

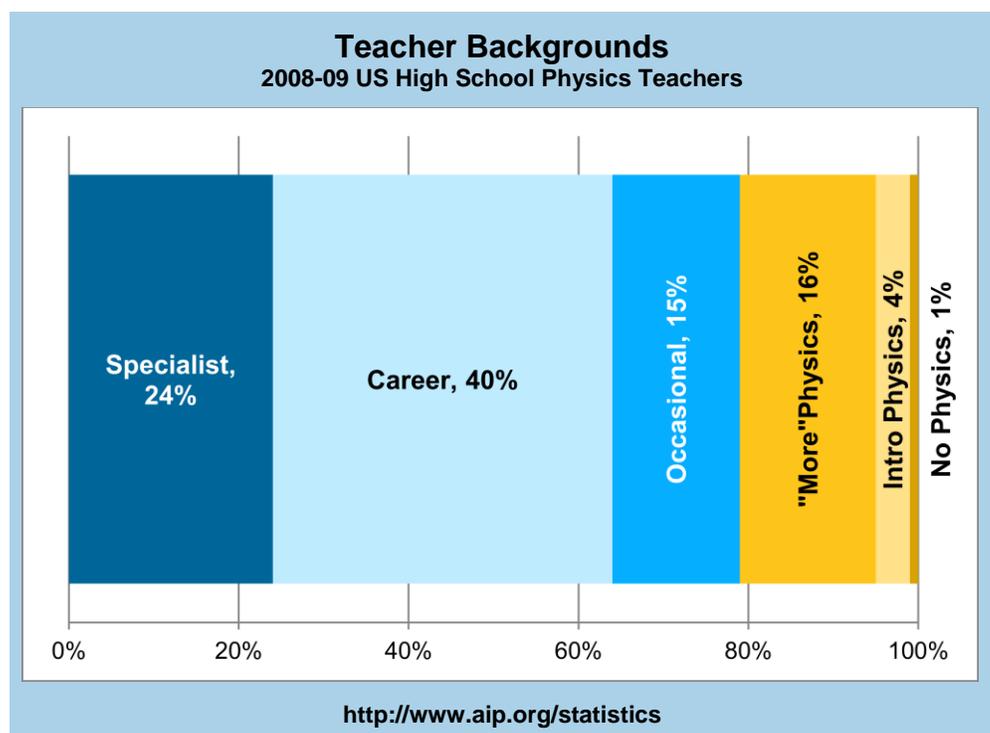
High School Physics Teacher Preparation

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Backgrounds of High School Physics Teachers

About 46% of high school physics teachers have a major or minor in physics or physics education. Many of the remaining 54% have taken post-secondary classes in physics and physics education and over 80% of them hold a degree in another STEM discipline. Furthermore, they have many years of experience teaching high school physics. In order to simplify the complex array of academic and teaching backgrounds of high school physics teachers, we have divided the teachers into two groups: those with at least five years of teaching experience at the high school level and those with less than five years' high school teaching experience. Specific details about the definitions are given on the following page.

Figure 1



**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.

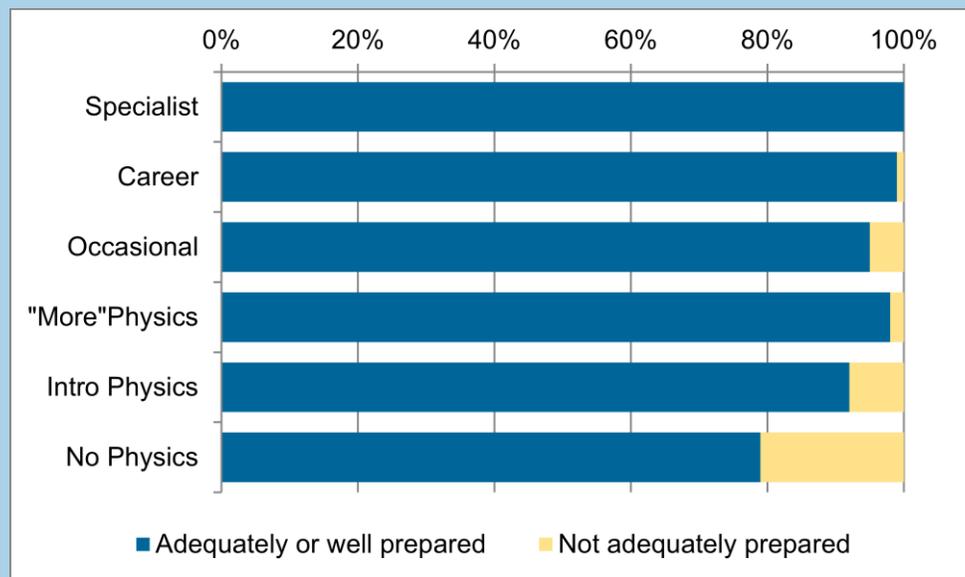
Within the more experienced group, we define physics **Specialists** to have a major in physics or physics education and to have taught physics at least as much as any other subject. **Career** physics teachers are those who have taught physics at least as much as any other subject, but do not have a major in physics or physics education. Finally, the **Occasional** physics teacher teaches other subjects more often than physics.

We looked at post-secondary physics courses taken by those teachers with less than five years' experience teaching at the high school level. Most of this group reports having taking physics beyond the introductory level; we call this "**More**" **Physics**. There are also teachers who have taken only **Intro Physics** courses at the post-secondary level, and a few who report having taken **No Physics** in college.

We see that about 80% of the high school physics teachers are either specialists or career teachers or have taken physics beyond the introductory courses during their post-secondary career.

Figure 2

Teacher Self-Assessed Level of Basic Physics Knowledge
2008-09 US High School Physics Teachers



<http://www.aip.org/statistics>

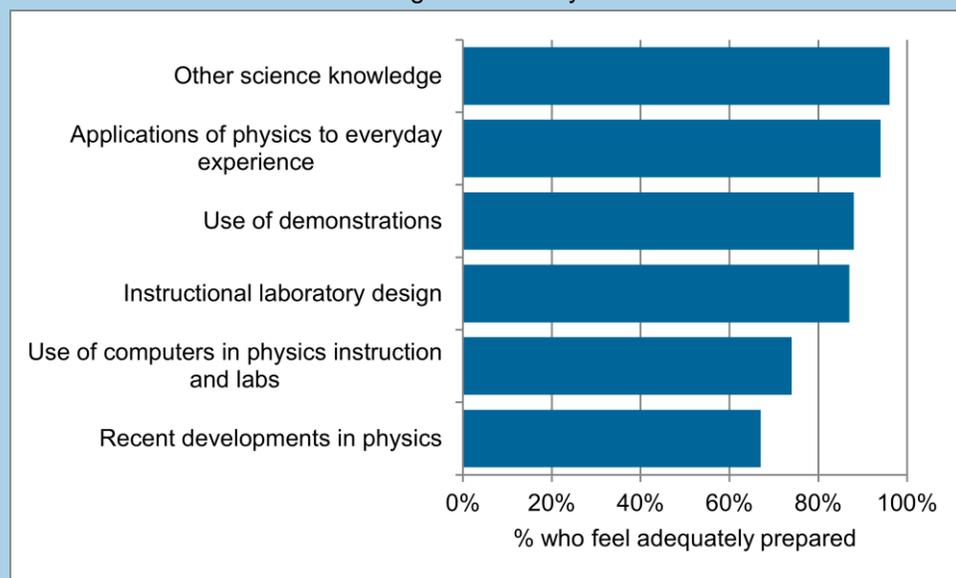
Teachers who had not taken physics courses during their post-secondary education and had little teaching experience were significantly more likely to feel inadequately prepared to teach basic physics principles.

Not only is it important to consider a teacher’s academic background; a teacher’s perception about his or her preparation is also an essential concern. We asked physics teachers to assess their level of preparation across a number of domains.

First we asked teachers how well prepared they felt they were regarding their basic physics knowledge. Almost all (98%) reported feeling adequately or well prepared; however, as seen in Figure 2, most of those who felt inadequately prepared had few or no physics classes in their post-secondary education.

Figure 3

**Teacher Self-Assessed Level of Preparation:
Respondents Who Feel Adequately or Well Prepared**
2008-09 US High School Physics Teachers



<http://www.aip.org/statistics>

Recent developments in physics and the use of computers are two areas in which more teachers feel inadequately prepared.

In addition to basic physics principles, we asked teachers about their self-assessed level of preparation in other areas of physics instruction. As seen in Figure 3, most teachers feel adequately or well prepared in most areas. The responses to these questions have changed little through the years, with one exception. In 2001, less than two-thirds of the respondents felt adequately or well prepared to use computers for instruction and labs; it is not surprising that this has risen given the steady increase in technology use in most aspects of our daily living.

*"Tell me and I forget.
Teach me and I
remember. Involve me
and I learn."
Benjamin Franklin*

*Traditional lectures
and solving problems
quantitatively are
teaching activities
used by almost all high
school physics
teachers.*

Teaching Methods

In the 2008-09 survey, we asked teachers about their use of various classroom activities. It would come as no surprise to Benjamin Franklin to learn that research in [physics pedagogy](#) has consistently shown that the traditional lecture is the least effective teaching method for teaching physics. Students learn physics concepts best through experience, discovery and the process of peer education.

Table 1

**Teaching Activities used by High School Physics Teachers
In US High Schools, 2008-09**

Activity	% of Teachers reporting ever using this activity	% of Teachers reporting this as the most used activity*
Traditional lecture	95	34
Class solves or discusses quantitative or mathematical problems	95	21
Students required to work together	93	10
Students design / perform experiments / activities	88	12
Class solves or discusses qualitative or conceptual problems	81	3
Students discuss ideas in small groups	72	6
Students use activity-based guided-inquiry curricular materials	65	10
Students present "findings" to class	45	1
Pre-class assessment drives instruction	24	1

* This column does not sum to 100% because a few teachers reported using other activities.

<http://www.aip.org/statistics>

We asked teachers about their classroom activities. As shown in Table 1 (on the previous page), almost all teachers use traditional lecture and quantitative problem solving in their classroom. An observer stepping into a physics classroom would also likely find students designing or performing experiments and related activities. Not only are these teaching approaches used by almost all of the teachers; they are also the activities teachers report as using most often.

We did find some differences between teachers who had taken a course in teaching physics and those who had not. While this is, admittedly, a crude measure of a teacher's exposure to physics education research, it is still interesting to note that teachers who had taken a course in teaching physics were more likely to rely on class lectures less — and participatory activities more. The participatory activities include asking their students to work together more, having students discuss ideas in small groups and presenting “findings” to the class. Teachers who reported having taken a course in physics teaching were also more likely to ask their classes to solve or discuss problems qualitatively and have their students use activity-based guided-inquiry curricular materials. Unfortunately, we have no student outcome data to test the effectiveness of the different teaching activities.

Teaching Resources

In over 80% of the schools where physics is taught, there is only one teacher teaching the subject, so most cannot readily turn to a colleague at their schools for answers or suggestions about issues that deal specifically with physics. When teachers do have questions about physics content, the most commonly used primary source for answers is the internet. Teachers also report using textbooks other than their class textbooks, their own class textbook, and another teacher. Table 2 (on the following page) depicts the teachers' responses.

Table 2**Self-Reported Primary Source of Answers
to Questions about Physics Content**

2008-09 US High School Physics Teachers

Source	% of Teachers indicating this as “best” source for answer
Internet	31
Another textbook	22
Class textbook	18
Another physics teacher	17
Other	12

* Other includes college professor, research scientist, listserve, and other

<http://www.aip.org/statistics>

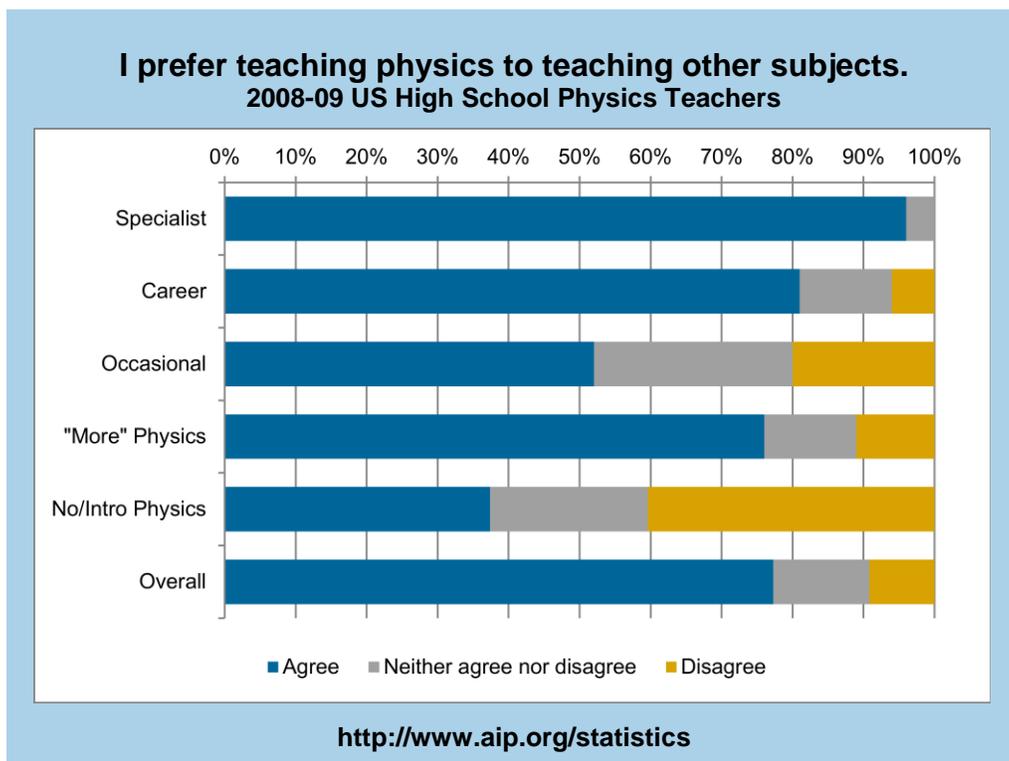
Most teachers turn to the internet or textbooks when they have a question about physics content.

Potentially demonstrating a better personal network or a better familiarity with the resources available to them, teachers who had completed physics education courses were significantly less likely to use their class texts as the best answer source. Instead, they were more likely to rely on college or university teachers. Having access to resources beyond the class text can help teachers develop a more nuanced understanding of physics concepts, as well as a better sense of perspective about the content they teach.

Physics Preferences

Over three quarters of high school physics teachers prefer to teach physics over other subjects. Not surprisingly, the physics specialists teachers, who have physics degrees and extensive experience teaching high school physics, are the most likely to prefer physics over other subjects (Figure 4). In contrast (as can be expected) the teachers with less teaching experience or teachers with little or no post-secondary physics training are significantly less likely to prefer it.

Figure 4



Over three quarters of physics teachers prefer teaching physics over teaching other subjects.

Most teachers agreed with the statement “If I had it to do over again, I would still choose high school teaching as my career.” Overall, 5 out of 6 high school physics teachers agreed with the statement (83%), with two-thirds strongly agreeing with it.

In addition to isolation (80% of the schools that offer physics have only one teacher teaching the subject), high school physics teachers also face other challenges. These will be examined more closely in the next **focus on** publication in this series.

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 when we send questionnaires to principals. Thank you very much for your help with this study.