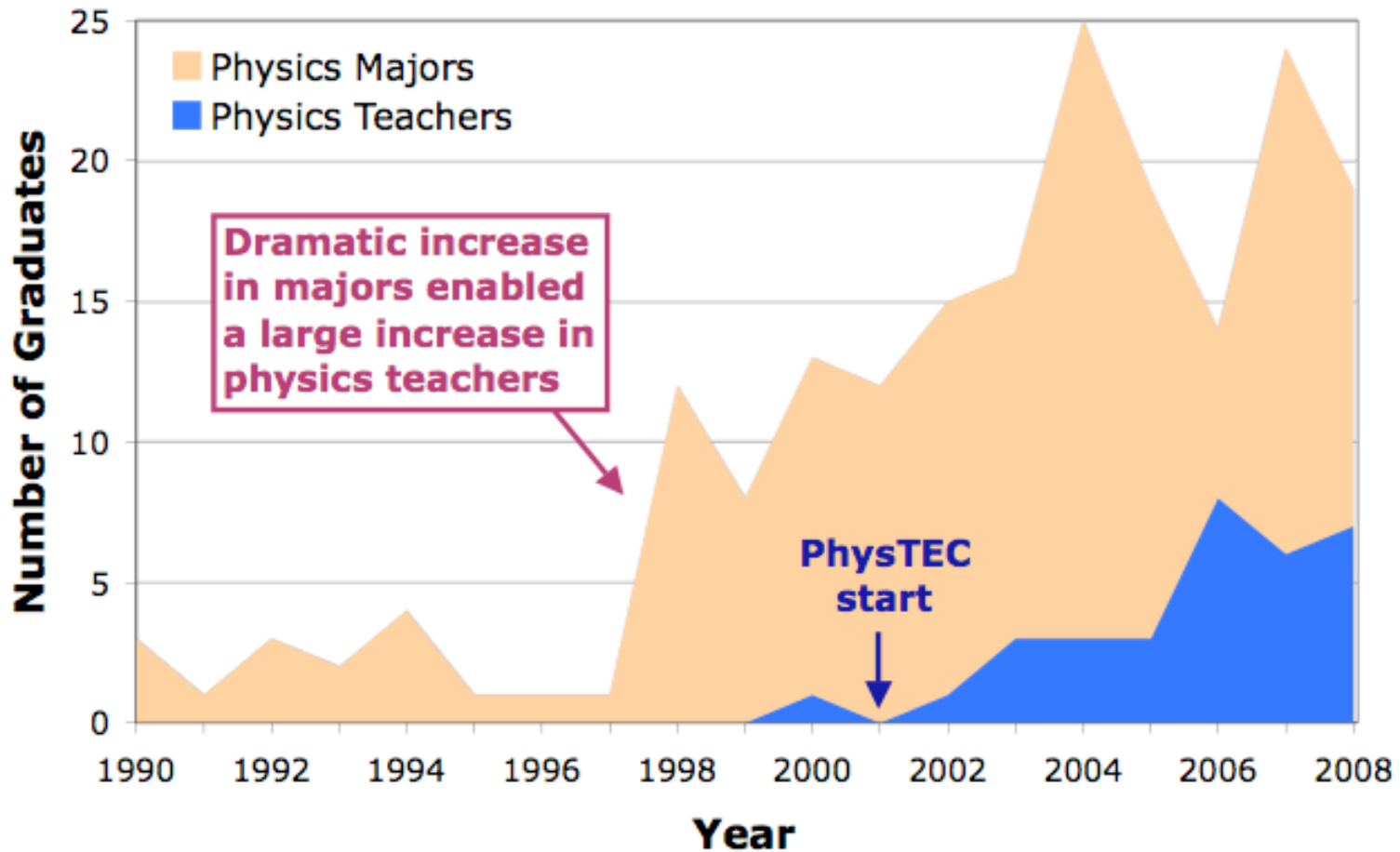


Physics Teacher Education Coalition

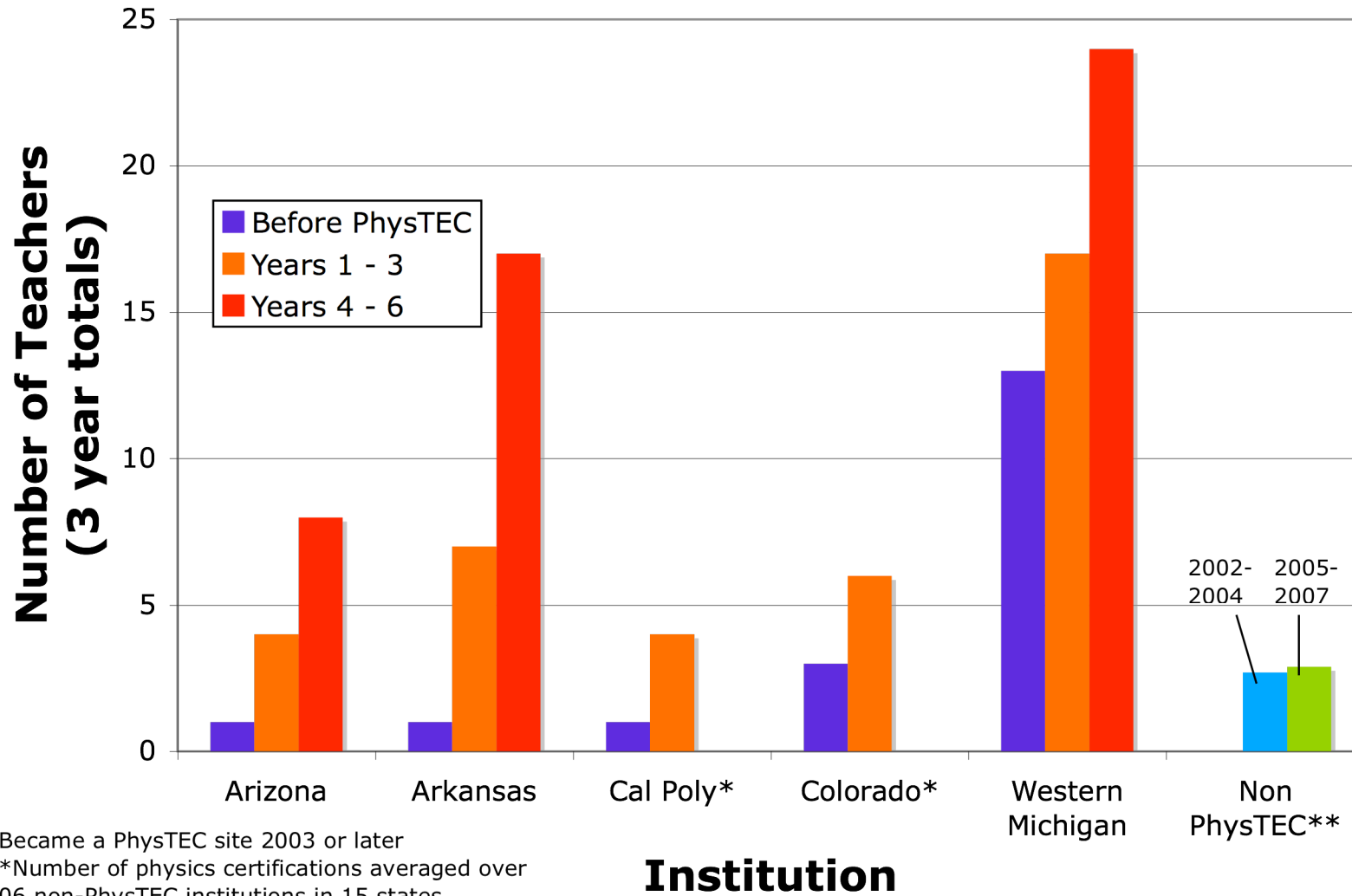
- **PhysTEC:** Significant support for a limited number of institutions to demonstrate model programs of physics and physical science teacher education
- **PTEC:** National coalition of colleges and universities dedicated to improving physics teacher education



Arkansas Success Story

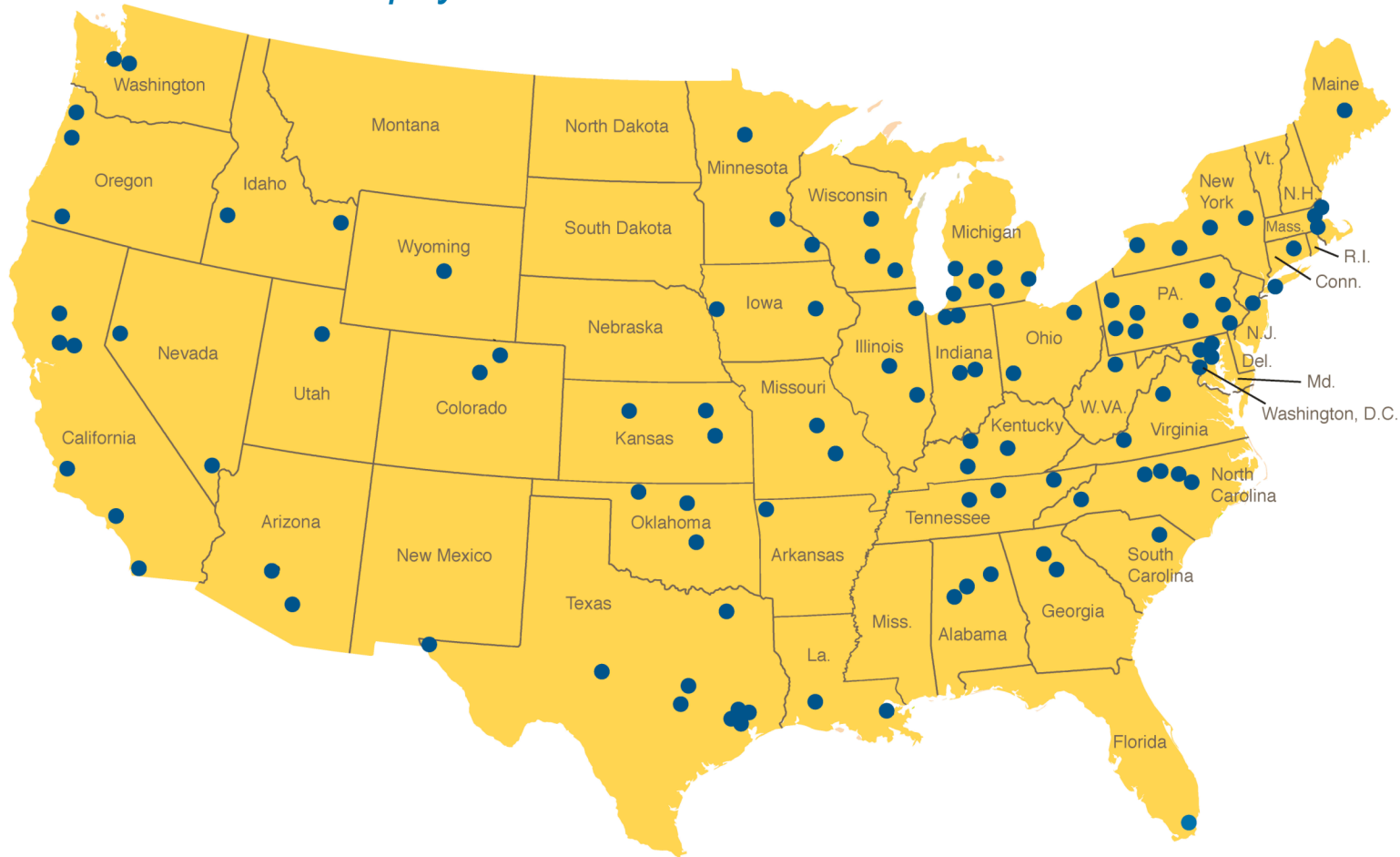


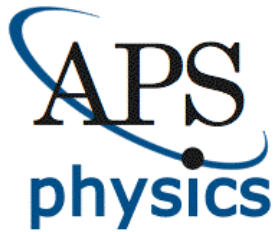
Increase in Physics Teachers Educated at PhysTEC Institutions



PTEC Member Institutions

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





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

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, black 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, black 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 a red and white patterned beanie, striking a confident pose. The text "PERSONAL EXPRESSION" is overlaid in a bold, black 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, black 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, black 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



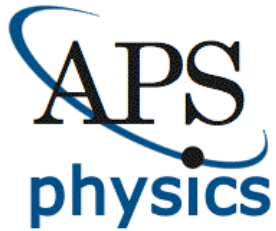
BASIC INSTINCTS
TRIBALISM
NAUGHTY





...inaction has downsides too





The Time is Now

To complete our race to the top requires the third pillar of reform -- recruiting, preparing, and rewarding outstanding teachers.

From the moment students enter a school, the most important factor in their success is not the color of their skin or the income of their parents, it's the person standing at the front of the classroom.

If you want to make a difference in the life of our nation... join the teaching profession. America needs you.

President Barack Obama, 9 March 2009