

What High School Physics Teachers Teach

Results from the 2012-13 Nationwide Survey of High School Physics Teachers

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**REPORTS
ON HIGH
SCHOOL
PHYSICS**

Who Teaches High
School Physics?
(12/2014)

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Teacher Experience and Background

As noted in an earlier report¹, we take two different approaches to describe the characteristics of the 27,000 teachers who teach high school physics in the US. One of our approaches considers only a teacher's formal academic training; specifically, we look at the proportion of teachers with a major or minor in physics or physics education. Our other approach includes physics teaching experience and academic preparation to examine teacher characteristics; we focus on the latter in this report. More than half of the teachers teaching physics for the first time have prior teaching experience at the high school level², so many of the "new" high school physics teachers are not novice teachers. Table 1 details the characteristics of teachers in each of the groups we consider. In the remainder of this report, we will examine the classes taught by these teachers.

Table 1

**Characteristics of High School Physics Teachers
by Type of Physics Teacher**

Type of Physics Teacher	Hold degree in physics or physics education	Taught high school for at least 5 years	Taught physics in at least half of years teaching	Currently teaching physics
Specialist	Yes	Yes	Yes	Yes
Career Teacher	No	Yes	Yes	Yes
Occasional Teacher	Maybe [‡]	Yes	No	Yes
Apprentice Teacher	Yes	No	Maybe [*]	Yes
Newcomer	No	No	Maybe [*]	Yes

[‡] A few Occasional Teachers have a degree in physics or physics education, but they do not meet the other requirements to be classified as a Specialist.

^{*} We do not consider the number of years teaching physics for teachers within their first five years of teaching at the high school level.

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**THE 2012-13
NATIONWIDE
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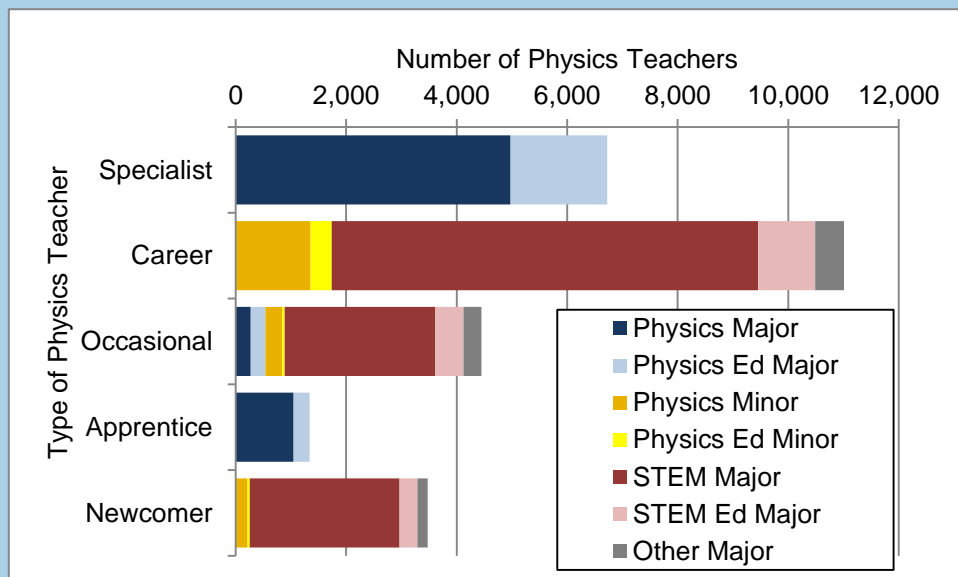
During the 2012-13 academic year, we collected data from a representative national sample* of over 3,500 public and private high schools across the U.S. to inquire about physics availabilities and offerings. This and future reports describe our findings.

*Hawaii opted out.

In the rest of this report, we will look at the classes, both the different types of physics classes and classes in other subjects, taught by teachers in each of these groups. First, we will look a little more closely at the relationship between a teacher's formal education and his or her physics teaching experience. In **Figure 1** (below), we show the number of physics teachers of each type by their academic major background; in total, we estimate 27,000 teachers taught at least one high school physics class. All of the Specialists and Apprentice Teachers have a degree in physics or physics education; the difference is that Specialists have been teaching at the high school level for at least five years and have taught physics in at least half of the years they have been teaching. Some Occasional Teachers hold a degree in physics or physics education degree; they are not classified as Specialists because they have not taught physics in at least half of the years they have been teaching. Some of these Occasional Teachers may move into the Specialist category in the future as they teach more physics.

Figure 1

**Number of Physics Teachers* of Each Type
by Academic Background, 2012-13**



Some Occasional Teachers have degrees in physics or physics education.

* Teachers are counted only once, so a teacher with both a physics major and a physics education minor counts here only as a physics major. The hierarchy for counting is physics major, physics education major, physics minor, physics education minor, STEM major, STEM education major, and other major.

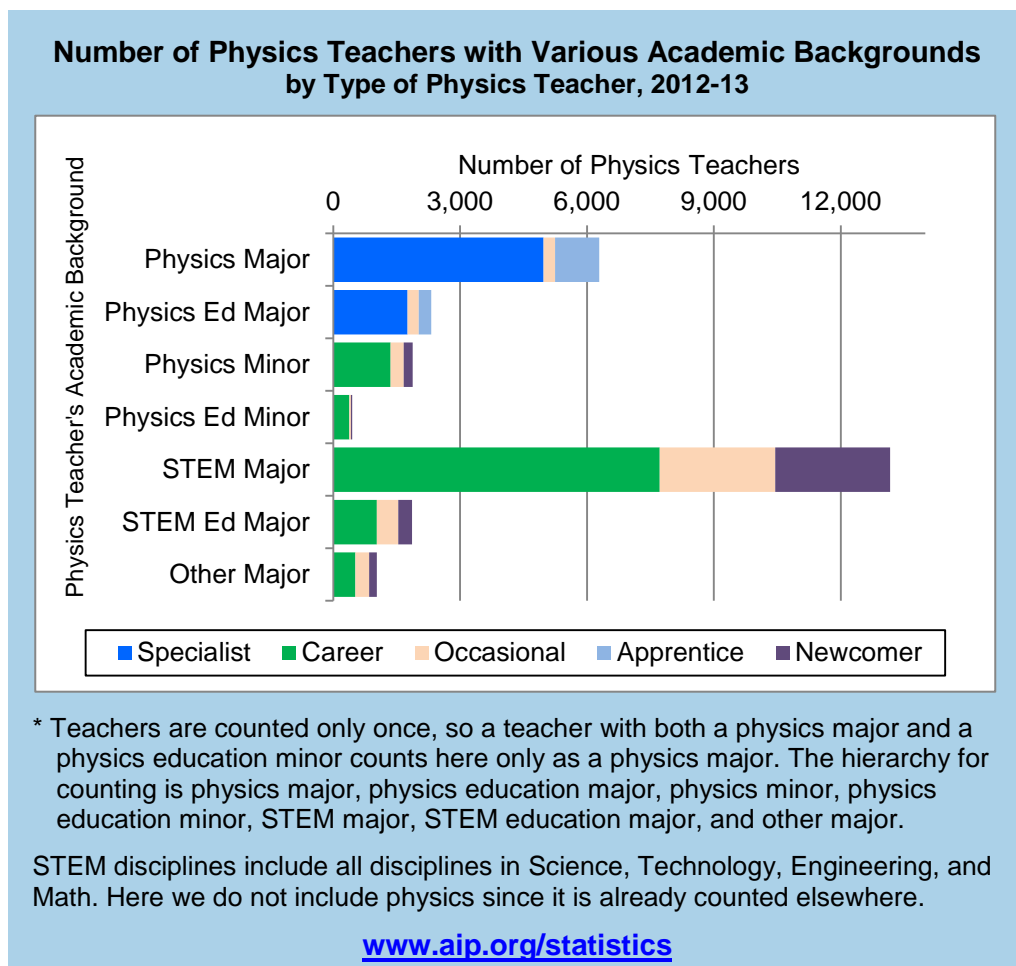
STEM disciplines include all disciplines in Science, Technology, Engineering, and Math. Here we do not include physics since it is already counted elsewhere.

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Of the physics teachers who have been teaching at the high school level for less than five years, most have a major in a STEM field other than physics.

In **Figure 2** (below), we present a complementary view of this same information: the number of physics teachers with various academic majors and minors by the physics teacher category into which they fall.

Figure 2



Most teachers with a minor in physics or physics education are Career Teachers – meaning they teach physics at least as often as they teach any other subject.

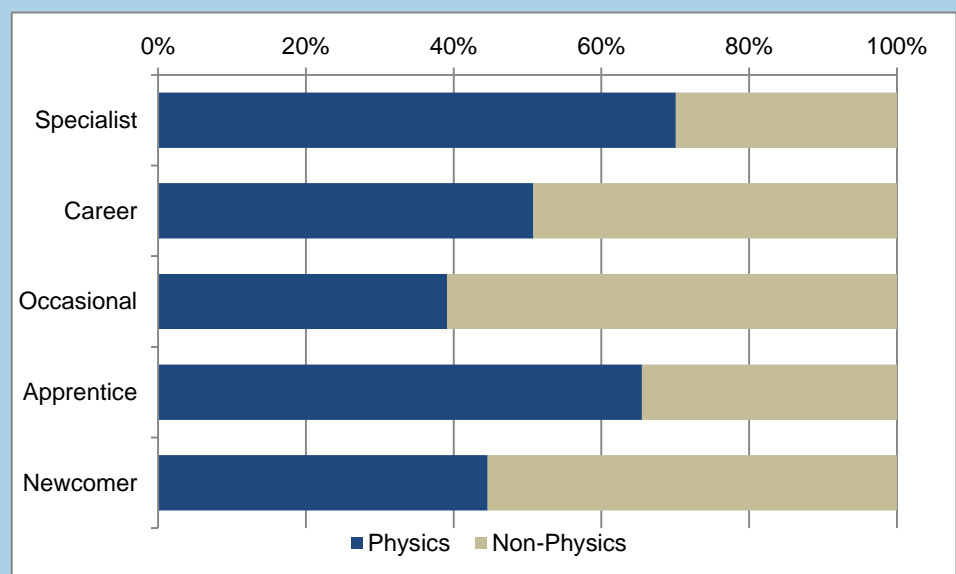
About 15,000 of the 27,000 teachers who teach at least one class in physics hold degrees in a STEM or STEM education field other than physics. Over 8,600 teachers hold a degree in physics or physics education. Some of the physics and physics education majors are classified as Occasional Teachers, and not as Specialists or Apprentice Teachers, because they have not taught physics in at least half of the years they have been teaching. A large majority of the physics and physics education *minors* are Career Teachers.

Physics and More

We know that about one-third of high school physics teachers teach only physics classes; the other two-thirds teach classes in at least one subject outside physics.¹ **Figure 3** (below) depicts the proportion of physics and non-physics classes taught by teachers who taught at least one physics class during the 2012-13 school year. There were a total of about 100,000 classes taught by physics teachers; physics classes made up roughly 53,000 of the total number of classes. More than 60% of the 28,000 high school classes taught by Specialists and Apprentice Teachers were physics classes. In contrast, about 60% of the 33,500 high school classes taught by Occasional Teachers and Newcomers were something other than physics. Career Teachers taught about 39,000 high school classes split almost evenly between physics and non-physics classes.

Figure 3

Proportion of Physics versus Non-Physics Classes Taught by Type of Physics Teacher, 2012-13



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Both Specialists and Apprentice Teachers report that more than 60% of their classes are physics classes. These are the two groups of teachers with a degree in physics or physics education.

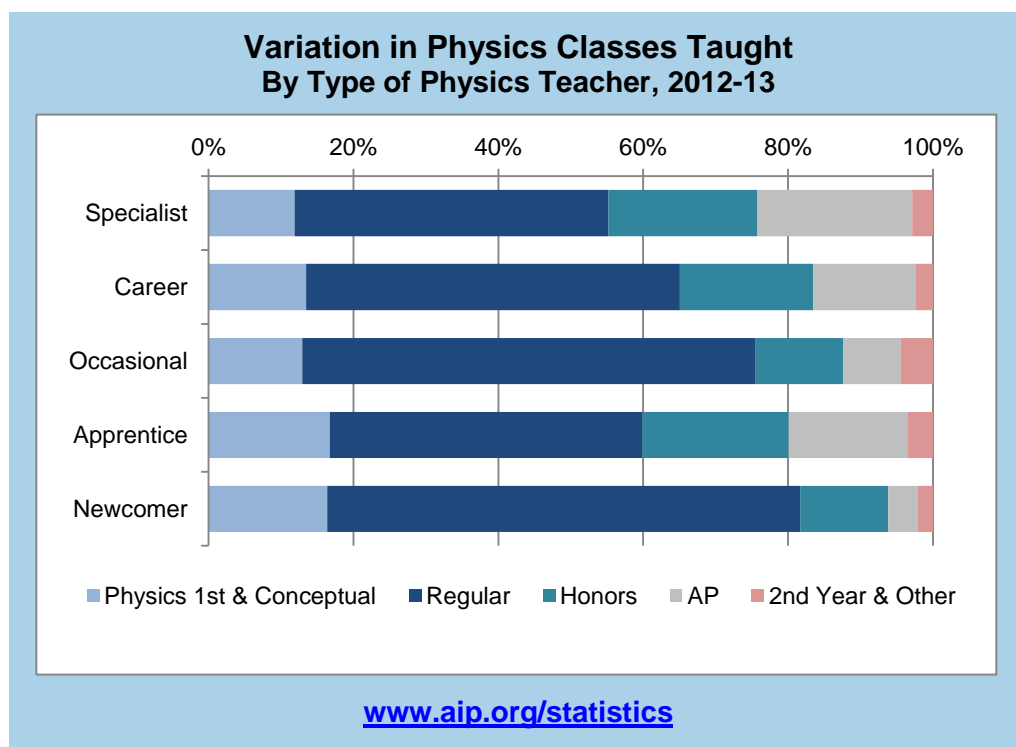
Both Specialists and Apprentice Teachers have a degree in physics or physics education; the main difference is the amount of time that they have taught in a high school. Specialists have taught at the high school level for at least five years and have taught physics in at least half of the years they have been teaching; Apprentice Teachers are within the first four years of their high school teaching career. These data, then, suggest that teachers with a degree in physics – whether they are new to teaching or not – teach mostly physics classes. This runs counter to

Ingersoll's finding "that out-of-field teaching is a common administrative practice whereby ... teachers are assigned by school principals to teach classes in subjects that do not match their fields of training."³ Ingersoll used data from 1993-94; perhaps principals are now more cognizant of a teacher's background when making teaching assignments.

Which Physics Classes?

Just as the Apprentice Teachers and Specialists are teaching a similar proportion of physics to non-physics classes, they are also teaching similar types of physics classes in proportions comparable to one another. Specialist and Apprentice Teachers are teaching higher level physics classes more often than their counterparts. **Figure 4** (below) and **Figure 5** (next page) detail these data.

Figure 4

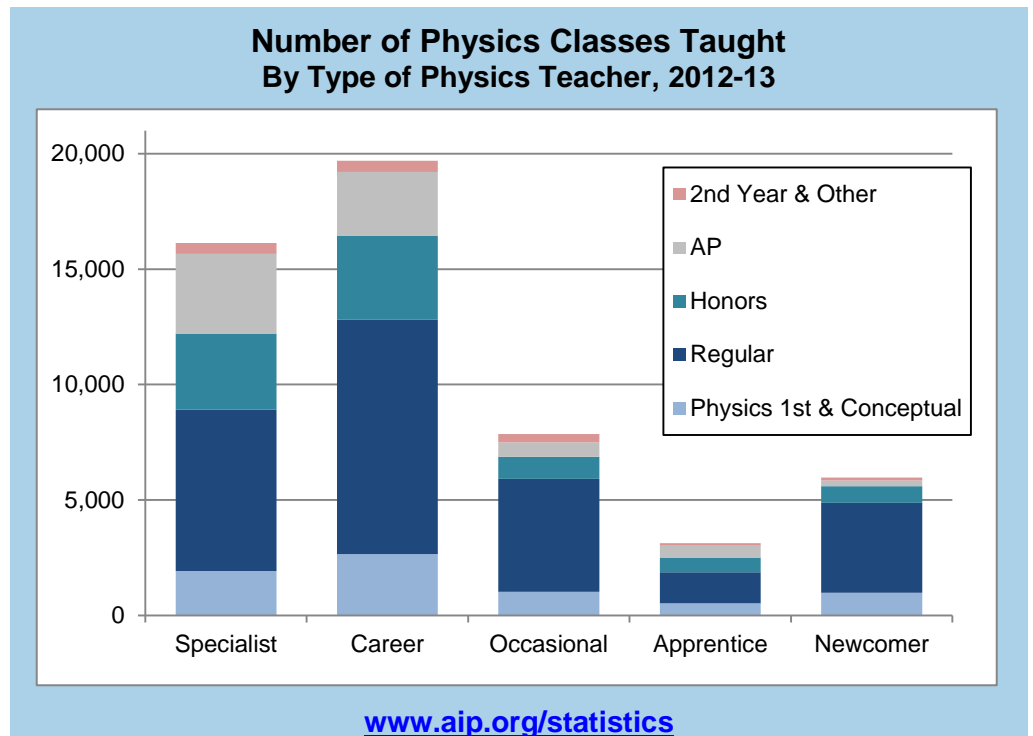


Specialists and Apprentice Teachers teach a higher percentage of higher level classes than their counterparts.

Newcomers and Occasional Teachers are more likely to be assigned to teach Physics First, Conceptual Physics, or Regular Physics courses, with these courses accounting for at least 80% of the physics classes they teach. These courses account for only 60% of the physics teaching load for Specialists and Apprentice Teachers; these teachers, who hold a degree in physics or physics education, are more likely to be assigned to teach the higher level courses. The physics teaching assignments for Career Teachers fall between the two aforementioned groups of teachers, being less likely to teach Honors and AP courses than the Specialists or Apprentice Teachers.

Teachers with a degree in physics or physics education are more likely to be assigned to teach the higher level physics classes, such as Honors and AP classes. It is also instructive to look at the number of classes these teachers teach. This is shown in **Figure 5**.

Figure 5



While Career Teachers teach more Regular Physics classes, Specialists teach more AP classes.

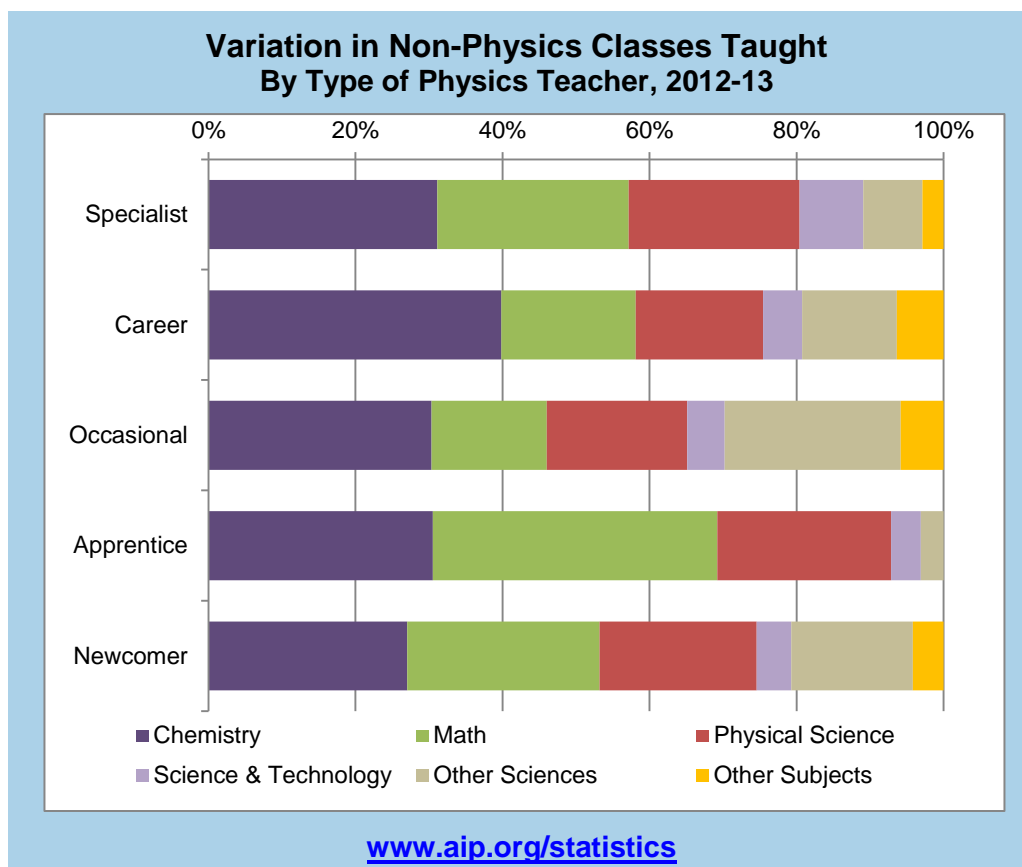
Out of a total 53,000 Physics classes, Career Teachers teach more physics classes, almost 20,000, than any other group of physics teachers. They teach the most Physics 1st, Conceptual, Regular, Honors, 2nd year, and other physics classes. This is not surprising since Career Teachers comprise over 40% of the physics teaching corps. Specialists teach more AP classes than the other teachers; recall that Specialists have high school teaching experience, extensive physics teaching experience, and a degree in physics or physics education. Specialists and Career Teachers teach the bulk of the Honors and AP Physics classes; Career Teachers have high school teaching experience and extensive physics teaching experience. Apprentice Teachers have a degree in physics or physics education and are within their first five years of teaching at the high school level; this group of teachers teaches the smallest overall number of physics classes because they are the smallest group of teachers.

Non-Physics Classes

We know that 40% of teachers who teach physics teach a majority of their classes outside physics; about one-third of physics teachers teach

only physics classes.¹ We asked high school physics teachers about all the classes they teach, so we can see what subjects they teach in addition to physics. As seen in **Figure 6** (below), chemistry and math are the two subjects most often taught in addition to physics. (We did not ask about specific classes such as Algebra 1 versus Calculus; we asked about the general subject area only.)

Figure 6

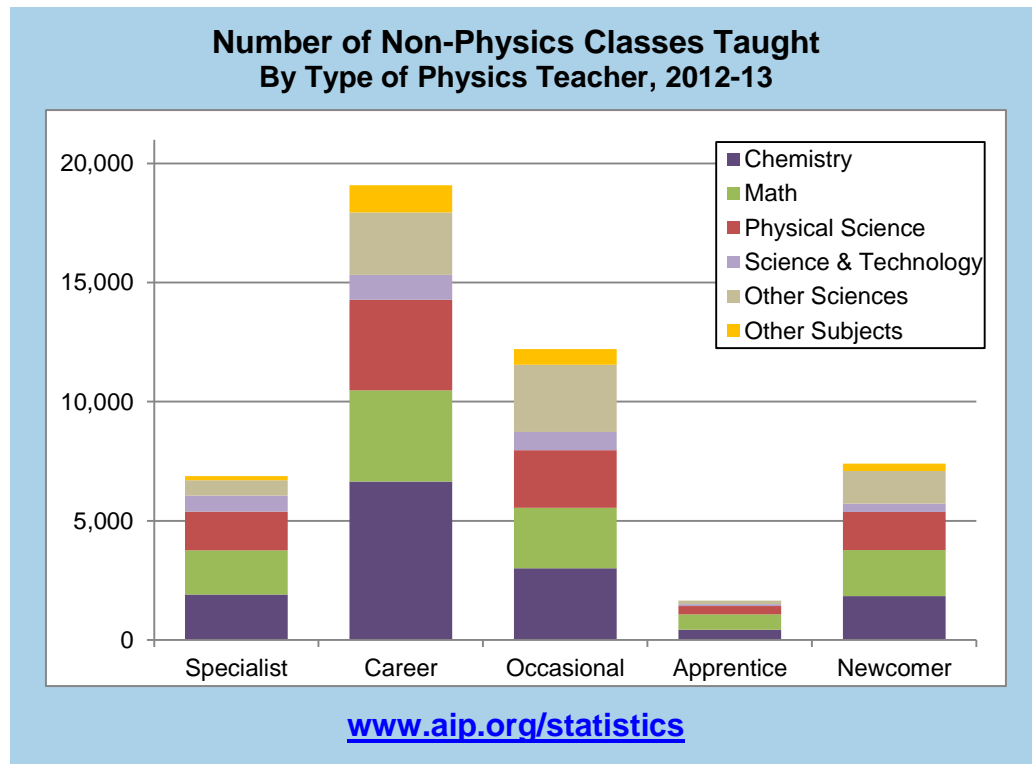


Physics teachers most often teach Chemistry, Math, and Physical Science in addition to their physics classes.

The most common classes that physics teachers teach other than their physics classes are chemistry, math, and physical science; these three subjects account for at least 70% of the non-physics classes that physics teachers teach. Unlike the variations seen in the proportion of upper-level and lower-level physics courses taught by teachers in the different groups, the variety among the non-physics courses is not as stark. It is interesting, and perhaps encouraging, to note that Apprentice Teachers do not teach any classes outside science, technology, and math; Apprentice Teachers have a degree in physics or physics education and are in their first five years of teaching at the high school level. In **Figure 7** (next page), we translate these data into the number of classes these teachers teach.

Out of a total of 47,000 classes outside physics, Specialists and Apprentice Teachers teach the smallest number of non-physics classes among teachers who teach at least one physics class. Again, since Career Teachers comprise the largest fraction of physics teachers, it is not surprising to see that these teachers teach the most non-physics classes, a total of 19,000.

Figure 7



Since they comprise the largest group of teachers, it is not surprising that Career Teachers teach the most non-physics classes.

References

- ¹ White, S. and J. Tyler, *focus on Who Teaches High School Physics?*, AIP Statistical Research Center, December 2014
- ² White, S. and C. Langer Tesfaye, *focus on Turnover among High School Physics Teachers*, October 2011, <http://www.aip.org/sites/default/files/statistics/highschool/hs-teacherturnover-09.pdf>, accessed November 24, 2014
- ³ Ingersoll, R.M. "Why some schools have more underqualified teachers than others," <http://www.gse.upenn.edu/pdf/rmi/BPEP-RMI-2004.pdf>, accessed November 24, 2014.

Physics in Hawaiian High Schools

For the first time in the history of our study, the Superintendent of Schools for the State of Hawaii refused to allow us to contact schools in Hawaii. Thus, the data in this report covers all high schools – both public and private – in every state in the US except Hawaii. Hawaii public schools account for less than one-half of one percent (<0.5%) of graduates from U.S. public schools; likewise, schools in Hawaii account for less than one percent (<1%) of graduates from private schools. The exclusion of these schools is unfortunate, but should not significantly affect the national results.

Survey Methodology

This study is based on a sample of one sixth of the public and private high schools in the US Data collection for this round began in the fall of 2012. Although in past years we began the study by surveying all of the schools in our sample, we changed our methodology this round in order to lower the burden on high schools in our sample, many of which are already heavily surveyed.

We began with web searches for each of the 3,858 schools in our sample. If we could identify a physics teacher at the school, we collected the contact information for that teacher. If not, we collected contact information for the principal or science chair. We then contacted each of the schools where we had not identified a physics teacher by phone and e-mail to determine whether or not physics was offered at the school and, if so, who taught it. We collected data on whether or not physics was offered from 3,553 of our 3,858 sampled schools (92%). We compared demographics for the non-responding schools with those of the responding schools and found no evidence to suggest that the two groups differ significantly. Thus, we believe we have a representative sample of schools.

During the spring of 2013, we contacted each of the 3,702 teachers we identified in the fall to learn more about physics in each of the high schools. We heard back from 56% of the teachers. Again, we compared demographics of the schools with responding teachers to those with no responding teachers. There is no evidence to suggest the teachers who responded differ significantly from those who did not.

Without the help of the principals, teachers, and staff at our sampled schools, we could not provide this information. We offer a sincere thanks to each of you.



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