The Market for New Science Teachers in Florida

A report to the National Research Council Committee on
Strengthening Science Education Through a Teacher Learning Continuum

by

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This report presents a descriptive analysis of the labor market for new science teachers in the State of Florida. The work was done at the request of the National Research Council's Committee on Strengthening Science Education Through a Teacher Learning Continuum. The committee requested an analysis of available administrative data from Florida that would address the following aspects of the science teaching workforce:

1. Number of secondary science teachers produced through traditional and alternative routes.
2. Number of people seeking certificates the number certified to teach science.
3. Number of people taking jobs teaching science.
4. Types of schools to which teachers are initially assigned.
5. Transfer behavior and attrition in the first 5 years.

I begin the analysis with background information on the certification requirements to teach in public schools in Florida, the associated pathways that individuals take to become teachers in Florida, science-specific certification requirements and the science curriculum in Florida. Next, I discuss the nature of the available data in Florida and the sources of those data. This is followed by a discussion of general trends in the market for teachers in Florida. Following this, evidence relating to each of the five research questions is presented. Finally, some supplementary material on the pre-service training and characteristics of new science teachers in Florida, broken down by pathway, is presented. This includes their college majors, college coursework, licensure exam scores and demographic characteristics.

I. Background Information on Science Teacher Preparation, Certification and Curriculum

A. General Certification Requirements and Pathways to Teaching in Florida[1]

Florida has one of the most diverse sets of options for being certified to teach. There are nine different sets of certification requirements or pathways, any one of which can be met in order to obtain a professional teaching certificate in Florida:[2]

[1] Much of the material in this section is drawn from my paper, "Licensure and Worker Quality: A Comparison of Alternative Routes to Teaching."

- Initial Degree College Courses in Traditional Teacher Preparation Program
- After Degree – District Alternative Certification Competency-based Program
- After Degree – Education Preparation Institute Competency-based Program
- After Degree – A valid ABCTE Passport Certificate in the Subject Area
- After Degree – Two semesters of successful college full-time teaching experience
- Initial and After Degree Approved College Professional Training Option – Content Major & College Education Courses per Rule 6A-4.006
- After Degree – Professional Preparation College Courses per Rule 6A-4.006
- After Degree – Full Reciprocity
- After Degree – A valid NBPTS Certificate in the Subject Area

The traditional teacher preparation program option requires completion of an approved teacher preparation program at a post-secondary institution within Florida. Program completers must also pass general knowledge and professional education certification tests as well as any necessary subject certification exams.

The next four options we designate as "alternative" pathways. Of these, the most frequently traveled alternative pathway to certification in Florida is the district alternative certification option. Unlike Teach for America or the Teaching Fellows program in New York City, the district alternative certification option does not involve any special recruitment procedures and teachers are not required to work toward an education degree while teaching. In fact, no formal education coursework is required. To become certified under this option, one must pass the standard general knowledge and professional education certification exams and complete a competency-based alternative certification program. The details of the program vary somewhat across districts, but involve an initial assessment of skills, an individualized training plan, mentoring, a training curriculum that targets a set of "accomplished teacher practices" and summative assessment that

[2] Professional certificates are valid for five years and are renewable. Individuals who have not met all of the requirements for professional certification may receive a temporary certificate that is valid for three years and is non-renewable. The criteria for certification are specified in 48 Florida Statutes 1012.56 (2012). The initial statute authorizing alternative routes became effective July 1, 2002 (see Florida Statutes 1012.56 (2002)).

documents mastery of the practices. The training programs are frequently web-based, but some also involve collaborations with local community colleges or universities.

Three additional alternative routes to certification, the "Educator Preparation Institute" option, "ABCTE Passport" option and the "College Teaching Experience" option, are all relatively new.[3] The education preparation institutes (EPIs) are essentially two-semester non-degree programs, nearly all of which are housed in community colleges. Typically they consist of seven required classes and a field experience component. Courses are specific to the EPI program and credits are not transferable to traditional education majors. Coursework is often a combination of face-to-face meetings and online instruction. Individuals completing the EPI program must also pass the standard certification exams to receive professional certification. The ABCTE passport option requires individuals to obtain a certificate issued by the American Board for Certification of Teacher Excellence and demonstrate professional education competence in the classroom. To obtain the ABCTE certificate candidates must pass both a professional teaching knowledge exam and a subject area exam administered by ABCTE. Candidates prepare for the exams with online and electronic documents provided by ABCTE. As they name implies, the college teaching experience option requires that one have successfully taught for two semesters at a community college or four-year university. No general knowledge or professional education exams are required; applicants need only pass a subject area certification exam.

The "Approved College Professional Training" and "Professional Preparation College Courses" options are essentially indistinguishable. In both cases an individual must complete a handful of core education courses, obtain teaching experience and pass the teacher certification

[3] . Provisions for the ABCTE option became effective June 10, 2004 (see Florida Statutes 1012.56 (2004). In 2004 Florida Statutes 1004.85 provided the opportunity for postsecondary institutions to create Educator Preparation Institutes. The first EPI programs were approved by the Florida Department of Education in August 2005.

exams. The former option covers cases where an individual receives a non-education college degree but minors in education and takes the required core classes as part of a minor in education. This education-minor route is very new. The latter option covers any individual who has successfully completed the required core education courses. The courses need not be part of a formal course of study nor from a single institution. Thus this route is a "catch all" category that includes individuals with a variety of educational backgrounds. Education majors who do not complete all of their institution's teacher preparation program requirements, but have passed the required core education courses can obtain certification through this route. Likewise, individuals who earn a non-education college degree and either took the required education courses while an undergraduate, or completed the required courses once they start teaching, can obtain certification in this manner. In the analysis these two routes are combined under the rubric "Individual Evaluation."

There are three avenues by which individuals from out of state can obtain certification when they move to Florida. New graduates of teacher preparation programs outside of Florida must meet the same requirements as those completing traditional teacher preparation programs within Florida. Experienced teachers receive certification in Florida if they possess a valid standard teaching certificate issued by another state or if they hold a valid certificate from the National Board for Professional Teaching Standards (NBPTS). To obtain NBPTS certification a teacher must be certified to teach in their state, have three years of experience, submit a portfolio of materials for evaluation and pass an exam. Since NBTS requires pre-existing state certification, the NBPTS option is only relevant for teachers whose state-issued certificate has lapsed or who require certification in a subject area not covered by their state certification. In the analysis, all three of these options are merged into a single category called "Interstate Reciprocity."

B. Science Certification Requirements

Beyond the general certification requirements, teachers must meet additional requirements in order to be certified in a science subject area in Florida. There is one science subject area at the middle-school level, Middle Grades General Science, and four at the high school level, Biology, Chemistry, Earth-Space Science and Physics. Certification in each of the five science certification area requires both meeting coursework requirements and passing a subject-specific exam. The coursework requirements can be met in any one of three ways: (i) a bachelor's degree in the relevant subject, (ii) a bachelor's degree with 30 semester hours in science including 21 hours in the relevant science subject, (iii) completion of specialization requirements for a different science subject area and completion of at least 18 semester hours in the relevant science subject.

C. Science Curriculum

The science curriculum corresponds roughly to the science certification areas. In middle school science courses fall into four categories: Life Science, Earth/Space Science, Comprehensive Science and Physical Science. At the high school level, there are five categories of science courses: Biological Sciences (Biology, Physiology, Botany, Ecology and Genetics), Earth/Space Sciences (Earth/Space Science, Astronomy), General Science, Integrated Sciences (Environmental Science, Integrated Science, Marine Science) and Physical Sciences (Chemistry, Physics).

II. Data Sources

The Florida Department of Education (FLDOE) maintains an integrated Education Data Warehouse (EDW) that contains data on students and teachers in both public K-12 and post-secondary institutions. While the Florida EDW is an extremely rich source for tracking students through the public education system, the data in the EDW relating to the supply of teachers are limited. The EDW contains information on each teaching certificate and when it was issued, including certificates in science subject areas. For teachers who were students in Florida public universities or community colleges, there is also college transcript and degree information. However, information on certification applicants and teacher preparation program completers is not part of the Florida EDW. Data from the EDW are also used to identify the prior experience of certification exam takers, certificate recipients and teachers of science courses.

To supplement data from the Florida EDW I obtained additional data files from the FLDOE's Bureau of Educator Certification covering the years 1999-2005. Unlike the data from the EDW, the files had not been prepared for external use and required extensive "cleaning." These additional data files indicated the certification option by which an individual obtained certification. The data are entered by a clerk at the time an applicant's materials are initially reviewed and are not verified in any way. As I discuss further below, the "Course Analysis" option appears to have been a default category and some teachers who completed a traditional teacher preparation program may have been designated as being certified through the Course Analysis option.

I also obtained data on the certification test results of all test takers, both those who passed and those who did not. Passage of the basic knowledge exams is required for all new teachers in Florida, except for teachers who already hold a valid certificate in another state. Given the number of new graduates entering Florida from out-of-state programs is relatively small, the number of test takers can be used as a crude proxy for the number of Floridians seeking a teaching credential.

Finally, I also obtained information on the total number of new hires in Florida, the number of "out-of-field" teachers, the number of program completers, school membership and class size from various FLDOE publications.

III. Results

A. Trends in the Demand for Science Teachers in Florida

Due to population growth and constitutionally mandated class-size restrictions, there was a high demand for new teachers in Florida until the economic downturn in Fall 2008. As a result, unlike New York and other states in the Northeast and Midwest, Florida has been a net importer of teachers until recently. Table 1 and Figure 1 document the growth in the number of public school students that rose throughout the early 2000s and peaked in the mid-2000s. Membership (attendance counts) in middle school peaked in the 2004/05 school year and topped out for high school in 2007/08.[4]

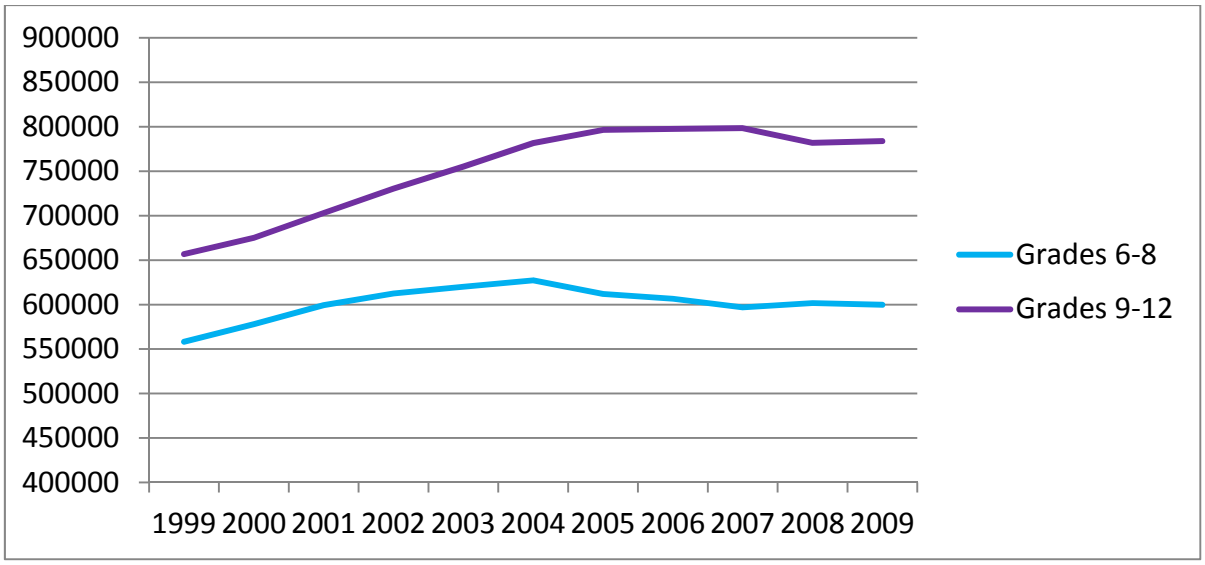
Table 1. Annual statewide membership in grades 6-8 and 9-12, 1999 to 2009

School Year	Grades 6-8	Grades 9-12
1999	558169	656697
2000	577957	675150
2001	599378	703013
2002	612551	730376
2003	620147	755180
2004	627304	781652
2005	611977	796418
2006	606492	797558
2007	596779	798399
2008	601652	781886
2009	599726	783781

Source: Florida Dept. of Education, "School Membership by Grade"

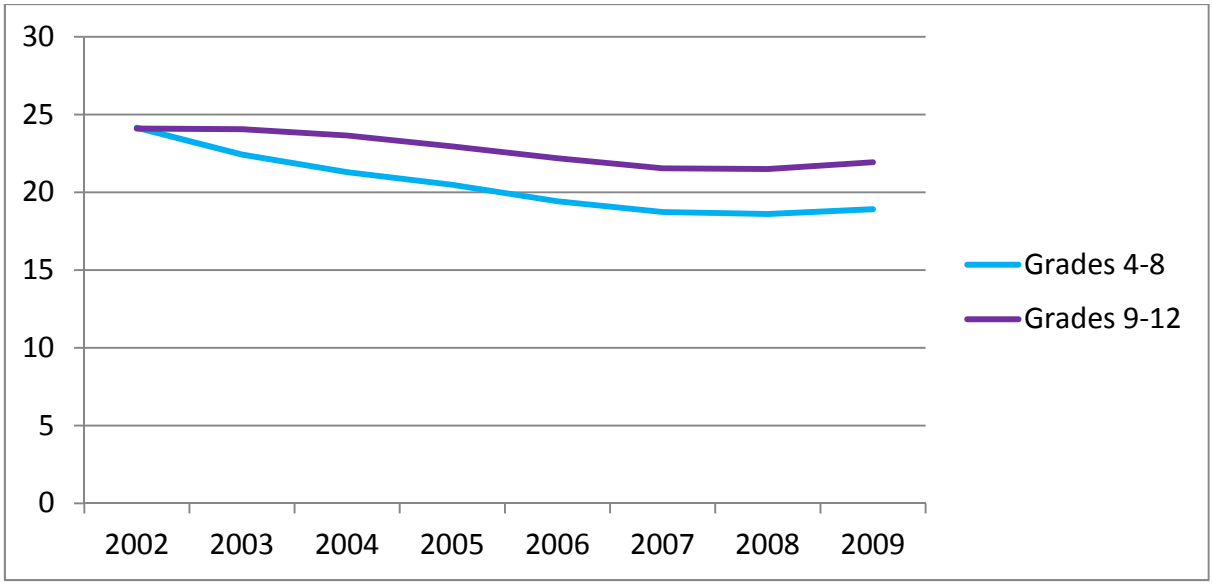
[4] Throughout this report, a school year is designated by the calendar year of the Fall semester, i.e. 1999 refers to the 1999/2000 school year.

Figure 1. Annual statewide membership in grades 6-8 and 9-12, 1999 to 2009



The impact of the constitutional class size initiative can be seen in Figure FL1. Class sizes fell from the 2002/03 school year through 2007/08, bottoming out just about the same time as high school membership peaked.

Figure FL1. Average class size in grades 4 -8 and 9-12, 2002 to 2009



Source: Florida Dept. of Education, "District Class Size Averages"

The combination of rising membership and falling class sizes meant that the demand for all teachers, including science teachers, was rising rapidly during early 2000s, peaked around 2007/08 and fell thereafter.

B. Preparation

Only aggregate data are available on preparation programs and numbers of completers are available, preventing an analysis of science teachers in isolation. As illustrated in Table FL1, there are currently over 500 traditional teacher programs in Florida offered at 47 colleges and universities in the state. This is down from a peak of 531 in 2011.

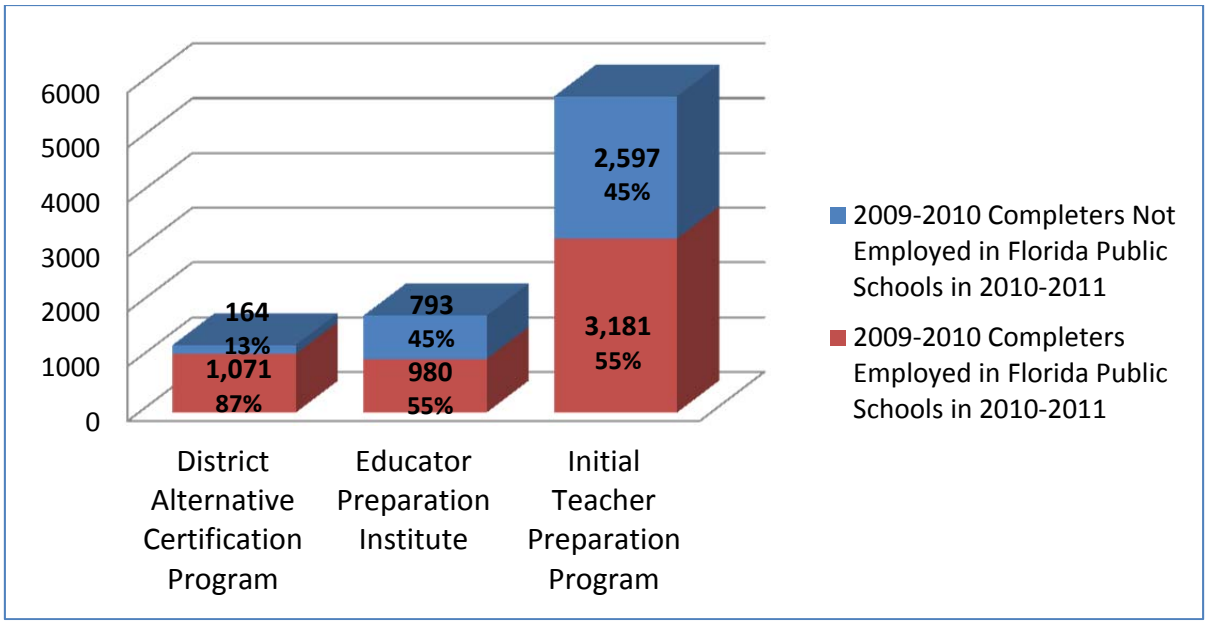
Table FL1. Number of Initial Teacher Preparation Programs and Number of Institutions, 2008-2013

Year (As of January)	Number of Initial Teacher Preparation Programs	Number of Institutions Offering Initial Teacher Preparation Programs
2008	389	32
2009	428	34
2010		
2011	531	45
2012	519	48
2013	502	47

Source: "Teachers From Florida Teacher Preparation Programs," various years.

Figure FL2 provides information on the total number of program completers in traditional teacher preparation programs ("initial teacher preparation program") and the two most common alternative routes, educator preparation institutes (EPIs) and district alternative certification programs. Interestingly, while only about half of the completers from the traditional and EPI programs go on to teach in Florida public schools whereas nearly 9 out of 10 district alternative certification completers teach in public schools.

Figure FL2. 2009-2010 Completers Employed in Florida Public Schools 2010-2011



Source: Florida Department of Education, "Teacher Preparation" Presentation

C. Certification

This analysis requires that two groups of prospective teachers be identified: (1) those interested in science teaching and (2) those being certified to teach science. Because data on the number of science certification applicants are not available, the interested group is defined as anyone taking a science certification exam. This measure will differ from the number of applicants in a given year for at least two reasons. First, exams may be taken long before a completed application is submitted. Second, teachers who are certified in a science field in another state do not have to take the relevant subject area exam in order to obtain a Florida subject area certification.

Table 2 presents data on the number of first-time science subject area certification exam takers and the number of certificates issued by year and by preparation pathway. The data are also presented graphically in Figures 2A and 2B. There are three things to note. First, some caution must be applied when interpreting these numbers exam takers and certificate recipients in specific pathways as there are large number of teachers in the catch-all "Individual Analysis" category and in the "Unknown"

category. This is particularly true in 2003 and 2004 when there was a spike in each of these categories. Second, there is a rapid increase in both the total number of science subject area exam takers and certificate recipients from 1999 through 2006, mirroring the increased demand for teachers in general. Third, while there were increases in the number of science subject area certificates issued to both traditional and alternative program completers in Florida throughout the early and mid-2000s, a large portion of the increased demand for teachers in Florida was met importing teachers from other states.

Table 2. Annual number of first-time science certification exam takers with no prior teaching experience and number of first-time science certificates issued to individuals with no prior teaching experience by preparation pathway, 1999 to 2009

Year	First-time Exam Takers						Issued					
	All Path-ways	Trad	Alt	Inter Recip	Ind Eval	Un-known	All Path-ways	Trad	Alt	Inter Recip	Ind Eval	Un-known
1999	654	51	3	12	446	142	860	30	6	28	427	369
2000	564	90	6	29	336	103	1230	68	32	56	715	359
2001	577	93	22	33	319	110	1238	73	74	132	595	364
2002	641	103	55	54	323	106	1244	80	130	190	476	368
2003	1180	154	117	83	462	364	1578	107	222	210	550	489
2004	1404	161	143	119	451	530	2131	139	268	404	602	718
2005	1195	136	118	94	347	500	1907	107	227	333	493	747
Subtotal	6215	788	464	424	2684	1855	10188	604	959	1353	3858	3414
2006	1581	n/a	n/a	n/a	n/a	n/a	1932	n/a	n/a	n/a	n/a	n/a
2007	1170	n/a	n/a	n/a	n/a	n/a	1579	n/a	n/a	n/a	n/a	n/a
2008	1669	n/a	n/a	n/a	n/a	n/a	1109	n/a	n/a	n/a	n/a	n/a
2009	1599	n/a	n/a	n/a	n/a	n/a	1064	n/a	n/a	n/a	n/a	n/a
Total	12234	n/a	n/a	n/a	n/a	n/a	15872	n/a	n/a	n/a	n/a	n/a

Figure 2A. Annual number of first-time science certification exam takers with no prior teaching experience by preparation pathway, 1999 to 2005

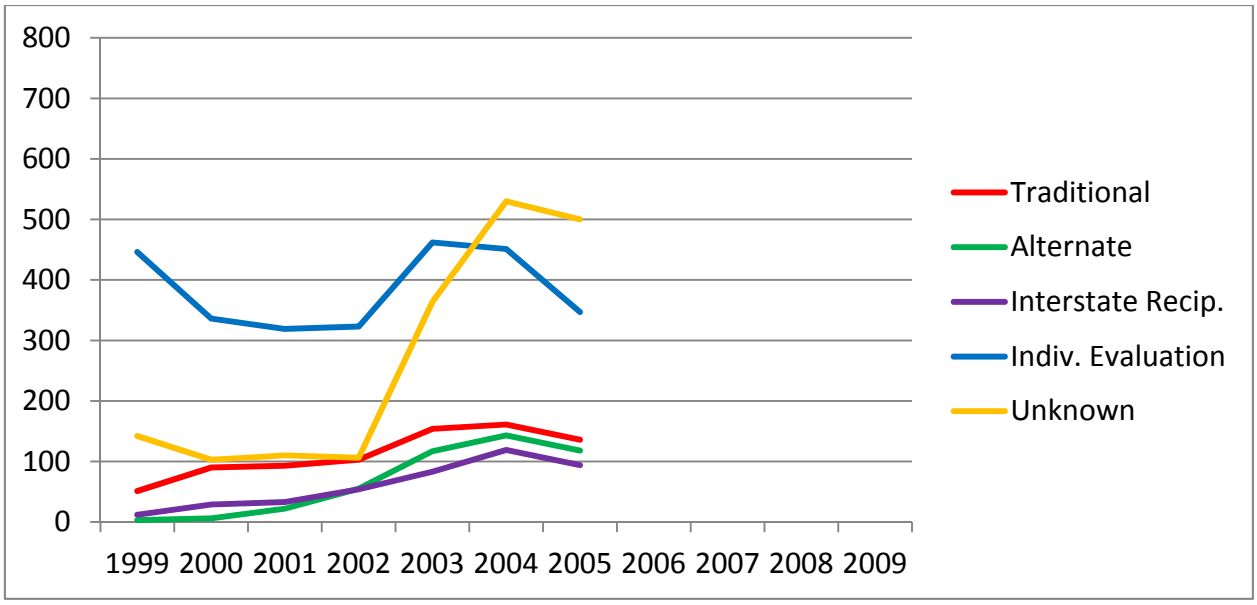
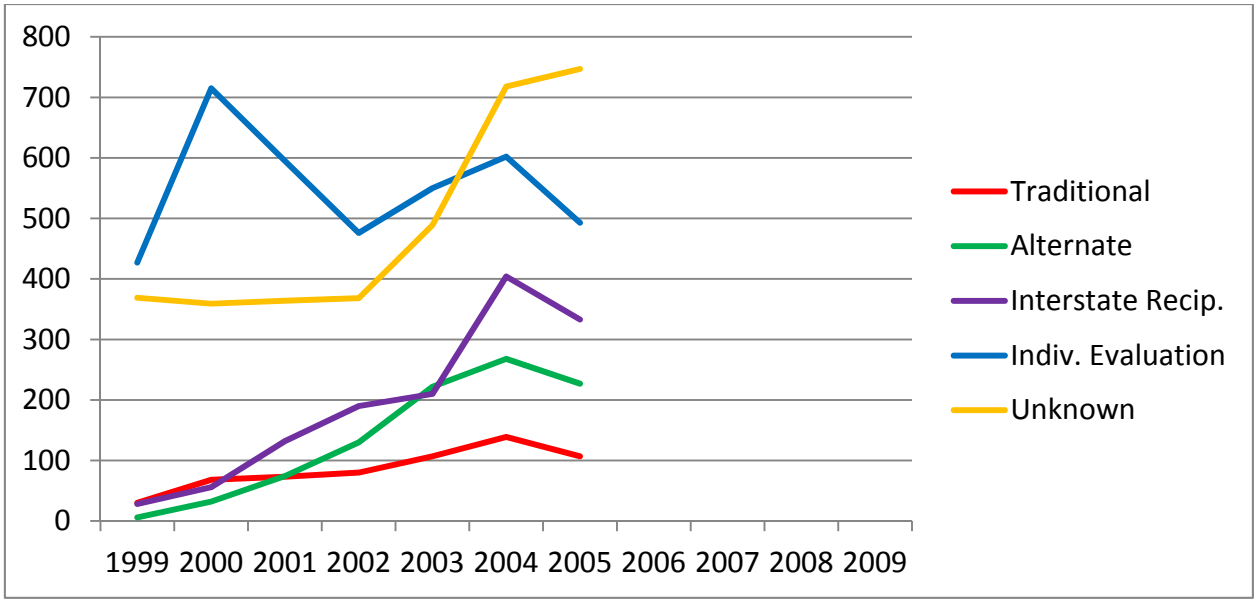


Figure 2B. Annual number of first-time science certificates issued to individuals with no prior teaching experience by preparation pathway, 1999 to 2005



Breakdowns of the number of science subject area exam takers and certificate recipients are presented in Table 3 and in Figures 3A and 3B. The vast majority of exam takers and certificates issued are in Middle Grades General Science and in Biology; the numbers for the high-school level

Table 3. Number of first-time science certification exam takers with no prior teaching experience and number of first-time science certificates issued to individuals with no prior teaching experience by subject, 1999 to 2009

Year	**Total**	Biology	Chemistry	Physics	Earth-Space Science	Middle Grades General Science
First-time science certification exam takers						
1999	654	250	81	36	16	271
2000	564	245	68	37	20	194
2001	577	258	64	28	31	196
2002	641	232	84	31	40	254
2003	1180	397	91	63	120	509
2004	1404	493	150	87	134	540
2005	1195	453	131	61	128	422
2006	1581	542	142	81	172	644
2007	1170	456	142	75	131	366
2008	1669	608	168	91	244	558
2009	1599	555	221	100	212	511
Total	12234	4489	1342	690	1248	4465
First-time science certificates issued						
1999	860	338	132	54	40	296
2000	1230	542	183	83	36	386
2001	1238	574	184	78	39	363
2002	1244	562	214	86	30	352
2003	1578	696	217	119	73	473
2004	2131	896	325	188	119	603
2005	1907	858	312	126	127	484
2006	1932	866	259	134	114	559
2007	1579	736	232	120	116	375
2008	1109	499	148	76	113	273
2009	1064	414	185	69	129	267
Total	15872	6981	2391	1133	936	4431

physical sciences (Chemistry and Physics) and Earth-Space Science are much lower. While the number of certificates issued in each subject area peaked around 2004, there was a general upward trend in the number of test takers throughout the 2000s. As depicted in Figure FL3, actual hiring of science teachers closely follows the trend in certificates issued, though with a one-year lag. This pattern of hiring essentially mirrors the hiring pattern over time for all teachers. The increased hiring of science teachers throughout much of the 2000s appears to not only have helped fill the increasing demand for science teachers over the period but also served to reduce the number of new hires teaching science courses were not fully certified as the number of "out-of-field" new hires in science fell throughout the period (Figure FL4).

Figure 3A. Number of first-time science certification exam takers with no prior teaching experience by subject, 1999 to 2009

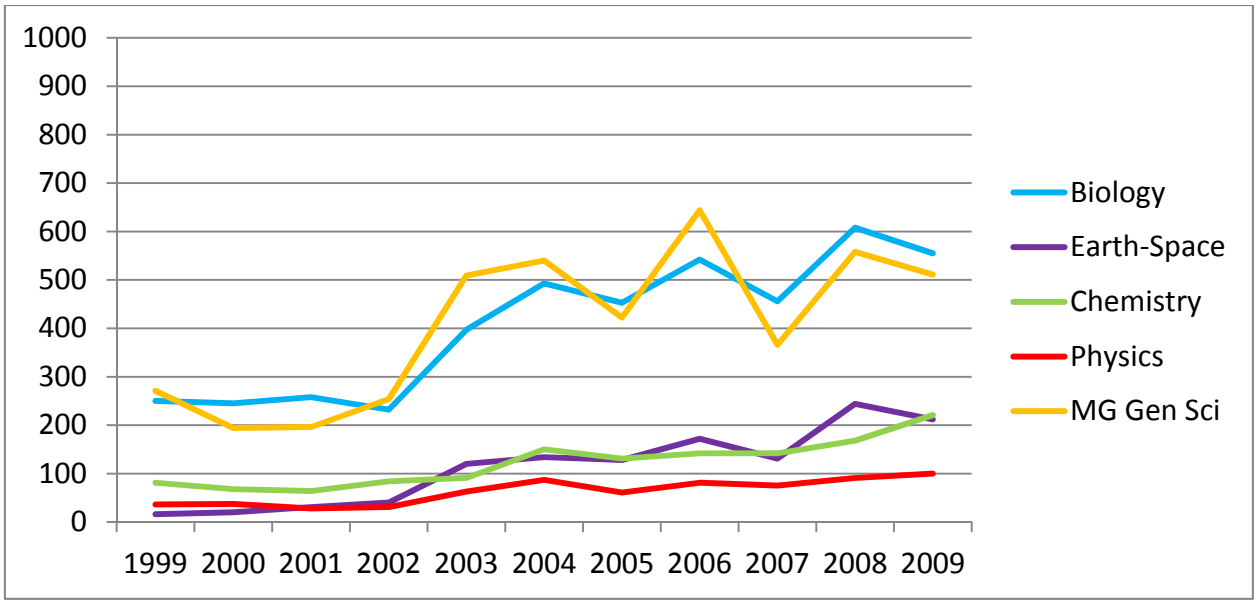


Figure 3B. Number of first-time science certificates issued to individuals with no prior teaching experience by subject, 1999 to 2009

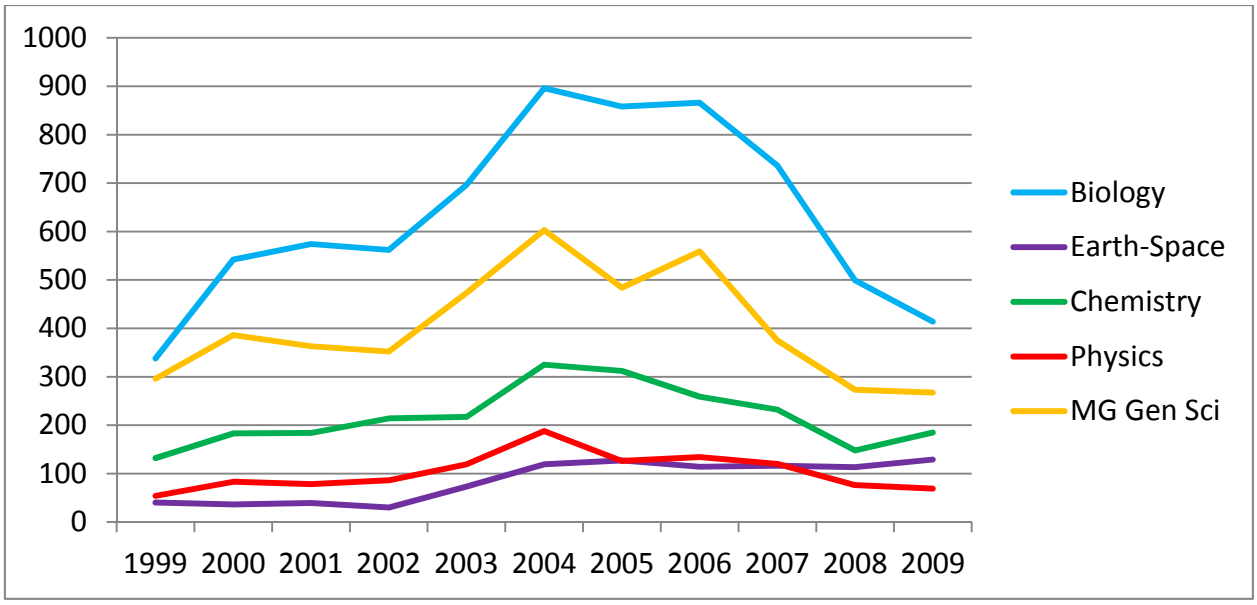
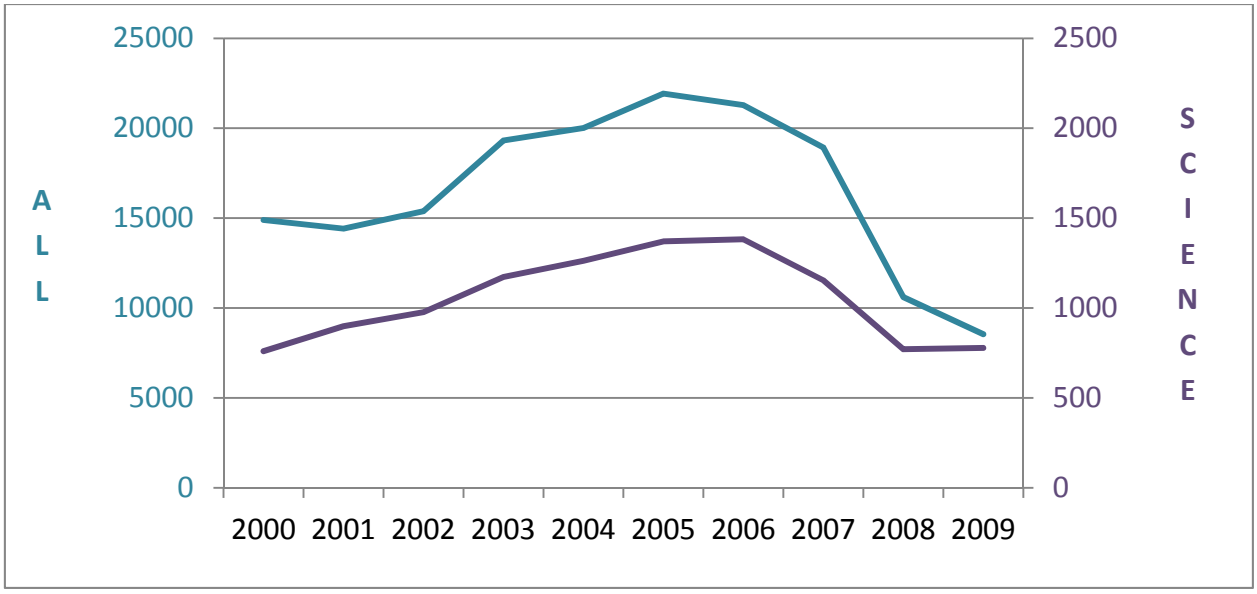
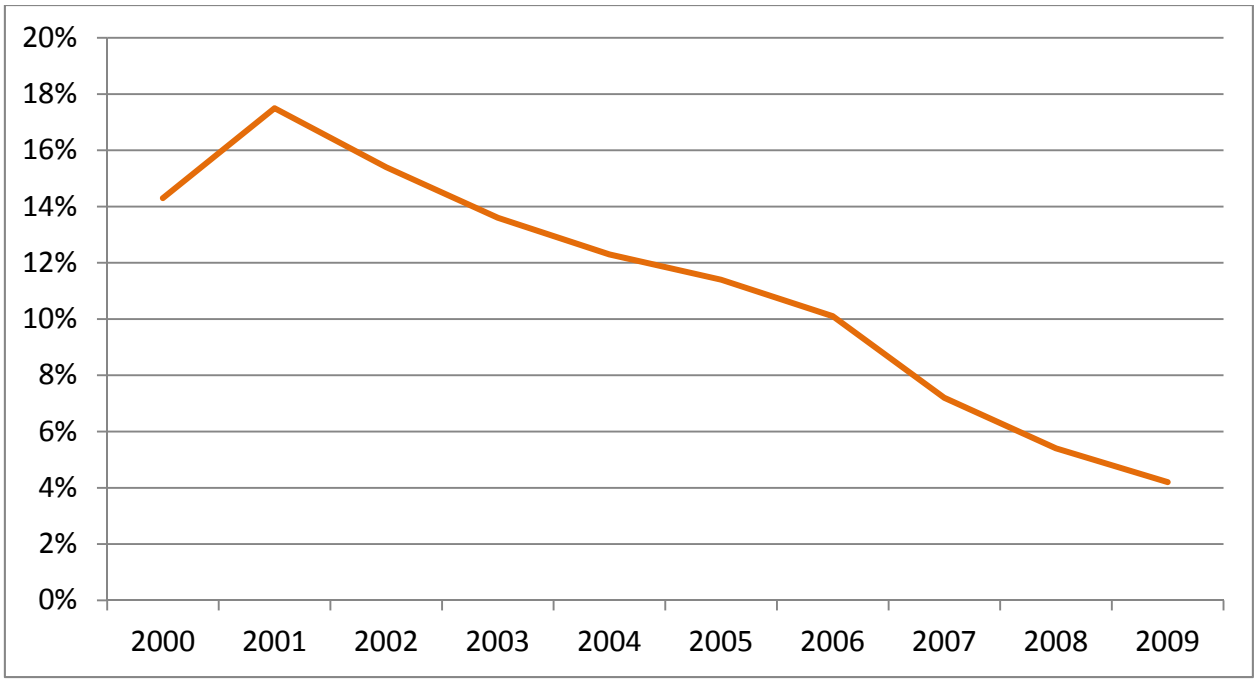


Figure FL3. Number of New Hires in Fall, 2000-2009 – All Subjects and Science



Source: Florida Dept. of Education, "New Hires in Florida Public Schools."

Figure FL4. Percent of Fall New Science Hires Not Certified in Appropriate Field, 1999 to 2009



Source: Florida Dept. of Education, "New Hires in Florida Public Schools"

Table 4 combines the information on pathways and subject areas and presents both the number of science certification subject area exam takers and the number of certificates issued by pathway and subject area for the period 1999 to 2005. Setting aside the catch-all "Individual Evaluation" and "Unknown" pathways, roughly half of all exam takers (47 percent) were from Florida Traditional Teacher Preparation programs. This is also true for the Biology, Earth-Space Science and Middle School General Science subject areas. For Chemistry and Physics, the proportion of exam takers from traditional Florida preparation programs is much smaller. As noted above, the numbers of exam takers do not include experienced science teachers from other states coming to teach in Florida (since those certified in another state are not required to take the relevant subject area exam in Florida). When looking at the number of certificates issued, which includes experienced out-of-state teachers, it is clear that a large proportion of new science teachers in Florida during the period 1999-2005 were imported from other states. This is particularly true in Chemistry and Physics, where there were over three times

as many certificates issued to out-of-state teachers than to graduates of traditional Florida teacher preparation programs.

Table 4. Number of first-time science certification exam takers and number of initial science certificates issued by subject and preparation pathway, 1999 to 2005

Preparation Pathway	**Total**	Biology	Chemistry	Physics	Earth-Space Science	Middle Grades General Science
First-time science certification exam takers						
Traditional	788	359	65	35	59	270
Alternative	464	154	58	26	38	188
Out-of-State	424	137	57	31	28	171
Course Analysis	2684	988	298	152	191	1055
Unknown	1855	690	191	99	173	702
Total	6215	2328	669	343	489	2386
First-time science certificates issued						
Traditional	604	309	58	21	31	185
Alternative	959	421	162	68	43	265
Out-of-State	1353	519	185	96	66	487
Course Analysis	3858	1652	549	232	156	1269
Unknown	3414	1565	613	317	168	751
Total	10188	4466	1567	734	464	2957

D. Placement

After preparation and certification, the next phase of the science teacher supply chain is the hiring and placement of teachers into classrooms. There are two ways to measure the placement of first-year science teachers. One could count the number of new (to Florida) teachers teaching science courses, but this would include both teachers who are certified to teach science and teachers who are not certified in a science subject area and may not have been prepared to teach science. Alternatively, one could count only first-year teachers who are certified in a science subject area, but that would include some teachers who are certified in a science subject but end up (at least initially) not teaching a science course. This is illustrated in Table 5, which gives the frequency of first-year teachers by their course assignments and by their science certification status. With the exception of the 1999-00 school year, it appears that roughly 30 to 40 percent of first-year teachers of science courses are not certified in a science subject when they begin teaching. Interestingly, approximately 15 to 20 percent of first-year teachers with a science certificate do not teach any science courses.

Table 5. Annual number of first-year teachers by science certification and subject taught

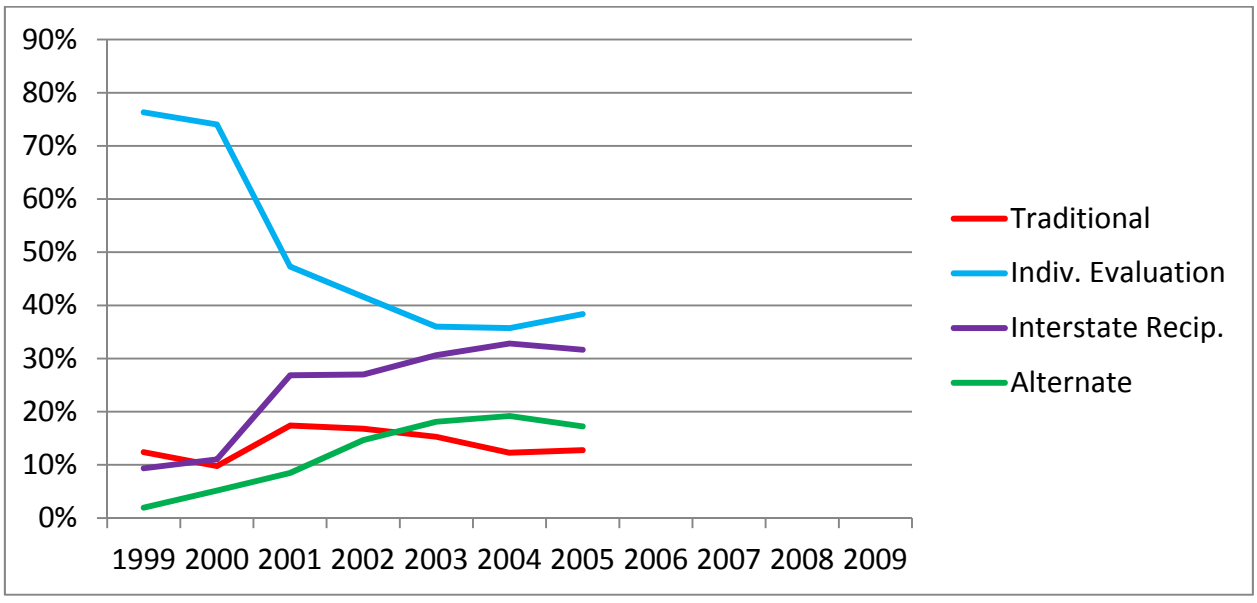
Year	All First-Year Teachers	Teaching One or More Science Courses		Not Teaching Any Science Courses	
		Certified in Science	No Science Certificate	Certified in Science	No Science Certificate
1999	6348	288	288	75	5697
2000	9793	560	401	116	8716
2001	9820	597	337	134	8752
2002	9476	571	359	127	8419
2003	13979	862	408	215	12494
2004	15182	945	414	206	13617
2005	15891	895	512	211	14273
2006	12643	771	312	157	11403
2007	15111	908	505	203	13495
2008	8271	557	326	103	7285
2009	6793	461	299	90	5943
Total	123307	7415	4161	1637	110094

Table 6 and Figure 6 present information on the number of new teachers teaching science courses (whether certified in science or not) by pathway by year. The number of rookie teachers from traditional Florida preparation programs rose in the early 2000s, topped out in 2003 and then began to decline. This was partly offset by a growing number of alternatively certified teachers.

Table 6. Number of first-year teachers assigned to science classes by pathway, 1999 to 2009

Year	Pathway					
	Trad	Alt	Out of State	Course Analysis	Unknown	Total
1999	57	9	43	351	116	576
2000	68	36	77	516	264	961
2001	123	60	190	335	226	934
2002	117	102	188	290	233	930
2003	134	159	269	316	392	1270
2004	106	166	284	309	494	1359
2005	108	146	268	325	560	1407
Subtotal	713	678	1319	2442	2285	7437
2006	n/a	n/a	n/a	n/a	n/a	1083
2007	n/a	n/a	n/a	n/a	n/a	1413
2008	n/a	n/a	n/a	n/a	n/a	883
2009	n/a	n/a	n/a	n/a	n/a	760
Total	n/a	n/a	n/a	n/a	n/a	11576

Figure 6. Pathway of first-year teachers assigned to science classes as a percentage of all first-year teachers assigned to science classes with known pathway, 1999 to 2005



As noted for certificates issued, a large portion of the increased demand for science teachers in Florida during the early-to-mid 2000s was met by importing teachers from other states. The number of first-year (in Florida) teachers teaching science courses who came from out of state increased over six-fold from 1999-2005.

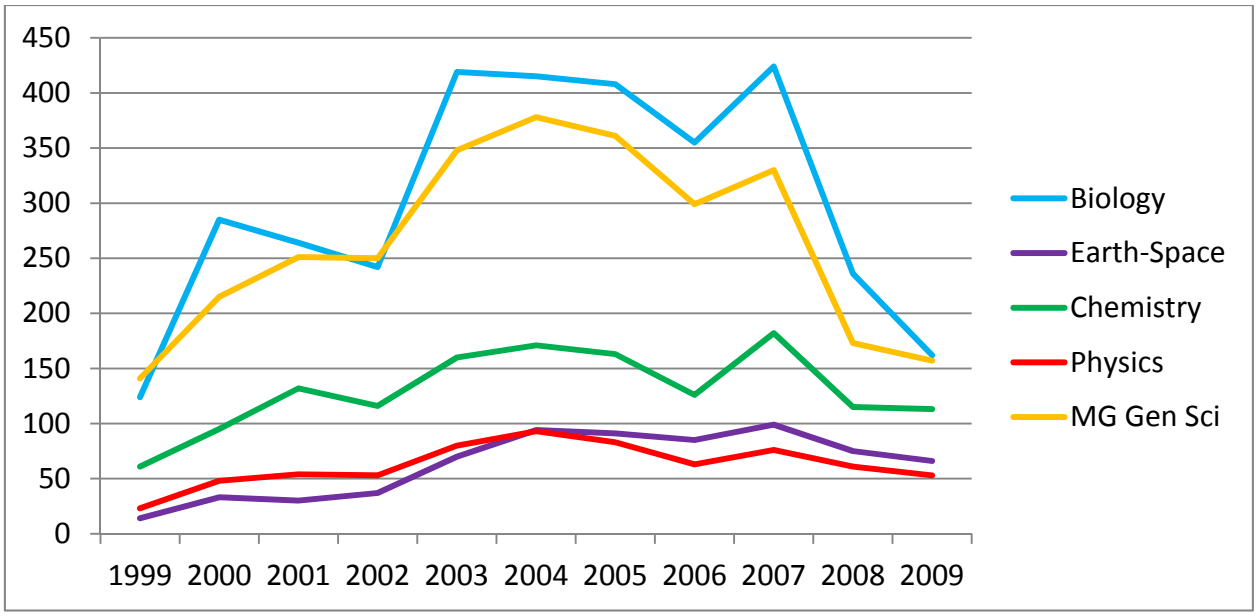
Table 7 and Figure 7 provide evidence on the number of new teachers with certification in science, by the subject area of certification and by year. The total number of rookie teachers with a science certification rose in the early 2000s, plateaued in 2004-2007, and then declined precipitously in 2008 and 2009. Similar patterns are observed for each certification subject area, though the relative decline post-2007 is smaller for physics and earth-space science than for other subjects.

Table 7. Annual number of first-year teachers certified in science by subject area certified, 1999 to 2009

Year	**Total**	Biology	Chemistry	Physics	Earth-Space	Middle Grades General
1999	363	124	61	23	14	141
2000	676	285	95	48	33	215
2001	731	264	132	54	30	251
2002	698	242	116	53	37	250
2003	1077	419	160	80	70	348
2004	1151	415	171	93	94	378
2005	1106	408	163	83	91	361
2006	928	355	126	63	85	299
2007	1111	424	182	76	99	330
2008	660	236	115	61	75	173
2009	551	162	113	53	66	157
Total	9052	3334	1434	687	694	2903

Notes: A teacher can be certified in more than one subject.

Figure 7. Annual number of first-year teachers certified in science by subject area certified, 1999 to 2009



Evidence on the number of new teachers teaching science courses (whether certified in a science subject area or not) by subject area and year are provided in Table 8 and Figure 8. Since most

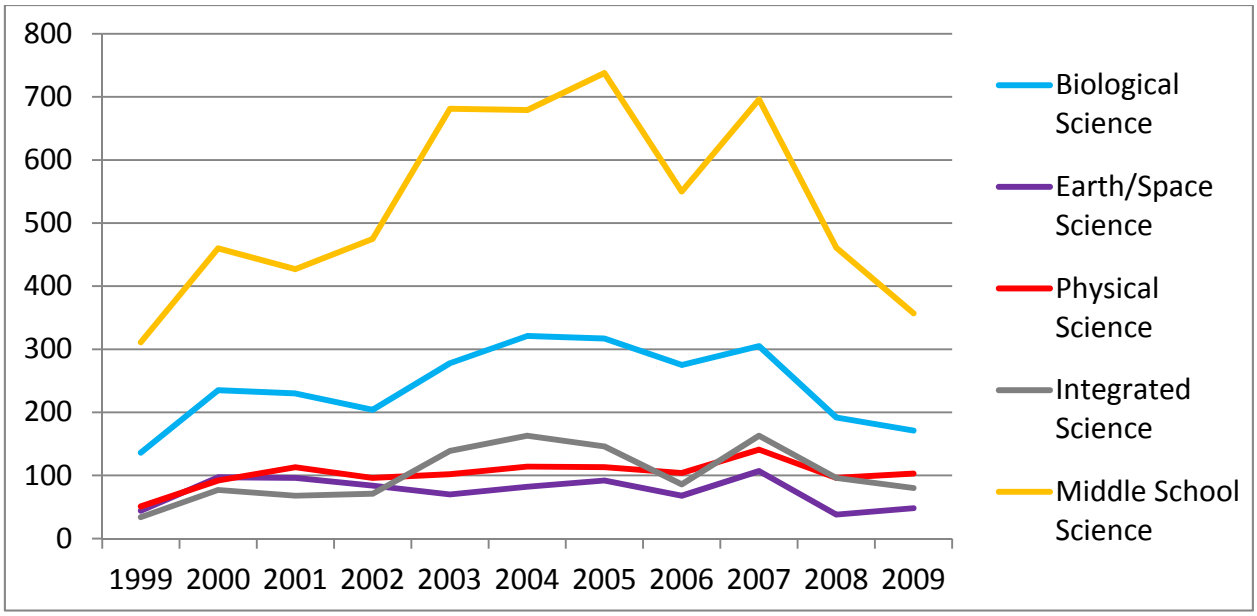
Table 8. Annual number of first-year teachers assigned to science classes by subject area taught, 1999 to 2009

Year	**Total**	Biological	Physical	Earth-Space	Integrated	Middle School
1999	576	136	51	44	34	311
2000	961	235	92	97	77	460
2001	934	230	113	96	68	427
2002	930	204	96	84	71	475
2003	1270	278	102	70	139	681
2004	1359	321	114	82	163	679
2005	1406	317	113	92	146	738
2006	1083	275	104	68	86	550
2007	1412	305	141	107	163	696
2008	883	192	96	38	96	461
2009	759	171	103	48	80	357
Total	11573	2664	1125	826	1123	5835

Notes: A teacher can teach in more than one subject. Excludes 3 teachers who taught "general science" courses.

rookie teachers who are certified to teach science do in fact teach at least one science course in their first year, the patterns are not markedly different from those observed for first-year teachers certified in a science subject area.

Figure 8. Annual number of first-year teachers assigned to science classes by subject area taught, 1999 to 2009



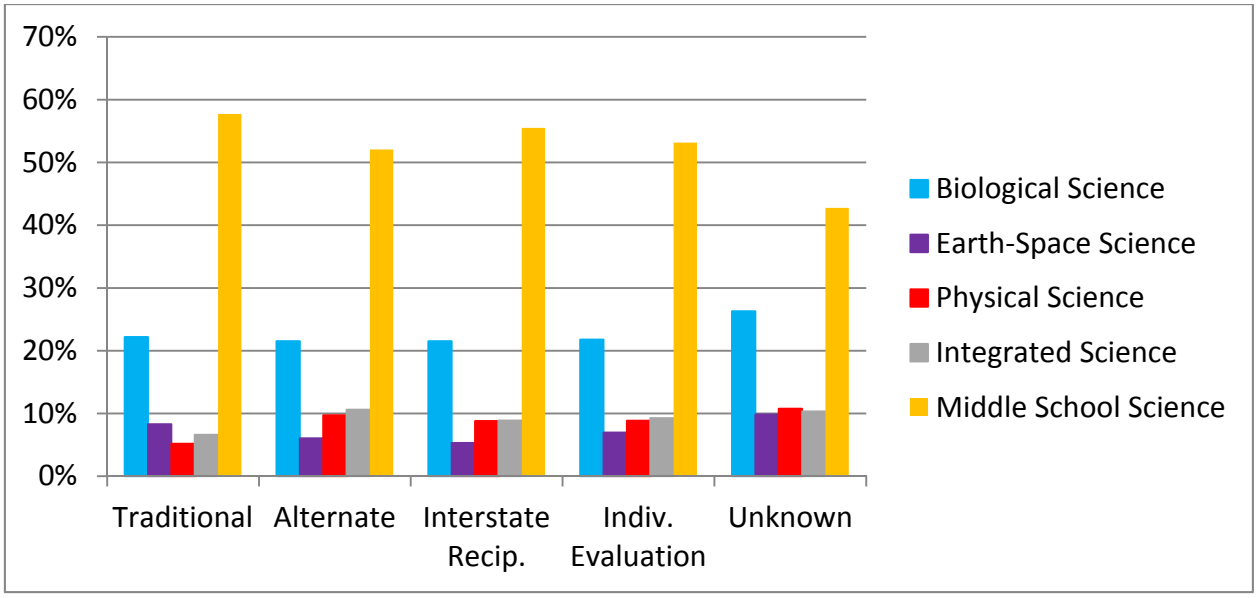
Finally, in Table 9 and in Figure 9 I combine information on teaching assignments and pathways to teaching and present the number of first-year teachers teaching science courses by pathway and by subject area taught. While the proportion of teachers in each known pathway who end up teaching courses in biological sciences, earth-space science and middle school science are nearly equal, much larger proportions of alternatively certified teachers end up teaching physical science and integrated science courses than do traditionally prepared teachers.

Table 9. First-year teachers assigned to science courses by subject area taught and by preparation pathway, 1999 to 2005

Preparation Pathway	Teachers (#)	Biological Science (%)	Physical Science (%)	Integrated Science (%)	Earth-Space Science (%)	Middle School Science (%)
Traditional	712	22.19	5.20	6.60	8.29	57.72
Alternative	678	21.53	9.73	10.62	6.05	52.06
Interstate Reciprocity	1319	21.53	8.79	8.87	5.31	55.50
Individual Evaluation	2442	21.79	8.85	9.25	6.96	53.15
Unknown	2285	26.30	10.77	10.33	9.85	42.76
Total	7436	23.14	9.16	9.39	7.60	50.71

Notes: excludes 1 teacher who taught "general science."

Figure 9. First-year teachers assigned to science courses by subject area taught and preparation pathway, 1999 to 2005



E. School Assignment

The distribution of new science teachers by school poverty level and by school racial composition are presented in Table 10 and in Figures 10a-10d. From 2000-2007 the distribution of new science teachers across schools serving different proportions of students eligible for free or reduced-price lunch (FRL), a crude measure of family income, is relatively constant. However, when demand for teachers and hiring of new teachers plummeted in 2008 and 2009, the proportion of new science teachers going into low-poverty schools (school with 0-30 percent FRL) declined. This suggested that as demand fell, schools serving more affluent populations were able to hold onto their more experienced science teachers whereas schools serving primarily students from low-income households continued to have to hire new science teachers. The pattern is the same whether new science teachers are identified by the courses they teach or by their certification status. However, the proportion of new teachers certified to teach in science who go into schools serving students from relatively affluent families (0-30 percent FRL), is smaller than the proportion of new teachers teaching science courses who work in schools serving students from relatively affluent families. This suggests that high-poverty schools tend to have a greater proportion of rookie teachers teaching science courses who are not certified in the subject they are teaching. Similar patterns are observed when schools are categorized by the proportion of students who are non-white, where white is defined as non-Hispanic whites.

Table 10. Distribution of first-year teachers certified in science and first-year teachers assigned to science classrooms by initial school percent free/reduced-price lunch and non-white, 1999 to 2009.

	Certified in Science			Teaching a Science Course		
	Percent eligible for free/reduced-price lunch					
Year	0-30%	>30-70%	>70-100%	0-30%	>30-70%	>70-100%
1999	115	228	15	165	338	55
2000	213	260	198	293	474	171
2001	205	290	232	275	477	159
2002	239	253	199	338	433	128
2003	266	454	341	373	666	195
2004	274	526	339	356	755	222
2005	254	493	354	335	767	284
2006	232	420	267	293	591	182
2007	274	496	333	371	790	232
2008	126	316	215	180	476	219
2009	73	246	222	92	392	254
Total	2271	3982	2715	3071	6159	2101
	Percent non-white					
Year	0-30%	>30-70%	>70-100%	0-30%	>30-70%	>70-100%
1999	112	220	26	201	289	68
2000	165	355	151	277	428	233
2001	172	394	161	272	409	230
2002	176	349	166	268	368	263
2003	199	597	265	310	575	349
2004	225	635	279	338	606	389
2005	180	632	289	308	665	413
2006	168	514	237	259	502	305
2007	155	631	317	265	645	483
2008	88	379	190	153	415	307
2009	63	294	184	116	323	299
Total	1703	5000	2265	2767	5225	3339

Figure 10a. Distribution of first-year teachers certified in science by initial school percent free/reduced-price lunch, 1999 to 2009

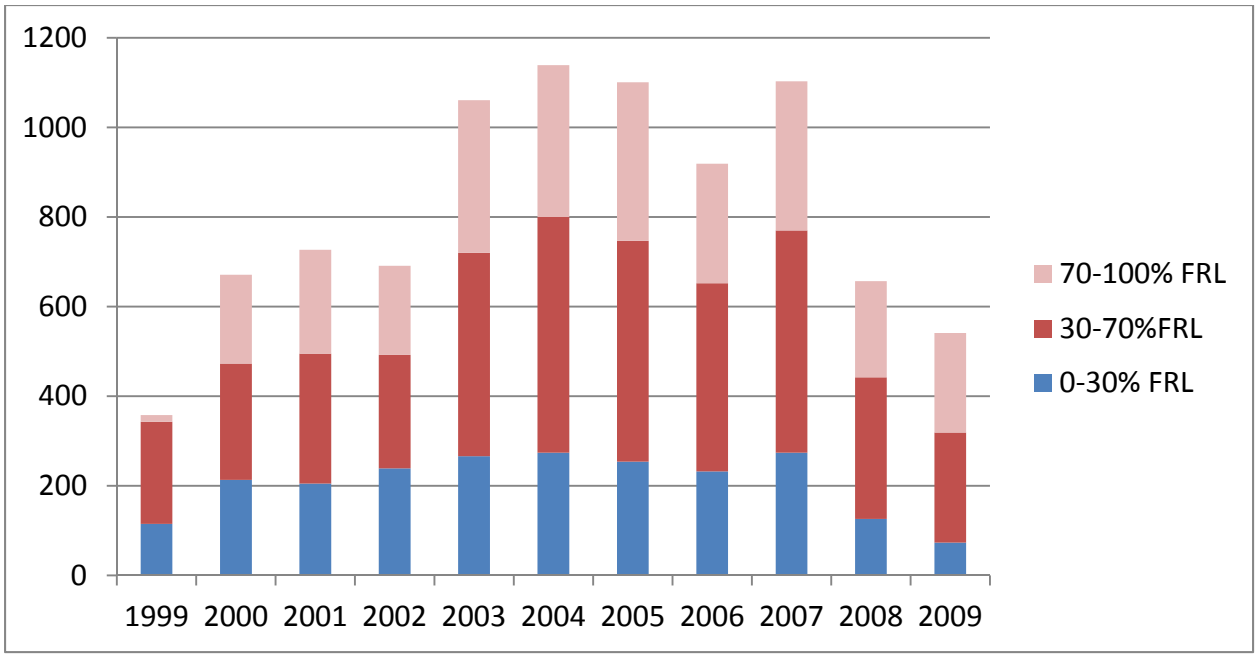


Figure 10b. Distribution of first-year teachers assigned to science classrooms by initial school percent free/reduced-price lunch, 1999 to 2009

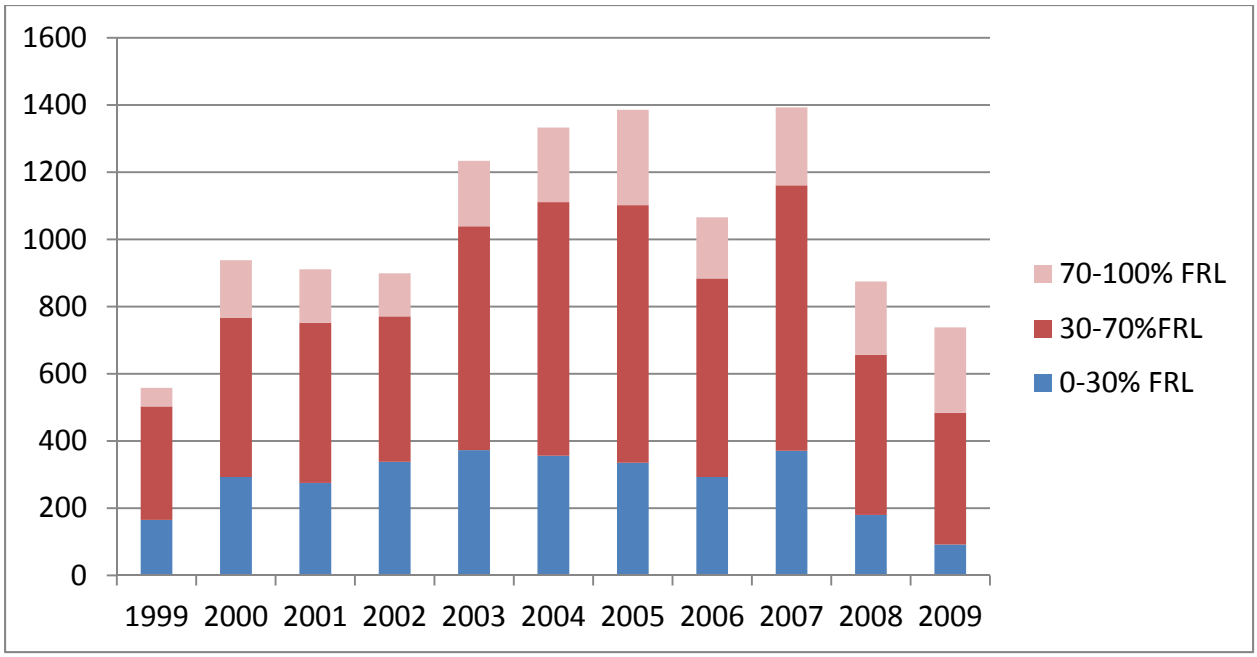


Figure 10c. Distribution of first-year teachers certified in science by initial school percent non-white, 1999 to 2009

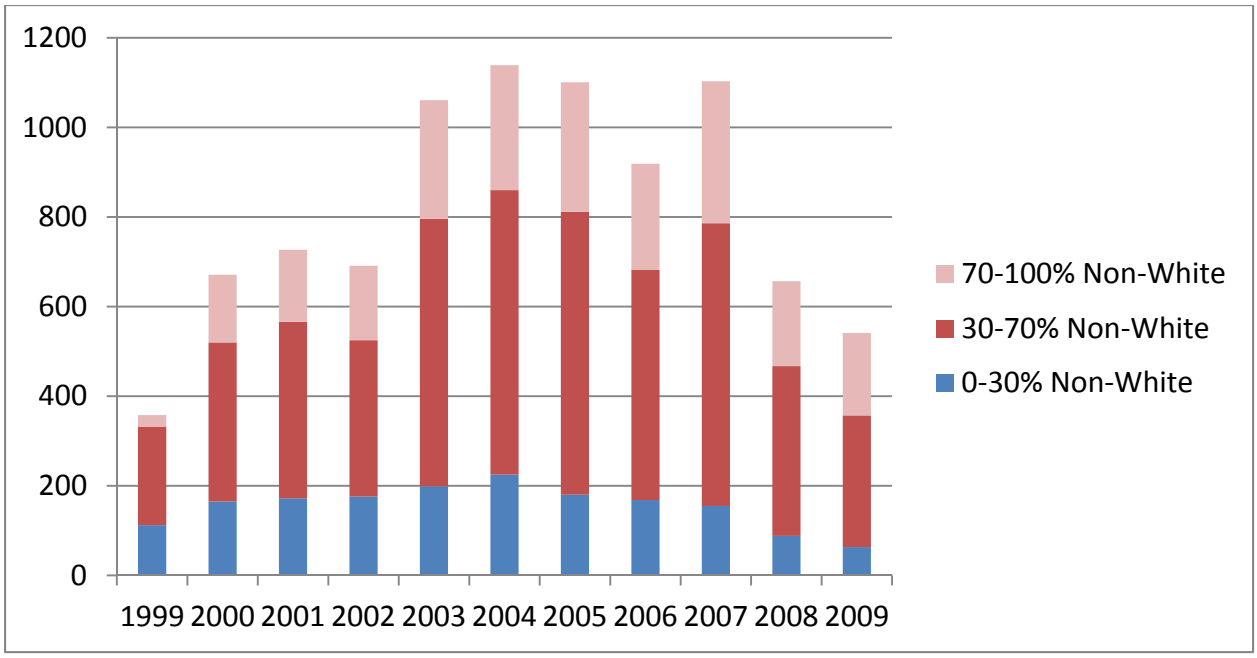


Figure 10d. Distribution of first-year teachers assigned to science classrooms by initial school percent non-white, 1999 to 2009

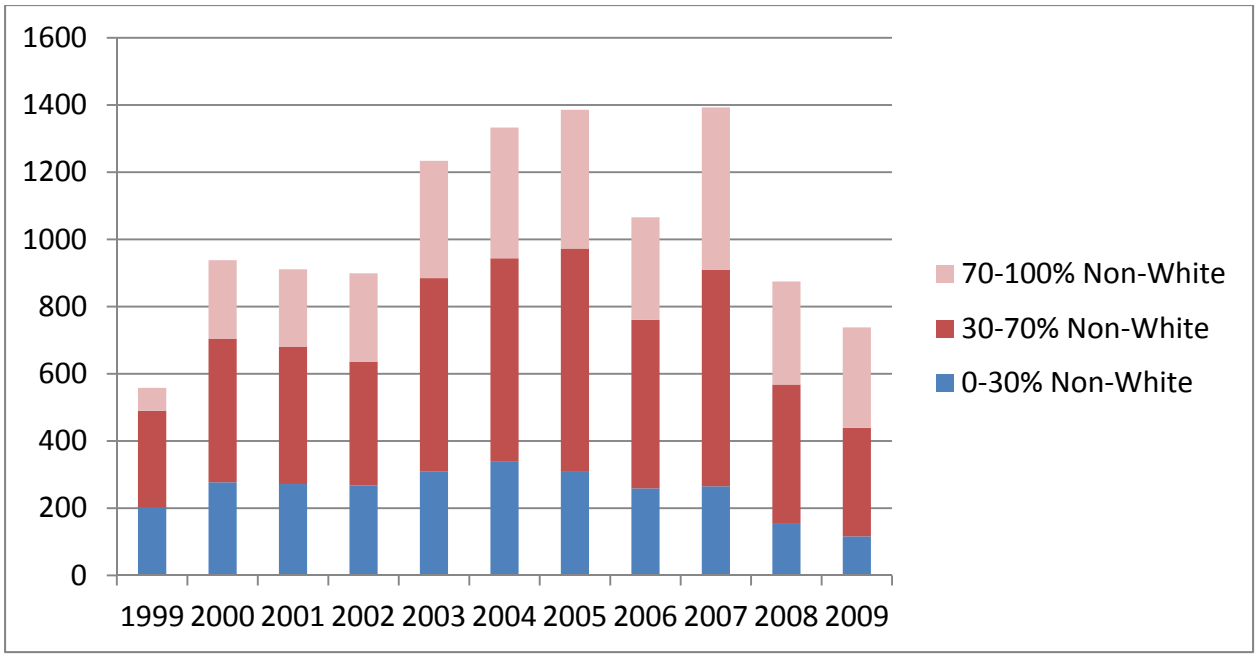


Table 11 presents a similar analysis, but breaks down the sample of new science teachers by subject area certification. For most of the certification subjects the number of first-year teachers teaching in high-poverty (70-100 percent FRL) and low-poverty schools (0-30 percent FRL) appear to be roughly equal. The one subject where there is a noticeable difference is Chemistry, where there are substantially more new teachers in low-poverty than in high poverty schools. When categorizing schools by the racial composition of the student body, the only large difference is a much greater number of new Biology teachers in high-minority schools (70-100 percent non-white) than in low-minority schools (0-30 percent non-white). The observed differences could be due to differences in the number of science faculty positions, difficulty in filling positions with certified teachers, or turnover in faculty.

Table 11. Number of first-year teachers certified in science by certified subject area and initial school percent free/reduced-price lunch and non-white, 1999 to 2009

	Percent eligible for free/reduced-price lunch			Percent non-white		
Year	0-30%	>30-70%	>70-100%	0-30%	>30-70%	>70-100%
Biology	879	1525	904	598	1731	979
Chemistry	518	636	264	300	714	404
Physics	199	257	225	148	404	129
Earth-Space	198	297	192	127	422	138
Middle Grades General	477	1267	1130	530	1729	615
Total	2271	3982	2715	1703	5000	2265

Note: totals do not equal those in Table 7 due to missing data on school average FRL or school average racial composition.

Finally, Table 12 provides information on the average student body characteristics and charter status of schools in which first-year teachers teaching science courses are place by pathway to teaching. There do not appear to be any significant differences in average school characteristics across teachers entering the profession from different pathways.

Table 12. Characteristics of schools at which first-year teachers assigned to science courses accept positions, 1999 to 2005, and by preparation pathway, 1999 to 2005

Preparation Pathway	Eligible for Free/ Reduced-Price Lunch (%)	Racial/Ethnic Minority (%)	Charter School (%)
Traditional	43.76	49.20	*
	(22.27)	(26.84)	
Alternative	45.42	52.33	*
	(22.13)	(24.86)	
Out of State	41.67	44.82	0.86
	(22.52)	(24.99)	(9.24)
Course Analysis	43.93	50.88	0.61
	(22.87)	(27.02)	(7.76)
Unknown	45.84	56.36	0.50
	(23.36)	(27.83)	(7.05)
	7259	7259	7134
Total	44.23	51.44	0.53
	(22.88)	(27.00)	(7.28)

Notes: Numbers in parentheses are standard deviations. *=fewer than 10 observations.

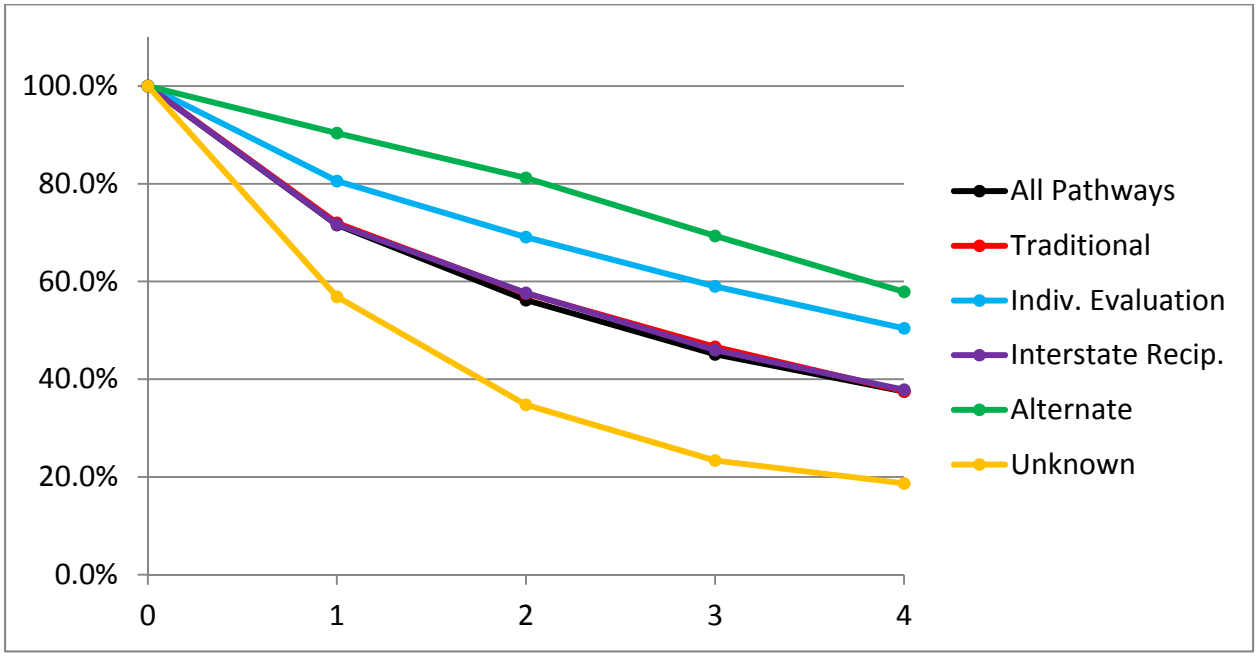
F. Length of Service

Attrition behavior is summarized by the proportion of first-year teachers teaching science courses who remain in the Florida public system with each passing year after the initial year of teaching. This information, broken down by pathway, is provided in Table 13 and in Figure 13. Traditionally prepared science teachers in Florida and out-of-state science teachers exhibit similar attrition behavior. In contrast, alternatively certified science teachers are much more likely to remain in the public school system than traditionally prepared teachers.

Table 13. Retention rates in science positions at initial school and any school among teachers beginning their careers between 1999 and 2005 during first five years of teaching

Years of Teaching	All Pathways (%)	Traditional (%)	Alternative (%)	Interstate Reciprocity (%)	Individual Evaluation (%)	Pathway Unknown (%)
			Stay in Science Position at Initial School			
1						
2						
3						
4						
5						
			Stay in Science Position at Any School			
1	71.6	72.0	90.4	71.7	80.6	56.9
2	56.2	57.5	81.2	57.7	69.1	34.8
3	45.1	46.6	69.3	46.0	59.0	23.4
4	37.5	37.5	57.9	37.9	50.4	18.7
5						

Figure 13. Retention rates in science positions at initial school and any school among teachers beginning their careers between 1999 and 2005 during first five years of teaching



G. Supplementary Analyses

The fact that transcript data exists in Florida for teachers who attended public colleges and universities makes it possible to analyze the academic preparation of science teachers who enter the profession from different pathways. Table FL2 presents evidence on the modal majors of first-year teachers certified in science subject areas by the pathway to teaching. Not surprisingly, traditionally prepared science teachers typically earn degrees in Science Teacher Education. In contrast, alternatively certified teachers and those who receive certification through the individual evaluation option are more likely to have majored in a science field. However, even among alternatively certified teachers, most receiving certification in the physical sciences (chemistry and physics) have not earned majors in the physical sciences.

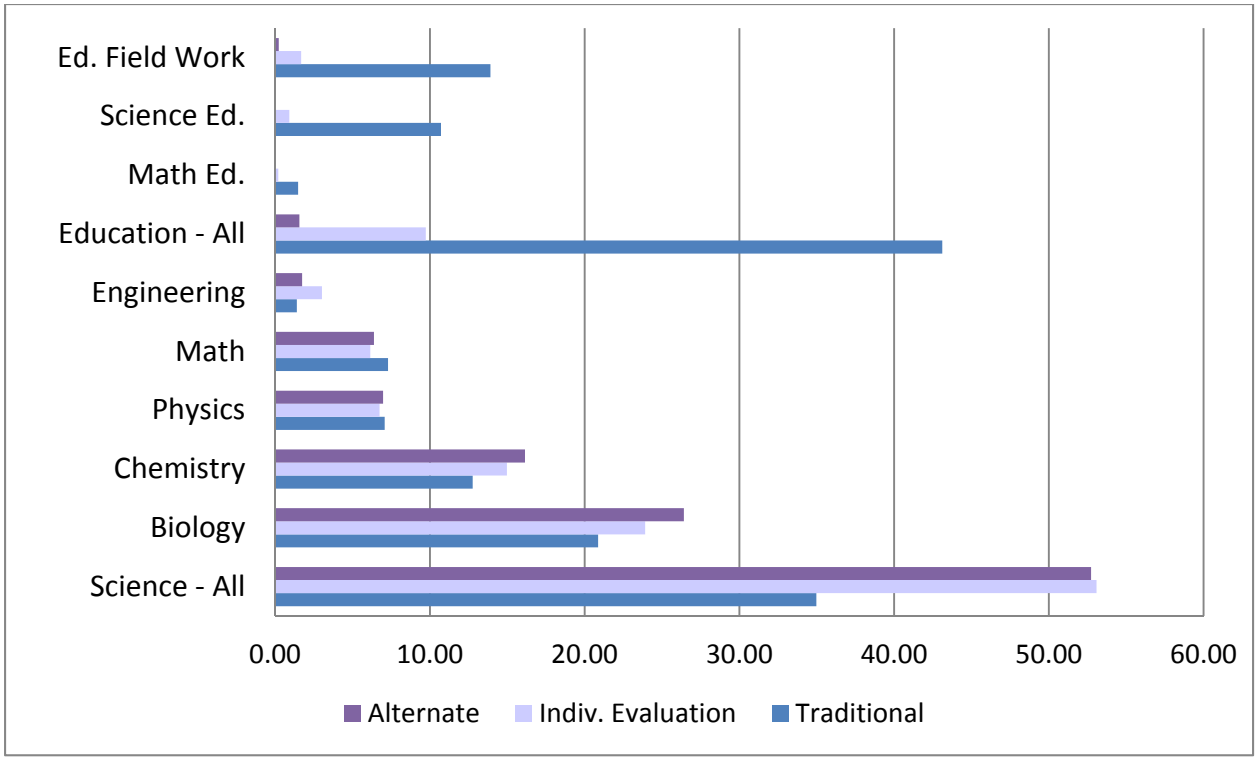
Table FL2. Modal Major of First Bachelor's Degree by Pathway and Certification Area - First-Year Teachers Certified in Science, 2000-2009

Pathway	Science Certification Area			
	Biology	**Chemistry**	**Physics**	**Earth-Space**
Traditional Teacher Prep. in FL	Science Teacher Ed.	Science Teacher Ed.	Science Teacher Ed.	Science Teacher Ed.
Individual Evaluation	Biology	Biology	Electrical Engineering	Science Teacher Ed.
Alternative Certification	Biology	Biology	Food Science	Geology

Figure FL5 presents evidence on the specific coursework of first-year teachers certified in science by pathway. Once again, it is no surprise that traditionally prepared teachers take many more education courses than do alternatively certified teachers or teachers who obtain their certification through the individual evaluation option. However, somewhat unexpectedly,

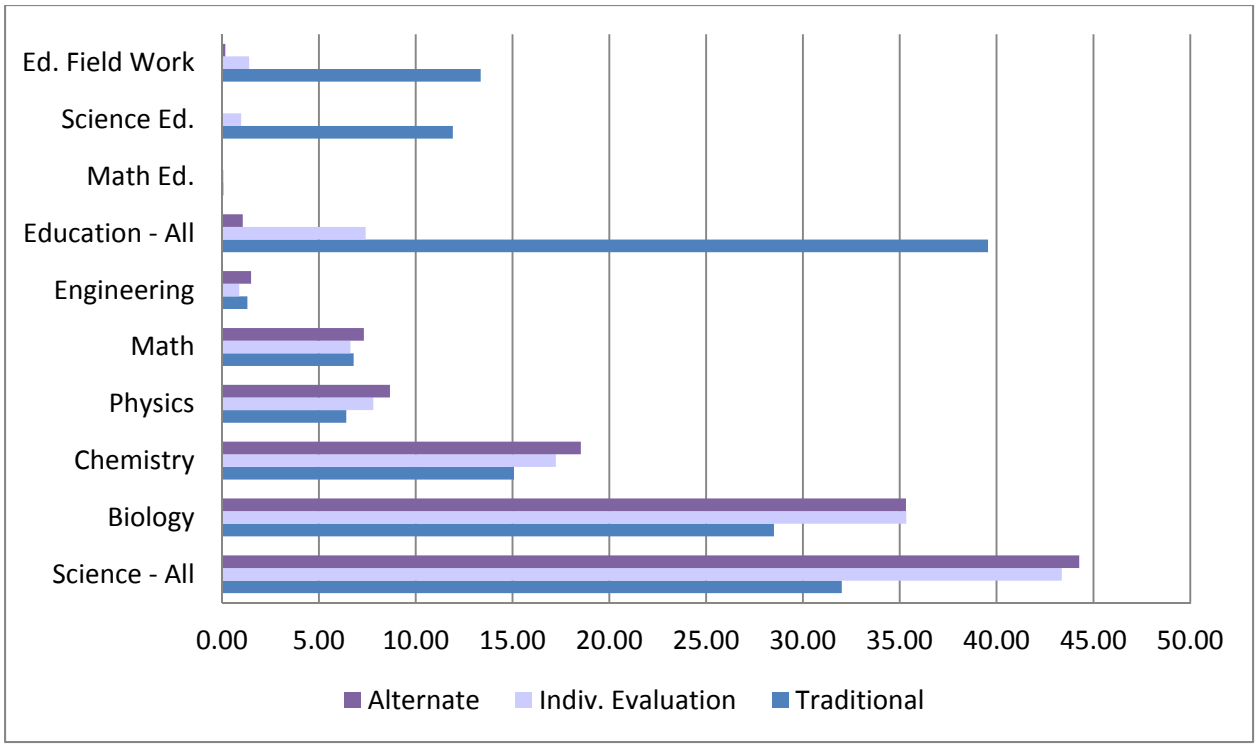
differences in the math and science coursework are relatively equal across teachers who enter the profession from different pathways. Although traditionally prepared take fewer science courses overall, the number of credit hours they earn in the specific areas of biology, chemistry and physics are very close to the number earned by alternatively certified teachers and those who enter through individual analysis.

Figure FL5. Coursework Credit Hours by Pathway, First-Year Teachers Certified in Science



Among first-year teachers certified in Biology (Figure FL6), traditionally prepared teachers take about 7 fewer credits or about two more courses in biology than do teachers from the alternative and individual evaluation routes. They also take about one less course (3 less credit hours) in chemistry and in physics, on average.

Figure FL6. Coursework Credit Hours by Pathway, First-Year Teachers Certified in Biology



Characteristics of first-year teachers certified in science, broken down by pathway, are presented in Table FL3. Several differences stand out. First, it appears there is some degree of adverse selection in the teachers who moved to Florida to teach science. Out-of-state science teachers were more likely to have graduated from the least competitive colleges and less likely to have graduated from the most competitive colleges (according to rankings produced by Barrons) than were science teachers who graduated from traditional teacher preparation programs in Florida. Similarly, they were less likely to pass the general knowledge math exam on the first try and had lower SAT scores that did traditionally prepared teachers from Florida. In contrast, alternatively certified teachers look similar to traditionally prepared teachers from Florida in terms of academic preparation (college selectivity, likelihood of passing the math general knowledge exam on the first try, average SAT score), but tend to be somewhat older and are more likely to be male.

Table FL3. Characteristics of First-Year Teachers Certified in Science by Pathway

Characteristic	Pathway			
	Traditional	Individual Evaluation	Out of State	Alternative
% from Most Competitive Colleges	22.3	21.1	9.0	28.9
% from Least Competitive Colleges	5.1	15.3	21.2	8.9
% Pass GK Math 1st Try	90.5	86.6	75.8	90.4
% Non-White	22.0	32.4	20.0	23.6
% Male	30.2	33.7	36.1	36.7
Average Age	29.8	34.0	36.4	33.4
Average SAT Score	1068	1021	980	1065