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Challenges High School Teachers Face

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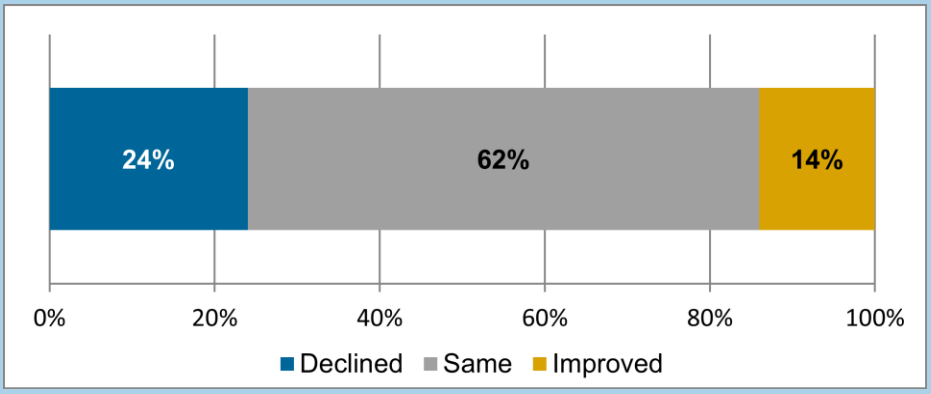
Many high school physics teachers find their job to be very rewarding. Teachers in our sample spoke about the "aha" moments when their students connected and engaged with the material, the pleasure of working with motivated students, and the particular joy of helping students enjoy a field that they themselves love. But, high school physics teachers also face distinct challenges in their work, including varying levels of student preparation and motivation, requirements and mandates, and varying levels of administrative and financial support. In addition, most high school physics teachers are the only physics teacher at their school, so there is no colleague with whom they can readily discuss the specific joys and challenges of teaching physics.

Figure 1

Experienced Teachers' Perceptions of Students' Preparation Compared to Students taught in Prior Years
2008-09 US High School Physics Teachers



*** Chart limited to teachers who have taught physics for more than 5 years**

Responses to: "How does the overall preparation of your entering physics students this academic year (2008-09) compare to that of past years?

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Reports on High School Physics: 2011-2012 Series

Turnover among High School Physics Teachers (October 2011)

High School Physics Teacher Preparation (February 2012)

Challenges High School Physics Teachers Face (April 2012)

For previous reports, please visit http://www.aip.org/statistics/highschool

The 2008-09 Nationwide Survey of High School Physics Teachers

During the 2008-09 academic year, we contacted a representative national sample of about 3,600 public and private high schools across the U.S. to inquire about physics availability and offerings. These reports describe our findings.

Student Preparation

The vast majority of high school teachers who have taught physics for more than five years reported that their current students are just as well prepared as students from past years. (See **Figure 1** on page 1.) Of those who did report a change in overall student preparation, nearly a quarter reported a decrease compared to past years, and fourteen percent reported an increase in the level of student preparation compared to past years.

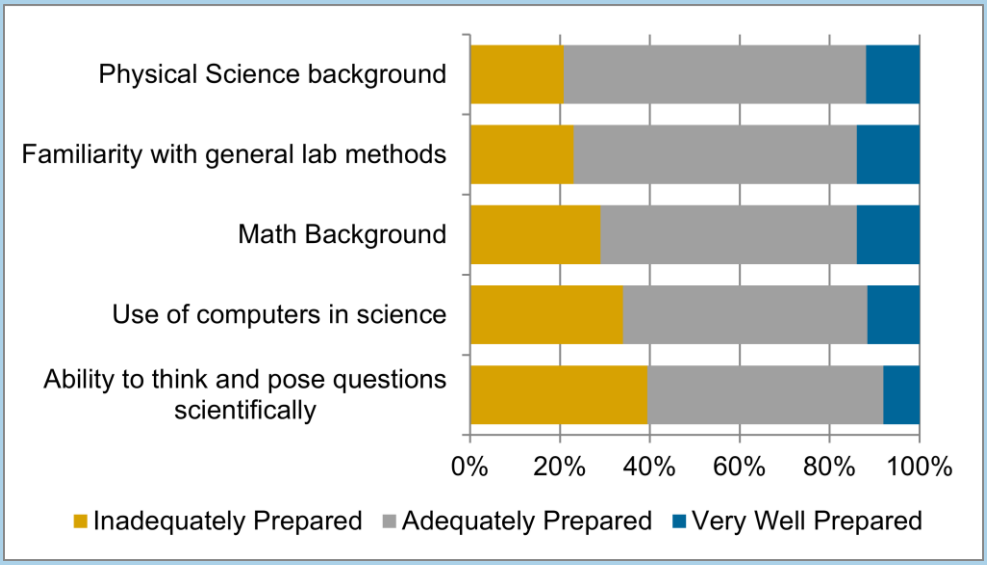
Student preparation can be quite nuanced. Not only have students been exposed to a variety of preparatory classes and outside influences, students approach those influences and their current classes with varying degrees of motivation. We asked teachers to rate their students' preparation for physics in a number of areas. The overall picture of teacher perception of student preparation in various domains is shown in **Figure 2**.

Over half of high school physics teachers described their students as adequately prepared for physics in these domains.

Figure 2

Student Preparation

2008-09 US High School Physics Teachers



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In each of the domains of student preparation detailed in Figure 2, more than half of the teachers felt that their students were adequately prepared. The area where teachers felt their students were the least prepared was in their ability to think and pose questions scientifically. Almost two fifths of the responding teachers reported that their students were inadequately prepared to think and pose questions scientifically, and less than 10% of teachers felt that their students were adequately prepared in this domain.

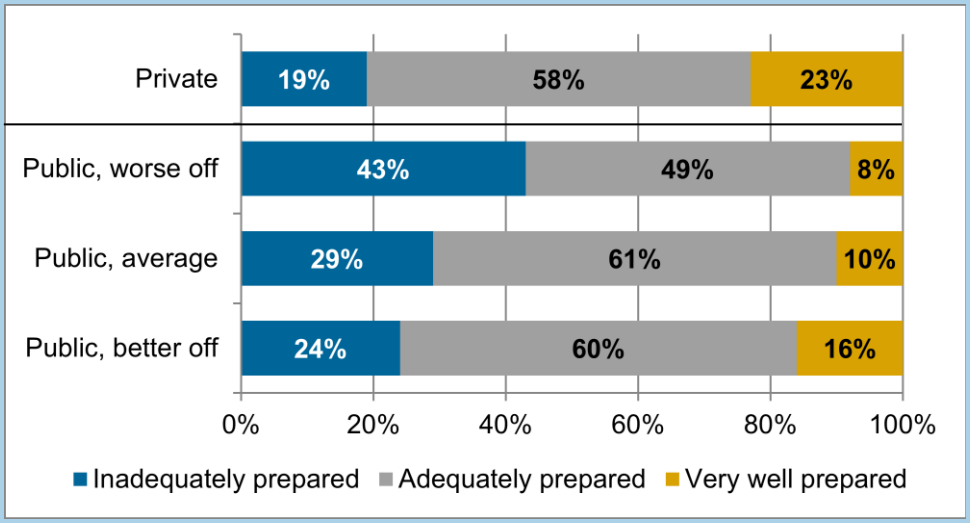
Students' Math Background

Looking more closely at teachers' perceptions of their students' math backgrounds, as shown in **Figure 3**, we found significant differences between teachers at public and private schools. Although the majority of teachers at both public and private schools described their students as adequately prepared for physics in terms of their math backgrounds, teachers at private schools were significantly more likely to describe their students as very well prepared (23% vs. 11%) and significantly less likely to describe their students as inadequately prepared (19% vs. 32%) than teachers at public schools.

Figure 3

Teachers' Perception of Student Math Preparation: Private Schools and Public Schools by SES*

2008-09 US High School Physics Teachers



*** Teacher / principal assessment of student economic circumstances relative to those of students at other schools in the local area.**

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Teachers at private schools generally rated the math backgrounds of their students higher than teachers from public schools, especially public schools in which students are worse off socioeconomically.

Among public school teachers, there was a relationship between the teacher's assessment of the math background of their students and the relative socioeconomic status of the school's student body. Teachers at schools that serve families where students are typically better off (economically) were less likely to describe their students as inadequately prepared (24%) than teachers at schools that serve families where students were typically worse off (43%).

Math was not the only area of student preparation that varied between public and private schools and the relative socioeconomic status of the students' families. In fact, the pattern shown in **Figure 3** for math applied to each of the areas of preparation in the survey, all of which are included in **Figure 2**. (Our socioeconomic classification is based

upon teachers' and principals' assessments of the circumstances of the student body relative to others in the local area. We started using this measure in 1997. We have found this measure to be consistent with the free and reduced-price lunches on the lower end of the spectrum – worse off – while allowing us to better distinguish between average and better off.)

Problems affecting Physics Teachers

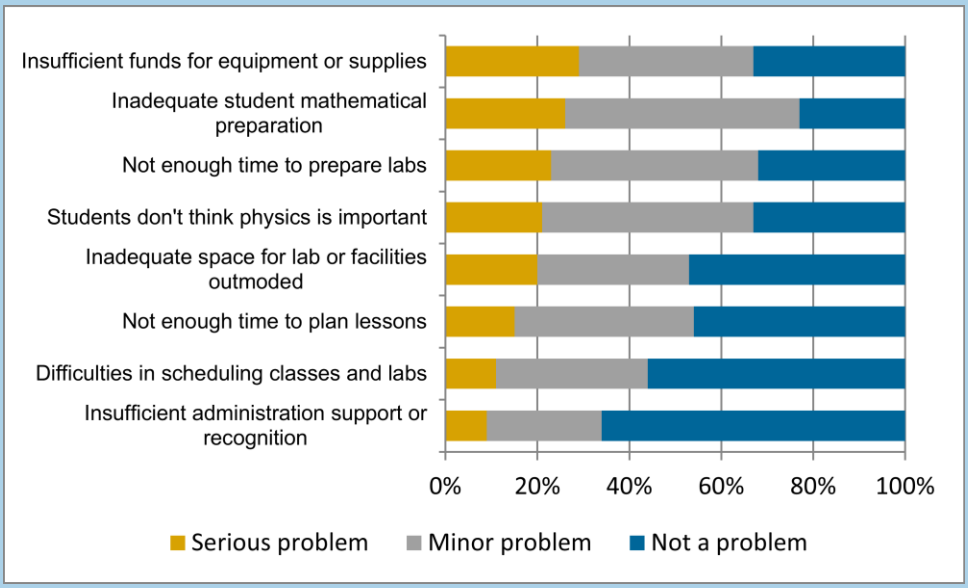
Teachers encounter a variety of problems, some of which are unique to physics teaching, and some of which are also true for other subjects. The particular set of problems we asked our sample about is shown in **Figure 4**.

Insufficient funds for equipment or supplies and inadequate student mathematical preparation are viewed, by teachers, as the most serious problems they face.

Figure 4

Teachers' Perceptions of Problems They Face

2008-09 US High School Physics Teachers



http://www.aip.org/statistics

Insufficient funds for equipment and supplies and inadequate student mathematical preparation were reported as serious problems by the highest proportion of teachers. Insufficient funds for equipment or supplies was more likely to be reported as a problem by teachers at schools that served students who were worse off (39%) than those at schools that served students who were better off (21%).

No Child Left Behind

We asked high school physics teachers about the impact of NCLB in both the 2008-09 and 2004-05 surveys. In the first round, over 80% of the respondents said that NCLB had not affected their physics classes or curriculum, and about 5 teachers in 6 (84%) said the provisions on teacher qualification had not affected them.

"No child left behind required that I attain a physics certificate yet funding was not made available to me. I paid for over 30 credits out of my personal savings."
–A HS physics teacher

In our 2008-09 survey, we asked about NCLB using an open ended question: "How has the No Child Left Behind Act affected the physics program or your physics classes at your school?" While open-ended questions result in richer responses, the interpretation of the answers requires some caution. For example, one respondent might choose to tell us that the time allotted for their physics classes had decreased, and another may not say anything about the time devoted to their classes. In the case where a respondent does not mention a topic, we cannot make any inferences about the teacher's feelings on that topic. Thus, it is not proper to include numbers or frequencies in a summary of the responses. With open-ended questions, we exchange the numerical precision for a wider range of information. In sidebars, we have included some direct quotes which reflect the range of teachers' responses.

"Some students dislike testing and therefore learn to dislike learning."
–A HS physics teacher

The open-ended responses from the 2008-09 survey suggest that the vast majority of teachers again fall into one of two groups which suggest they see little or no effect: (a) those who are not sure whether NCLB has affected their classes or not and (b) those who think that there has been no effect. There are also a sizeable proportion of teachers who report seeing the effects of the policy on their classes. This range of responses is consistent with the variations in the implementation of NCLB across states. While the 2007-08 school year was the first for which NCLB requirements included annually testing all students in science in at least one grade (10 – 12), the specific requirements physics teachers are subject to vary widely. In some states, physics is one subject included in a mandatory science test all students must take prior to graduation; in others, students who elect to take physics may have to take a subject-specific test. There are also states in which physics is not included in any NCLB testing.

"Seems to have little affect, directly. Resources are diverted to lower level classes."
–A HS physics teacher

The two main elements of the NCLB policy that could affect physics programs the most are (1) assessments and (2) teacher qualification standards. With respect to the latter, many teachers mentioned their certification or qualifications for teaching in their comments about NCLB. Some had to pursue additional certification to teach physics, and others had less flexibility in their class load because of their physics certification.

Turning to assessment and classroom impacts, the vast majority of the responses about NCLB were neutral in tone. More of the non-neutral comments were negative than positive in tone. Some talked about the

changing math requirements and the consequences of those changes. The increased math requirements sometimes resulted changes in the amount of class time allotted to physics (usually, but not always, decreases in class time). Some teachers reported a redirection of funds away from science, toward math, although reports about funding varied greatly. Some programs lacked the necessary funding and equipment for physics classes and labs, and others had plenty of resources allocated to physics. (See **Figure 4** on page 4 for a more quantitative examination of problems teachers face.) Many teachers reported changes in the focus or approach to math education – more of an emphasis or more of a focus on teaching to the tests – because of the increase in standardized testing in the subject. (Student math preparation was examined in more detail on page 3.)

"Students' math preparation has declined, since all their math instruction is now geared towards taking multiple-choice exams."
–A HS physics teacher

These observations match findings from a 2007 Center on Education Policy report entitled Choices, Changes, and Challenges Curriculum and Instruction in the NCLB Era; some of the findings are shown in **Table 1**. This study found that instruction time in math at the grade school level had increased at the expense of instruction time in other subjects, including the sciences.

Table 1

Changes in Instructional Time in Elementary Schools since 2001-02

	Percentage of All Districts That **Increased** Time	Percentage of All Districts That **Decreased** Time	**Average Increase** (Number of minutes per week)	**Average Decreases** (Number of minutes per week)
Mathematics	45%		89	
Science		28%		75

Source: Center for Education Policy, July 2007

http://www.menc.org/documents/advocacy/harrispoll/cepstudyjuly2007.pdf

"My concern is that all students will be required to take physics in 5 years and how that will impact honors and regular physics programs."
–A HS physics teacher

Teachers in schools where physics was mandatory were more likely to describe a wider breadth of students in terms of preparation and motivation. Some reported a rise in conceptual physics courses. Some of these teachers were concerned about the level of physics they were able to teach to a wider body of students. In contrast, teachers in schools where physics was not mandatory were more likely to report smaller class sizes and higher student motivation, or, conversely, to complain about the small proportion of students enrolled in physics or lower student motivation. Some teachers in schools where physics was not required had particularly bleak comments; however, comments such as these are rarer than the public debate would suggest. Some

"Those students who do take my class don't take it seriously …"
–A HS physics teacher

teachers saw the lack of physics mandates as an opportunity to teach a less-structured class. It is clear from the wide variety of teacher comments that the policies vary widely between school systems, and each of the different sets of policies comes with its own unique set of advantages and disadvantages.

Professional Development and Connectedness

In over 80% of the schools where physics is taught, there is only one physics teacher. In the past, this has left many physics teachers feeling isolated, but advances in technology help to connect physics teachers from different schools. At the time of the survey, 22% of the teachers in the sample belonged to a listserv or internet discussion group for physics or science teachers. Some of the most popular listservs are shown in **Table 2**.

"One of my main problems of teaching physics is the isolation. I am the only teacher at my school and so it is difficult to get new ideas. I do not have a lot of time to research online."
–A HS physics teacher

Table 2

Popular Listservs for Physics Teachers
2008-09 US High School Physics Teachers

AAPT
AP listservs
College Board listservs
Local or school sponsored listservs
Modeling listservs
NSTA
OPHUN
Phys-L
physhare
physics first
PTSOS

http://www.aip.org/statistics

"The 'ahah' moment is why I went in to teaching and why I'm still here. I love seeing the moment when everything finally shifts together in a student's head and they 'get it'. … I love getting them excited about a subject that I am passionate about."
–A HS physics teacher

Respondents from schools where they were the only physics teacher were dramatically less likely to agree that they "have ample opportunity to share ideas with other physics teachers" (17%, compared to 65% of teachers who had at least one other physics teacher at their school). These solo teachers were also less likely to participate in a listserve or internet discussion group, less likely to belong to NSTA or AAPT groups at the national or local level, and less likely to attend workshops or meetings. This was especially true for teachers in more rural locations, where workshops may be more difficult to attend.

Survey Methodology

In the fall of 2008, we contacted a representative sample of over 3,600 high schools in the U.S., both public and private, to determine whether or not physics was taught there. We received responses from over 99% of the schools. For the schools which indicated they were offering physics, we obtained contact information for the teachers. In the spring of 2009, we contacted each of the teachers who were thought to be teaching physics. We received responses from over 2,500 teachers (a 62% response rate). Our findings are based on their responses.

For a copy of the principal survey or the teacher survey, please contact Susan White at swhite@aip.org.

We are able to conduct this research only with the gracious help of the more than 6,000 people who provided responses, including an administrator at each school and each of the teachers who responded. We are deeply grateful for their assistance and their time.

This marks the seventh time we have conducted a survey examining physics in U.S. high schools. Our eighth study will begin in the Fall of 2012. Thank you very much for your help with this study.

Note: The questions in this survey about student preparation and teachers' perceptions of the problems they faced included three possible responses. The questions are given below:

How does the overall preparation of your entering physics students this academic year (2008-09) compare to that of students in past years? (This is my first year teaching physics / Improved / Stayed about the same / Declined)

When students first entered your class, how well prepared were they to take physics in terms of:
(inadequately prepared / adequately prepared / very well prepared)

- *Math background*
- *Physical science background*
- *Ability to think and pose questions scientifically*
- *Familiarity with general laboratory methods*
- *Use of computers in science*

Which of the following are problems that affect your physics teaching? (Not a problem / minor problem / serious problem)

- *Inadequate space for lab or lab facilities outmoded*
- *Insufficient funds for equipment or supplies*
- *Difficulties in scheduling classes and labs*
- *Not enough time to plan lessons*
- *Not enough time to prepare labs*
- *Insufficient administration support or recognition*
- *Students do not think physics is important*
- *Inadequate student mathematical preparation*