

Reaching the Critical Mass: Highlights from the 2005 High School Physics Teachers Survey

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Enrollments

Enrollments in high school physics continue to grow. In 2005, approximately one out of every three high school seniors had taken at least one physics course before graduating. Twenty years ago this figure was closer to one in five (Figure 1). In absolute terms, the number of students having taken physics during high school has almost doubled in fifteen years increasing from about 620,000 students in 1990 to 1.1 million in 2005 (Figure 2). Furthermore, the number of students taking an honors, AP, or second-year course has almost tripled growing from about 106,000 in 1990 to about 308,000 in 2005. Of course, some of the increase is likely attributable to helpful trends in population and college attendance, and furthered spurred by energetic and creative efforts to promote refinement and reform.

Demographics

Among students, no longer is high school physics predominantly a preserve of white males. In terms of overall enrollment, female students have reached near parity (Figure 3). Among high school students, underrepresented minorities have made great strides, especially in the last dozen years, towards closing the historical gap in enrollment (Figure 4).

The demographic profile of physics teachers has changed much more slowly. The proportion of female high school physics teachers is virtually unchanged from the previous survey with less than one-third of those teaching physics being women (Figure 5). African American and Hispanic teachers each make up only 1.5% of the total, and Asian Americans account for 2%.

Teacher Preparation & Specialization

In 2005, there were about 23,000 teachers who taught at least one physics class. This was up from 17,900 in 1987. This increase of 28%, while not negligible, is far smaller than the growth in the number of students. The average class size has remained stable at 18 students; this coupled with the slower growth in the number of teachers has resulted in a 57% increase – from 28% in 1987 to 44% in 2005 – in the proportion of teachers who had all or most of their class assignments in physics (Figure 6). Additionally, over 70% of those teaching physics possess either a physics degree or extensive physics teaching experience, or both (Figure 7). Among those with no physics degree and little teaching experience, roughly two-thirds have degrees in one or more other science fields.

Physics First

Over the last decade or so, there has been growing interest in the idea of restructuring the order of the science curriculum in U. S. high schools. Some educators have proposed that physics is the foundational science which provides the foundation for much of chemistry, which in turn forms the platform for much of what is new and exciting in biology. These scientists and educators have proposed to reorder the sequence in which high school science is taught, starting with physics first. The movement to promote the idea and encourage the implementation of Physics First (PF) has been slowly but steadily gaining ground over the last several years. We

estimate that 4% of all U.S. high schools – 3% of all public and 8% of all private schools – had implemented some variant of Physics First by 2005. Figure 8 reveals that, overall, teachers' opinions regarding the efficacy of the Physics First approach are little changed from 2001; however, over 70% of those participating in a PF curriculum had positive opinions about it (Figure 9).

Funding

Funding available per class for equipment and supplies has fallen from about \$300 in 1987 to about \$250 in 2005. After adjusting for inflation, physics teachers have less than half of the funds available to support the purchase of equipment and supplies than they did twenty years ago (Figure 10). In terms of starting salaries, the picture is slightly better with the growth in salaries outpacing inflation by about 0.8% per year (Figure 11).

Textbooks

Finally, an examination of the percent of teachers using various textbooks reflects the ebb and flow that naturally occurs as publishers introduce and periodically revise their offerings. The top four texts account for over 85% of the teacher/school system adoptions in the regular first-year physics course. The choices for honors physics courses vary more widely (Table 1).

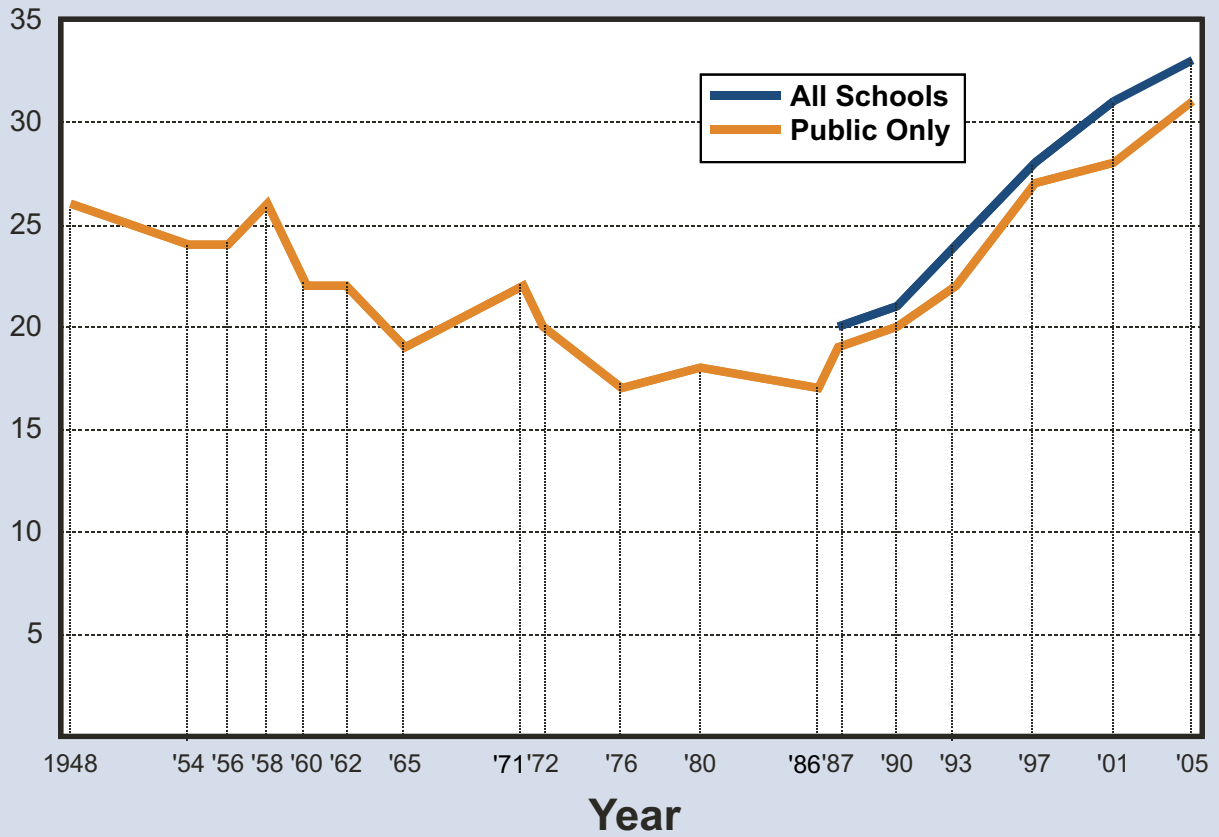
How the Survey Was Conducted

The 2004-05 Nationwide Survey of High School Physics Teachers is the sixth in a series of studies begun by the American Institute of Physics in the mid-1980s. In the fall of 2004, we contacted the principals at over 3,500 randomly-selected schools¹ to obtain the name of all teachers with physics class assignments for that year and some basic information about the schools. We received names of over 3,700 teachers. In early 2005, we asked those teachers to tell us about themselves, their schools, their students, and their curricula. We combined their responses with those from the principals.

¹ The schools were randomly selected from databases maintained by the U.S. Department of Education's National Center for Education Statistics listing all public and private high schools in the U.S.

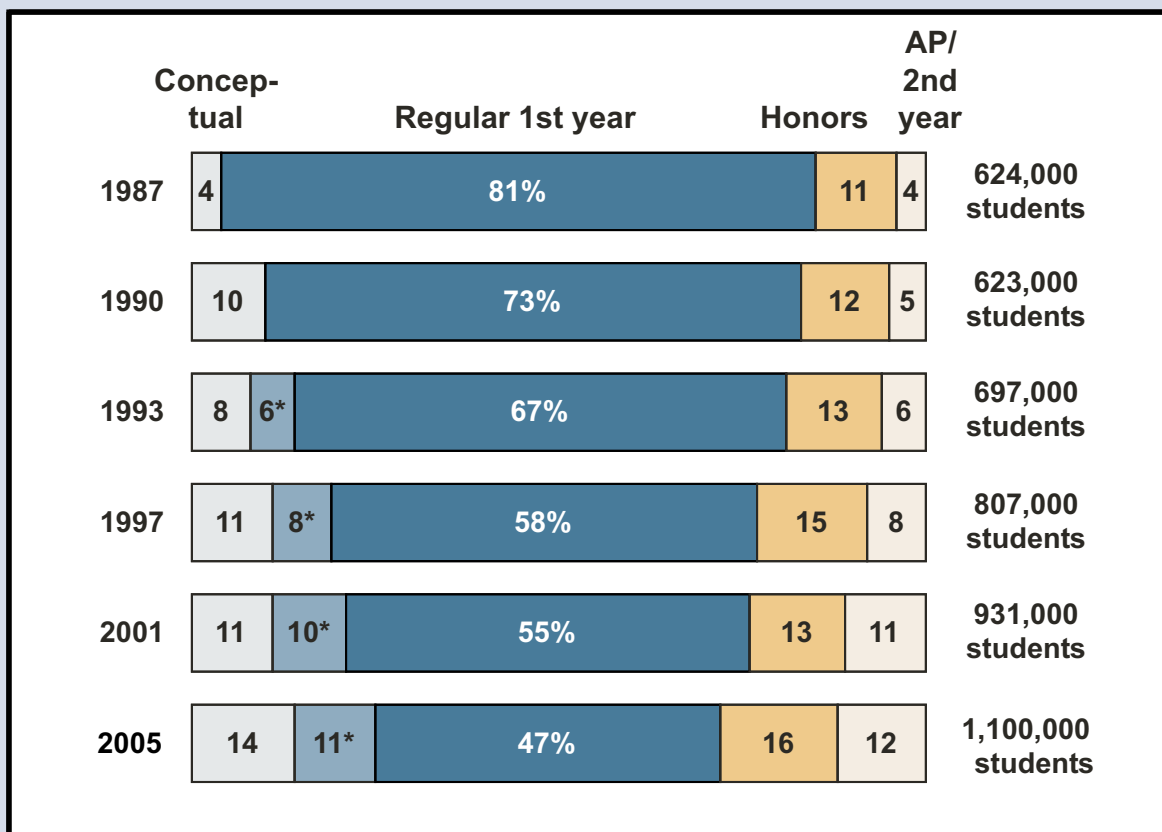
Figure 1. Physics Enrollment in U.S. High Schools, 1948-2005

**% of seniors who have taken
or are taking physics**



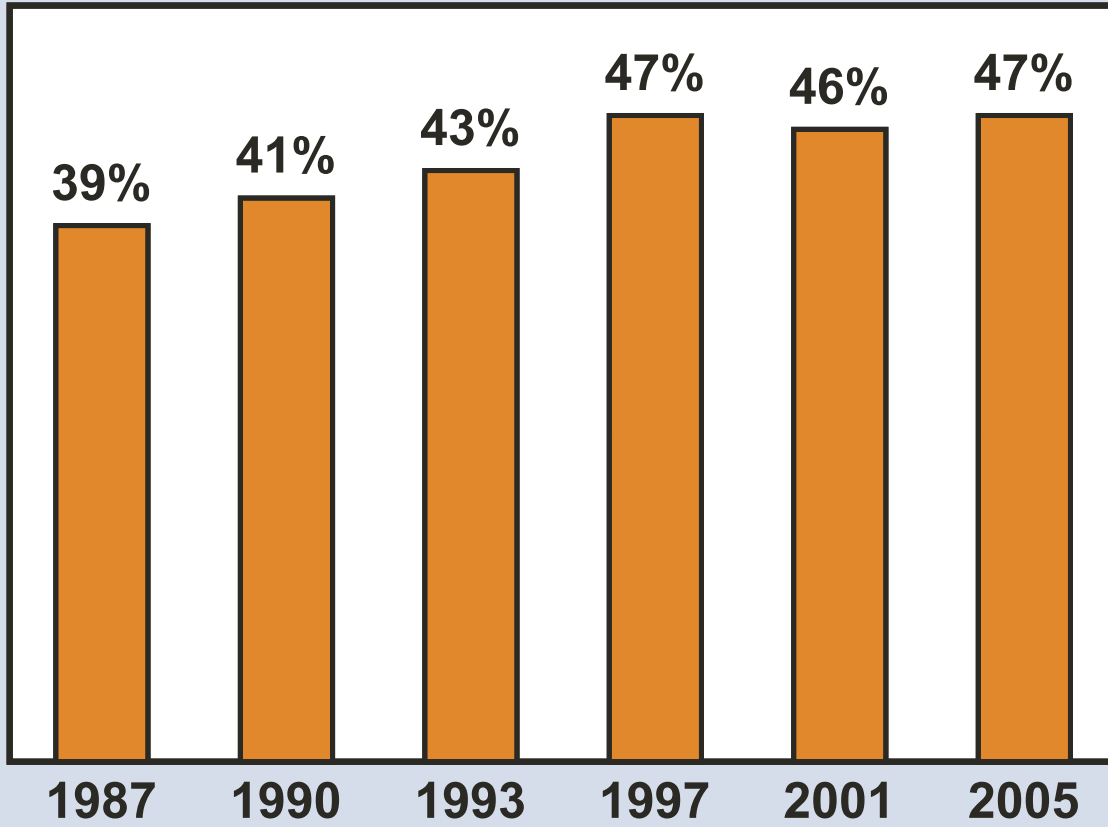
AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05 High School Physics Surveys;
Pallrand et al. (1985); Dept. of Education., Nat'l Center for Education Statistics (Various Years)

Figure 2. High School Physics: Enrollment Distribution



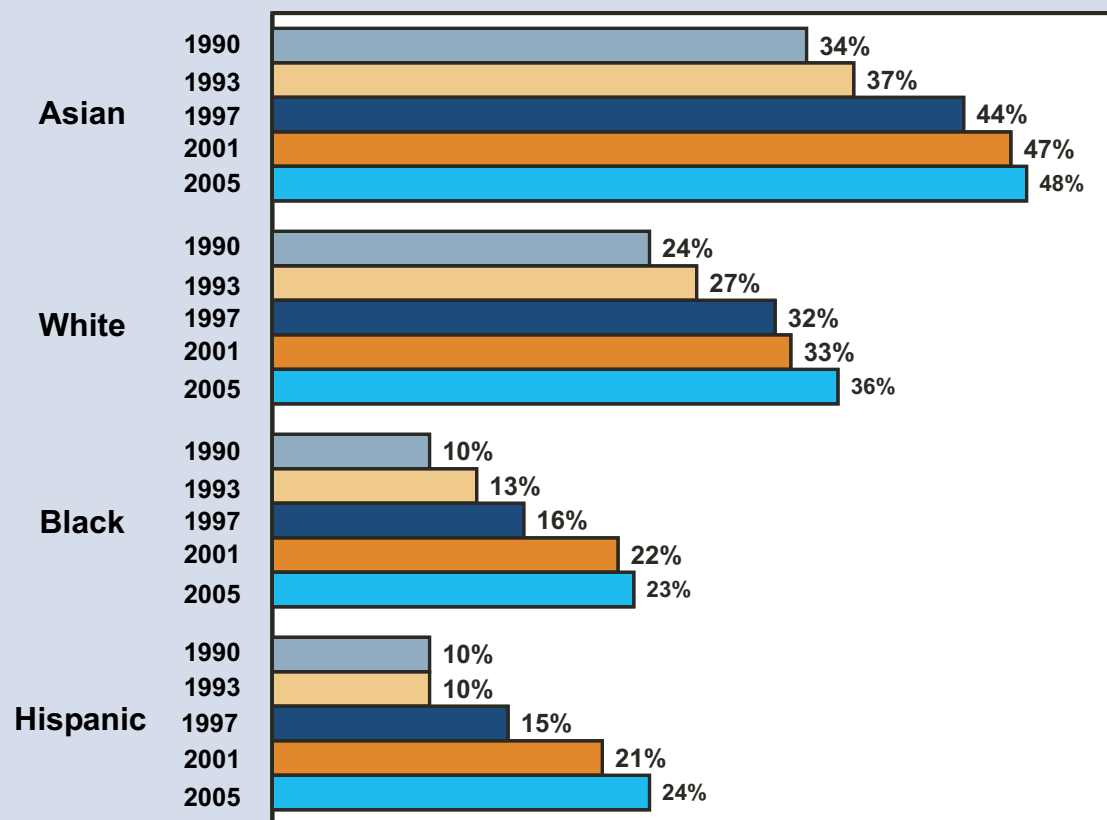
* Percent of students in regular first-year physics courses that use conceptual physics textbooks.

Figure 3. Females as a Percentage of Total Enrollment in High School Physics



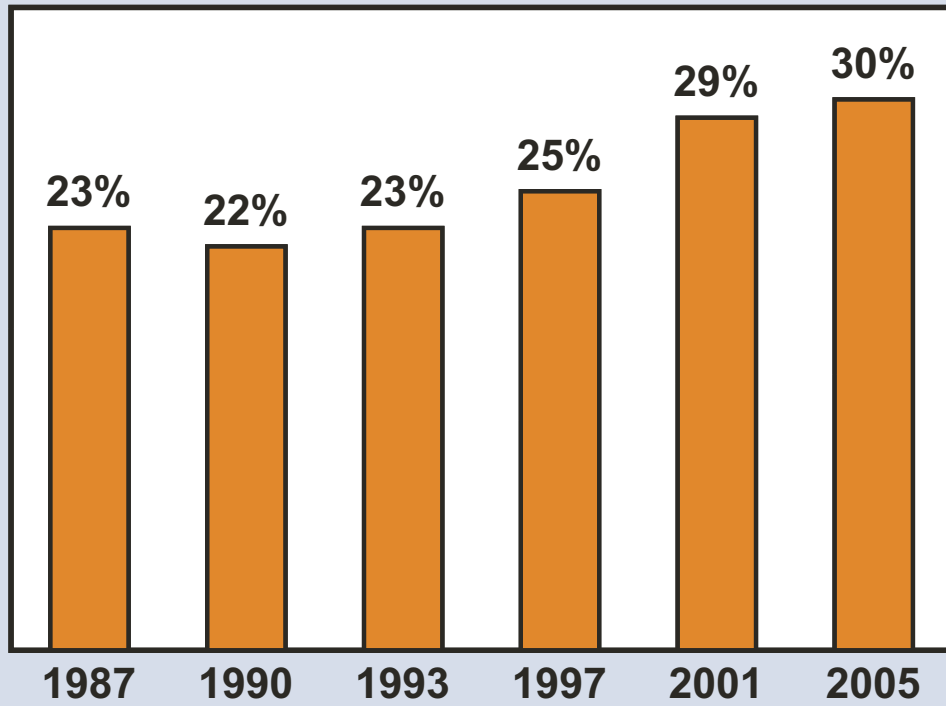
AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05 High School Physics Surveys

Figure 4. Percent of Students in Each Racial Group Taking Physics



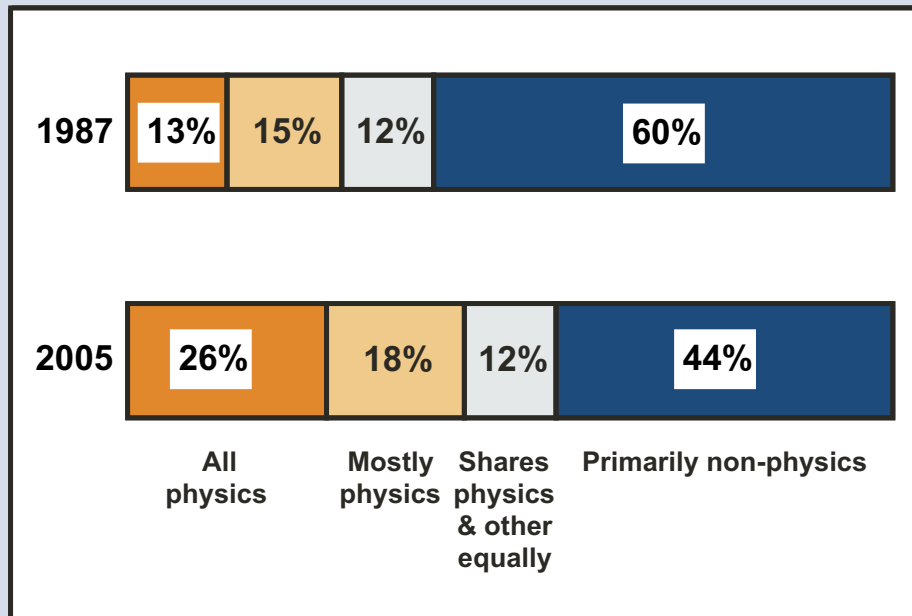
AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05 High School Physics Surveys

Figure 5. Percent of High School Physics Teachers who are Women



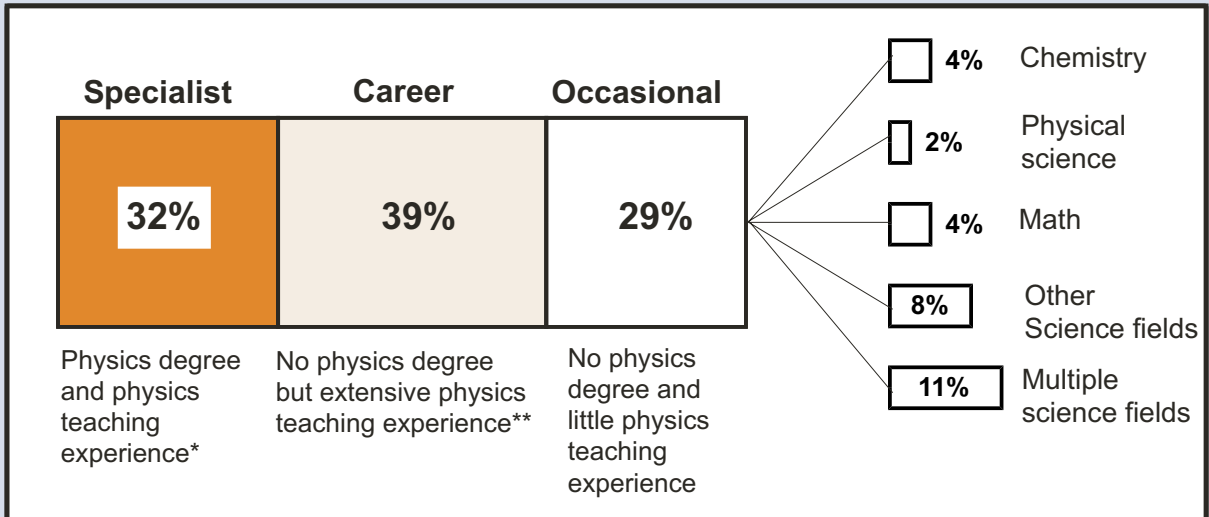
AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05 High School Physics Surveys

Figure 6. Place of Physics in Current Teaching Assignment



AIP Statistical Research Center: 1986-87 & 2004-05 High School Physics Surveys

Figure 7. Teacher Specialization: Academic Training and Experience

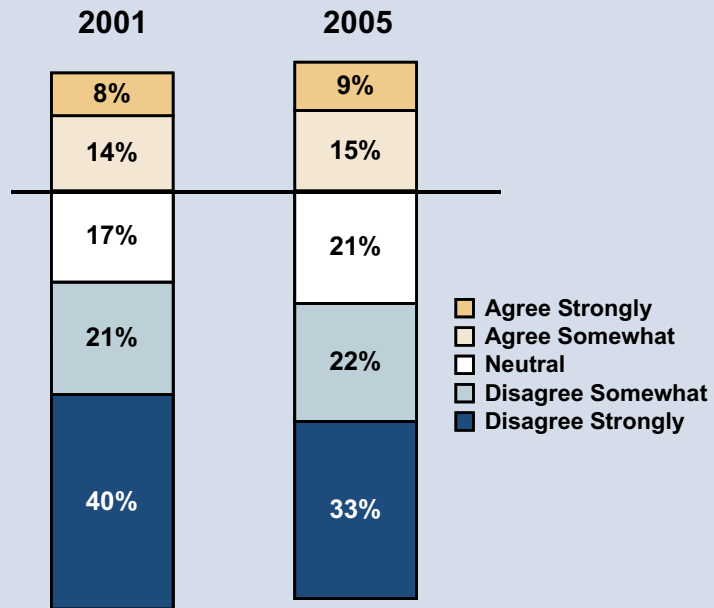


*Teachers with physics degrees but insufficient physics teaching experience are excluded from this figure (3%).

**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 25% in math/engineering, 23% in biology, 17% in chemistry, 18% in other science fields and 17% in other fields.

Figure 8. Teacher's Opinion on Physics First*, 2001 and 2005

The extent to which teachers agree with the statement: "The sequence of high school sciences should be reversed, so that students take physics first, before chemistry or biology."



AIP Statistical Research Center: 2000-01, 2004-05 High School Physics Surveys

Figure 9. Teacher's Opinion on Physics First

The extent to which teachers agree with the statement: " The sequence of high school sciences should be reversed, so that students take physics first, before chemistry or biology."

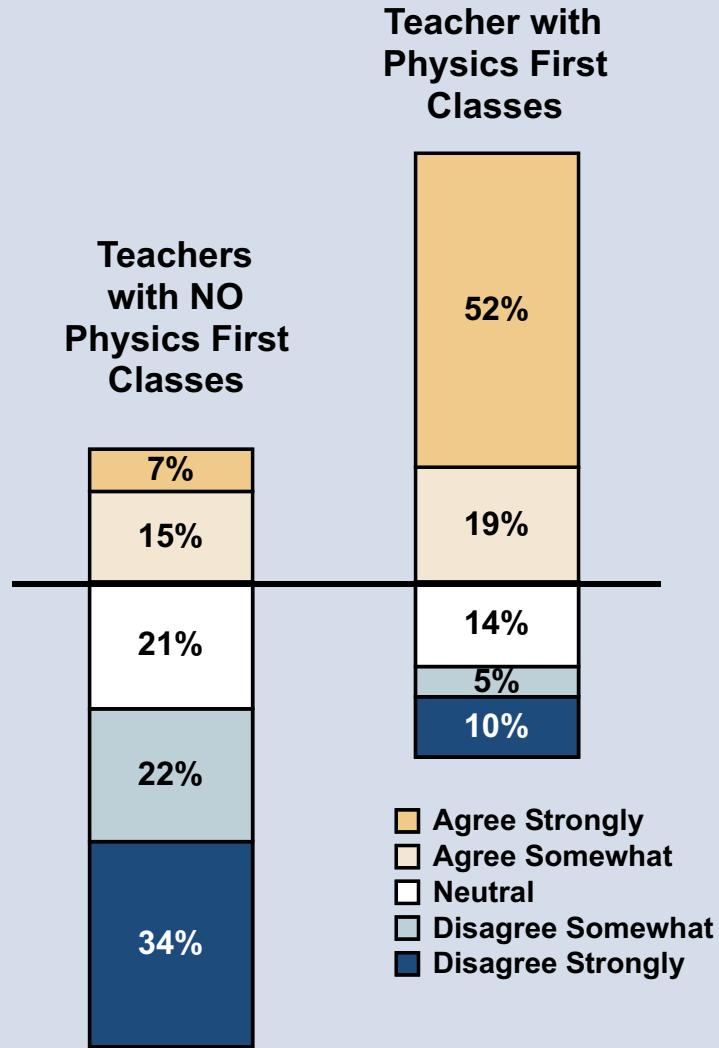
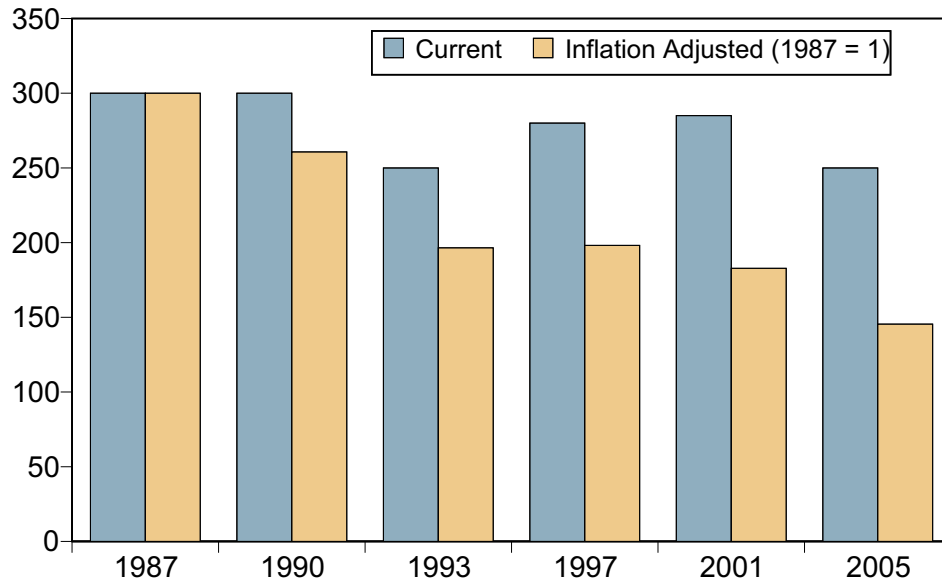
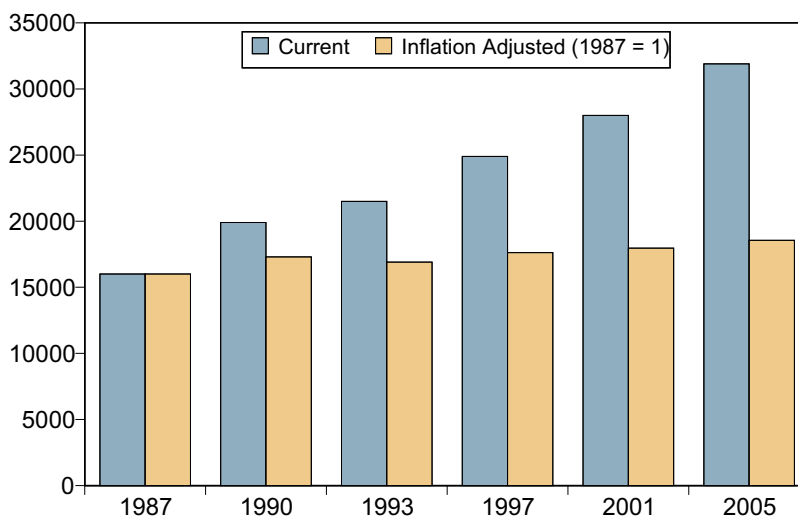


Figure 10. Median Funding Available per Class for Equipment and Supplies.



AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05
High School Physics Survey

Figure 11. Starting Salaries for New Teachers.



AIP Statistical Research Center: 1986-87, 1989-90, 1992-93, 1996-97, 2000-01 & 2004-05
High School Physics Survey

Table 1. Most Widely Used Textbooks

	Percent of teachers using this text in:						% rating text high in quality**
	'05	'01	'97	'93	'90	'87	
Regular first year physics	%	%	%	%	%	%	%
1. <i>Physics: Principles & Problems</i> (Zitzewitz / Glencoe-McGraw)	40	49	53	44	42	33	46
2. <i>Conceptual Physics - HS Level</i> (Hewitt / Addison Wesley)	16	13	13	9	*	*	59
3. <i>Holt Physics</i> (Serway & Faughn / Holt)	25	13	—	—	—	—	49
4. <i>Physics: Principles with Applications</i> (Giancoli / Prentice Hall)	5	—	—	—	—	—	62
5. <i>Modern Physics</i> (Trinklein / Holt)	*	5	20	23	32	36	53
Physics for non-science students							
1. <i>Conceptual Physics - HS Level</i> (Hewitt / Addison Wesley)	76	75	74	79	75	27	69
2. <i>Active Physics</i> (Eisenkraft / <i>It's About Time</i>)	5	—	—	—	—	—	20
3. <i>Physics: Principles & Problems</i> (Zitzewitz / Glencoe-McGraw)	*	6	7	8	7	28	29
Honors physics							
1. <i>Holt Physics</i> (Serway & Faughn / Holt)	26	9	—	—	—	—	61
2. <i>Physics: Principles & Problems</i> (Zitzewitz / Glencoe-McGraw)	18	30	25	18	*	*	46
3. <i>Physics</i> (Giancoli / Prentice Hall)	17	16	19	14	10	7	73
4. <i>College Physics</i> (Serway & Faughn / Brooks-Cole)	8	9	*	—	—	—	65
5. <i>Physics</i> (Cutnell & Johnson / Wiley)	8	7	*	—	—	—	76
6. <i>Conceptual Physics - HS Level</i> (Hewitt / Addison Wesley)	6	6	*	*	*	*	52
7. <i>Modern Physics</i> (Trinklein / Holt)	5	*	15	20	27	28	55
8. <i>College Physics</i> (Wilson and Buffa / Prentice Hall)	5	—	—	—	—	—	57
Advanced Placement B							
1. <i>Physics: Principles with Applications</i> (Giancoli / Prentice Hall)	35	33	27	28	—	—	73
2. <i>College Physics</i> (Serway & Faughn / Brooks-Cole)	20	25	24	10	—	—	87
3. <i>Physics</i> (Cutnell & Johnson / Wiley)	19	15	9	—	—	—	68
Advanced Placement C							
1. <i>Fundamentals of Physics</i> (Halliday, Resnick & Walker / Wiley)	45	47	41	39	—	—	73

— not separately rated *less than 5% **On a scale of 1 to 5, with 5 the highest quality rating, the percent rating a text as a 4 or 5.