

GRADUATE ENROLLMENT IN SCIENCE AND ENGINEERING FIELDS REACHES A NEW PEAK; FIRST-TIME ENROLLMENT OF FOREIGN STUDENTS DECLINES

by Lori Thurgood¹

Graduate enrollment in science and engineering (S&E) programs reached a new peak of nearly 455,400 students in fall 2002, having recovered from the downward trend of 1994 to 1998 (table 1). This represents a 6 percent gain over enrollment in 2001 and a 5 percent gain over the previous peak, in 1993, of about 435,700 students. The number of postdoctoral appointees (postdocs) in S&E fields in U.S. institutions reached a total of 32,100 in 2002, also an all-time high.

Trends in Graduate Enrollment

Enrollment Status

Full-time enrollment was 325,700 in 2002—a gain of 7 percent from the previous year. Part-time enrollment

grew at half that rate, to 129,700 part-time students. Full-time students constituted 72 percent of all S&E graduate students in 2002 compared with 67 percent in 1992 and 1993.

Nearly 27 percent of full-time S&E graduate students in 2002 were enrolled for the first time. First-time enrollment grew 5 percent between 2001 and 2002, to more than 86,900, an all-time peak.

Field of Study

Graduate enrollment in 2002 grew in all major S&E fields and in nearly all subfields (table 2). Engineering and mathematical sciences led in percentage gains, both

TABLE 1. Graduate student enrollment in science and engineering, by enrollment status and sex, and postdocs in science and engineering: 1992–2002

Characteristic	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Percent change 2001–2002
All graduate students	430,517	435,723	431,142	422,466	415,181	407,630	404,856	411,182	413,536	429,242	455,355	6.1
Full time	290,408	293,905	292,979	287,171	284,039	280,669	278,943	283,893	291,355	304,021	325,699	7.1
First time	83,102	79,280	78,038	74,364	73,448	73,600	74,373	75,447	78,332	82,411	86,921	5.5
Other	207,306	214,625	214,941	212,807	210,591	207,069	204,570	208,446	213,023	221,610	238,778	7.7
Part time	140,109	141,818	138,163	135,295	131,142	126,961	125,913	127,289	122,181	125,221	129,656	3.5
Men	280,305	279,185	272,031	262,256	253,510	245,619	241,429	242,786	243,057	251,812	266,521	5.8
Women	150,212	156,538	159,111	160,210	161,671	162,011	163,427	168,396	170,479	177,430	188,834	6.4
Postdocs	23,883	24,665	25,787	26,160	26,569	27,264	27,876	28,980	30,224	30,194	32,075	6.2

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2002.

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TABLE 2. Graduate student enrollment in science and engineering, by field: 1992–2002

Field	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Percent change 2001–2002
All science and engineering fields	430,517	435,723	431,142	422,466	415,181	407,630	404,856	411,182	413,536	429,242	455,355	6.1
Sciences	312,478	318,851	318,118	315,265	311,957	306,482	304,818	309,491	309,424	319,749	335,747	5.0
Physical sciences	35,357	35,328	34,466	33,399	32,333	31,105	30,575	30,691	30,385	31,038	32,342	4.2
Astronomy	869	880	973	912	874	778	820	832	888	916	990	8.1
Chemistry	19,929	20,131	19,803	19,570	19,334	18,774	18,482	18,416	18,105	18,366	19,046	3.7
Physics	14,122	13,841	13,162	12,425	11,728	11,147	10,809	10,869	10,841	11,248	11,701	4.0
Other physical sciences	437	476	528	492	397	406	464	574	551	508	605	19.1
Earth, atmospheric, and ocean sciences	15,324	15,721	15,957	15,716	15,183	14,548	14,258	14,083	13,941	13,841	14,240	2.9
Atmospheric sciences	1,089	1,112	1,109	1,072	1,086	1,092	965	913	963	924	1,036	12.1
Geosciences	7,723	7,759	7,713	7,582	7,304	6,959	6,687	6,637	6,596	6,544	6,712	2.6
Oceanography	2,542	2,627	2,870	2,723	2,615	2,479	2,562	2,624	2,668	2,585	2,618	1.3
Other earth, atmospheric, and ocean sciences	3,970	4,223	4,265	4,339	4,178	4,018	4,044	3,909	3,714	3,788	3,874	2.3
Mathematical sciences	20,355	20,000	19,573	18,504	18,008	16,719	16,485	16,257	15,650	16,651	18,163	9.1
Computer sciences	36,325	36,213	34,158	33,458	34,626	35,991	38,027	42,478	47,350	52,196	55,559	6.4
Agricultural sciences	12,153	12,305	12,611	12,768	12,301	12,203	12,168	12,312	12,023	12,235	12,698	3.8
Biological sciences	53,693	55,950	57,676	58,344	57,749	56,705	56,695	56,959	56,282	57,639	61,132	6.1
Psychology	53,484	54,557	54,554	53,641	53,122	53,126	52,557	51,727	50,466	50,467	51,335	1.7
Social sciences	85,787	88,777	89,123	89,435	88,635	86,085	84,053	84,984	83,327	85,682	90,278	5.4
Agricultural economics	2,522	2,415	2,289	2,338	2,117	2,043	1,995	2,014	2,079	2,161	2,187	1.2
Anthropology	7,123	7,361	7,665	7,693	7,773	7,560	7,577	7,633	7,626	7,491	7,522	0.4
Economics	13,252	13,214	12,913	12,673	12,080	11,097	10,701	10,562	10,748	11,408	12,009	5.3
Geography	4,102	4,378	4,502	4,371	4,331	4,287	4,326	4,250	4,036	4,304	4,432	3.0
History and philosophy of science	360	369	387	401	409	443	508	557	532	571	663	16.1
Linguistics	3,277	3,321	3,279	3,194	3,156	3,068	2,935	2,799	2,674	2,744	2,875	4.8
Political science	33,797	35,076	34,317	34,298	33,252	32,083	30,828	31,372	31,131	31,805	34,907	9.8
Sociology	9,011	9,425	9,498	9,564	9,425	9,413	9,058	8,966	8,652	8,812	8,946	1.5
Sociology/anthropology	979	935	987	941	923	948	857	741	745	808	719	-11.0
Other social sciences	11,364	12,283	13,286	13,962	15,169	15,143	15,268	16,090	15,104	15,578	16,018	2.8
Engineering	118,039	116,872	113,024	107,201	103,224	101,148	100,038	101,691	104,112	109,493	119,608	9.2
Aerospace engineering	4,036	3,940	3,715	3,343	3,208	3,083	3,137	3,349	3,407	3,451	3,685	6.8
Biomedical engineering	2,537	2,675	2,750	2,732	2,732	2,847	2,905	3,121	3,241	3,639	4,378	20.3
Chemical engineering	7,433	7,554	7,639	7,452	7,408	7,288	7,093	6,883	7,056	6,913	7,414	7.2
Civil engineering	19,572	19,583	19,925	19,218	18,528	17,193	16,517	16,226	16,451	16,665	17,713	6.3
Electrical engineering	36,428	35,290	33,067	30,861	29,941	30,787	31,384	31,822	33,611	36,100	39,958	10.7
Industrial/manufacturing engineering	13,826	13,905	13,992	13,475	12,675	11,957	11,221	11,803	12,119	12,940	14,033	8.4
Mechanical engineering	18,637	18,477	17,761	16,363	15,509	15,045	14,696	14,956	15,235	15,852	17,115	8.0
Metallurgical/materials engineering	5,550	5,410	5,228	4,956	4,747	4,688	4,680	4,481	4,377	4,721	4,992	5.7
Other engineering	10,020	10,038	8,947	8,801	8,476	8,260	8,405	9,050	8,615	9,212	10,320	12.0

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2002.

rising more than 9 percent over the previous year. Other fast-growing fields were computer sciences and biological sciences, which each increased by 6 percent.

Demographics

The proportion of women among S&E graduate students grew from 35 percent in 1992 to more than 41 percent in 2001 and 2002 (table 1). The number of female students has increased every year for the last 20 years, including a gain of more than 6 percent in 2002. In contrast, after reaching a peak in 1992, enrollment of men declined every year from 1993 to 1998. The number of male graduate students in S&E fields in 2002 was up nearly 6 percent from 2001 but was still 13,800 below peak male enrollment.

Over the past decade, enrollment of minority students in graduate S&E programs has grown faster than enrollment of white students (table 3). White, non-Hispanic students accounted for about 69 percent of all U.S. citizens and permanent residents enrolled in S&E graduate programs in 2002, down from 79 percent in 1992. White enrollment declined from 1994 to 2000, whereas underrepresented minority enrollment has increased every year. In 2002 white enrollment was 213,500, a 4 percent gain over the 2001 figure but 43,300 below the peak in 1993.

Asians/Pacific Islanders were the second largest racial/ethnic group among U.S. citizens and permanent residents in S&E graduate programs in 2002. They ac-

TABLE 3. Graduate student enrollment in science and engineering, by citizenship, enrollment status, sex, and race/ethnicity, and postdocs in science and engineering: 1992–2002

Characteristic	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Percent change 2001–2002
U.S. citizens and permanent residents												
Graduate students	321,083	330,057	329,026	323,962	317,075	308,668	302,879	301,254	290,711	294,792	310,243	5.2
Full time	197,399	204,405	206,809	204,113	200,674	195,974	191,945	190,076	185,673	188,295	200,861	6.7
First time	NA	NA	NA	NA	NA	NA	NA	NA	46,316	48,259	54,824	13.6
Other	NA	NA	NA	NA	NA	NA	NA	NA	139,357	140,036	146,037	4.3
Part time	123,684	125,652	122,217	119,849	116,401	112,694	110,934	111,178	105,038	106,497	109,382	2.7
Men	NA	NA	195,794	189,915	182,519	174,934	169,490	165,823	157,023	158,060	165,580	4.8
Women	NA	NA	133,232	134,047	134,556	133,734	133,389	135,431	133,688	136,732	144,663	5.8
White, non-Hispanic	253,358	256,772	255,660	245,857	238,032	228,007	220,667	216,750	205,569	206,027	213,497	3.6
Asian/Pacific Islander	21,741	24,048	26,471	25,902	25,929	26,012	26,726	27,570	25,058	26,665	29,712	11.4
Black, non-Hispanic	15,441	17,113	17,610	18,285	19,066	19,341	19,651	20,273	20,834	21,459	22,711	5.8
Hispanic	12,242	13,380	13,273	14,112	14,571	14,984	15,487	16,520	17,203	17,974	19,630	9.2
American Indian/Alaskan Native	1,243	1,309	1,382	1,516	1,538	1,599	1,607	1,553	1,602	1,683	1,736	3.1
Other or unknown race/ethnicity	17,058	17,435	14,630	18,290	17,939	18,725	18,741	18,588	20,445	20,984	22,957	9.4
Postdocs	11,184	11,635	12,469	12,823	12,930	12,835	12,966	12,725	12,627	12,088	13,502	11.7
Temporary visa holders												
Graduate students	109,434	105,666	102,116	98,504	98,106	98,962	101,977	109,928	122,825	134,450	145,112	7.9
Full time	93,009	89,500	86,170	83,058	83,365	84,695	86,998	93,817	105,682	115,726	124,838	7.9
First time	NA	NA	NA	NA	NA	NA	NA	NA	32,016	34,152	32,097	-6.0
Other	NA	NA	NA	NA	NA	NA	NA	NA	73,666	81,574	92,741	13.7
Part time	16,425	16,166	15,946	15,446	14,741	14,267	14,979	16,111	17,143	18,724	20,274	8.3
Men	NA	NA	76,237	72,341	70,991	70,685	71,939	76,963	86,034	93,752	100,941	7.7
Women	NA	NA	25,879	26,163	27,115	28,277	30,038	32,965	36,791	40,698	44,171	8.5
Postdocs	12,699	13,030	13,318	13,337	13,639	14,429	14,910	16,255	17,597	18,106	18,573	2.6

NA = not available.

NOTE: For 2000, 2001, and 2002, the few graduate students who were reported to be "Native Hawaiian/Other Pacific Islander" or "multi-racial" were included in "Asian/Pacific Islander" or "other/unknown race/ethnicity," respectively.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2002.

counted for almost 10 percent of the total, followed by blacks (7 percent), Hispanics (6 percent), and American Indians/Alaskan Natives (less than 1 percent). Increases from 2001 to 2002 in S&E graduate enrollment for minority students ranged from 3 percent for American Indians/Alaskan Natives to 9 percent for Asians/Pacific Islanders.

Trends in Foreign-Student Graduate Enrollment

The fall 2002 Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS) offers the first national data on enrollment of S&E graduate students since the terrorist attacks of September 11, 2001. There has been concern that enrollment of foreign students in U.S. graduate programs may have been adversely affected in the wake of those events. This *InfoBrief* provides an opportunity to examine short-term changes in enrollment of foreign students in the context of longer-term trends in such enrollment. In this analysis, foreign students are those who are in the United States on temporary visas.

The short-term analysis of foreign student enrollment was based on the following expectations. (1) Total enrollment for temporary visa holders is unlikely to show a substantial decline from the fall 2001 figure because a large majority of such graduate students in fall 2002 were already enrolled in U.S. institutions in 2001. (2) Any immediate impact of 9/11 on graduate enrollment of temporary visa holders is most likely to be seen in first-time enrollment. (3) Declines in S&E graduate enrollment of temporary visa holders are more likely among men than among women, given the predominance of men among such students as well as among known terrorists. Data from the fall 2002 GSS support each of these expectations.

The gain in graduate S&E enrollment from 2001 to 2002 was greater for temporary visa holders (8 percent) than for U.S. citizens and permanent residents (5 percent) (table 3). The 2002 numbers represent all-time highs for both the number and proportion (32 percent) of S&E graduate students who were temporary visa holders. Fields with high proportions of temporary visa holders include engineering (49 percent), computer sciences (48 percent), physical sciences (40 percent), and mathematical sciences (39 percent) (table 4).

The 8 percent gain for temporary visa holders in the 2002 GSS data was smaller than gains in the previous two years (12 and 9 percent), but it exceeded the annual gains for most other years during the last two decades. Graduate enrollment of students with temporary visas rose every year from 1982 to 1992, declined from 1993 to 1996,² and has increased every year since (table 3).

The 20-year trend for graduate S&E enrollment of U.S. citizens and permanent residents shows less growth and more years of decline than does the trend for temporary visa holders. Enrollment of U.S. citizens and permanent residents increased more slowly during the 1980s than did enrollment of temporary visa holders, and it declined from 1994 to 2000. Enrollment in 2002, of 310,200 students, was 6 percent below the peak year of 1993. Nevertheless, the addition of 15,500 students in 2002 represents the second largest numerical increase in U.S. citizen and permanent resident S&E graduate enrollment in the last 20 years, exceeded only by a 17,100 gain in 1992.

Country of Origin

The net aggregate gains in enrollment of temporary visa holders in 2002 may include different patterns among various countries and regions of origin, but the GSS does not collect information on the countries of origin of temporary visa holders. Another information source is the Institute of International Education: data for the 2002–2003 academic year show a 3.5 percent increase in foreign graduate enrollment in U.S. institutions for all fields (including non-S&E fields).³ This increase was primarily due to substantial increases in the numbers of students from China, India, Kenya, and the Republic of Korea. Many other countries, including several predominantly Muslim countries, had notable decreases in 2002–2003. The number of students from Saudi Arabia was 17 percent lower than the number in the 2001–2002 academic year.

²These declines reflect the adoption of the Chinese Student Protection Act of 1992, which made thousands of Chinese students enrolled in U.S. institutions in 1989 (at the time of the Tiananmen Square uprising) eligible for permanent residency on July 1, 1993.

³Graduate student enrollment was generated from data available at <http://opendoors.iienetwork.org>.

TABLE 4. Graduate student enrollment in science and engineering, by citizenship and field: 1992–2002

Field	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Percent change 2001–2002
U.S. citizens and permanent residents												
All S&E fields	321,083	330,057	329,026	323,962	317,075	308,668	302,879	301,254	290,711	294,792	310,243	5.2
Sciences	244,514	252,480	253,008	252,245	248,907	244,026	240,630	241,066	234,000	237,821	248,897	4.7
Physical sciences	22,552	23,076	22,757	21,990	21,155	20,210	19,837	19,559	18,730	18,835	19,290	2.4
Earth, atmospheric, and ocean sciences	12,320	12,713	12,693	12,769	12,417	12,033	11,759	11,563	11,249	11,059	11,472	3.7
Mathematical sciences	13,878	13,866	13,510	12,695	12,247	11,175	11,064	10,330	9,593	10,167	11,158	9.7
Computer sciences	24,209	24,304	23,096	22,663	22,779	23,074	23,605	25,323	25,088	26,223	28,758	9.7
Agricultural sciences	8,872	9,083	9,380	9,567	9,283	9,414	9,514	9,774	9,612	9,722	10,085	3.7
Biological sciences	41,022	43,175	44,997	46,276	46,377	45,641	45,359	45,770	44,521	45,205	47,398	4.9
Psychology	51,551	52,676	52,211	51,554	51,149	51,118	50,371	49,488	48,203	47,946	48,469	1.1
Social sciences	70,110	73,587	74,364	74,731	73,500	71,361	69,121	69,259	67,004	68,664	72,267	5.2
Engineering	76,569	77,577	76,018	71,717	68,168	64,642	62,249	60,188	56,711	56,971	61,346	7.7
Temporary visa holders												
All S&E fields	109,434	105,666	102,116	98,504	98,106	98,962	101,977	109,928	122,825	134,450	145,112	7.9
Sciences	67,964	66,371	65,110	63,020	63,050	62,456	64,188	68,425	75,424	81,928	86,850	6.0
Physical sciences	12,805	12,252	11,709	11,409	11,178	10,895	10,738	11,132	11,655	12,203	13,052	7.0
Earth, atmospheric, and ocean sciences	3,004	3,008	3,264	2,947	2,766	2,515	2,499	2,520	2,692	2,782	2,768	-0.5
Mathematical sciences	6,477	6,134	6,063	5,809	5,761	5,544	5,421	5,927	6,057	6,484	7,005	8.0
Computer sciences	12,116	11,909	11,062	10,795	11,847	12,917	14,422	17,155	22,262	25,973	26,801	3.2
Agricultural sciences	3,281	3,222	3,231	3,201	3,018	2,789	2,654	2,538	2,411	2,513	2,613	4.0
Biological sciences	12,671	12,775	12,679	12,068	11,372	11,064	11,336	11,189	11,761	12,434	13,734	10.5
Psychology	1,933	1,881	2,343	2,087	1,973	2,008	2,186	2,239	2,263	2,521	2,866	13.7
Social sciences	15,677	15,190	14,759	14,704	15,135	14,724	14,932	15,725	16,323	17,018	18,011	5.8
Engineering	41,470	39,295	37,006	35,484	35,056	36,506	37,789	41,503	47,401	52,522	58,262	10.9

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2002.

Enrollment Status

Students with temporary visas are more likely to enroll full time (86 percent in 2002) than are U.S. citizens and permanent residents (65 percent in 2002) (table 3).

Both citizenship groups experienced gains in full-time and part-time graduate enrollment in 2002, but temporary visa holders had greater percentage gains in both categories—approximately 8 percent in both categories for temporary visa holders compared with increases of 7 percent in full-time and 3 percent in part-time enrollment for U.S. citizens and permanent residents.

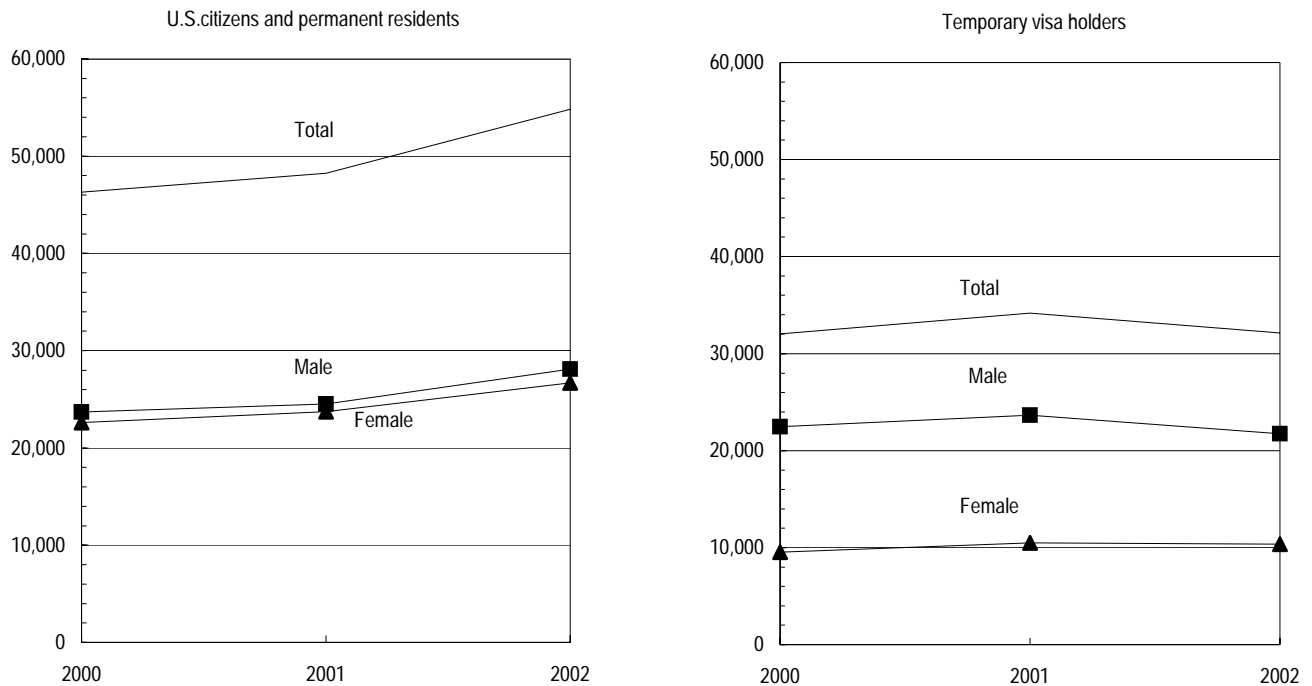
Full-time, first-time enrollment declined among temporary visa holders by about 2,100 in 2002, with most of the decrease (2,000 students) being among male students (figure 1). Full-time, first time enrollment of temporary visa holders was down about 8 percent for men and 1 percent for women. In contrast, full-time, first-

time enrollment increased by almost 14 percent for U.S. citizens and permanent residents, with increases of 15 percent for men and more than 12 percent for women.

Field of Study

Graduate enrollment increased in 2002 in all S&E major fields for U.S. citizens and permanent residents and in nearly all S&E major fields for those with temporary visas (table 4). The only exception was a slight decline in earth, atmospheric, and ocean sciences among temporary visa holders. In all but three of the major fields (computer sciences; mathematical sciences; and earth, atmospheric, and ocean sciences), the gains for temporary visa holders exceeded those for U.S. citizens and permanent residents. Perhaps the most notable change for temporary visa holders in 2002 was the slowing of enrollment increases in computer science programs after rapid growth from 1997 to 2001, when annual gains

FIGURE 1. Full-time, first-time graduate student enrollment in science and engineering, by citizenship and sex: 2000–2002



SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2002.

ranged from 9 percent (in 1997) to 30 percent (in 2000). Graduate enrollment of students with temporary visas decreased in a few subfields in 2002, including nuclear engineering (down 7 percent), which is on the U.S. State Department's watch list for foreign citizens applying for visas to study in the United States.

A different picture emerges when full-time, first-time enrollment is examined by field. In 2002 first-time graduate enrollment of students with temporary visas declined in all S&E major fields except biological and social sciences, which showed gains of less than 1 percent (figure 2). The greatest loss was in computer sciences, which was down 15 percent in 2002, compared with a gain of 7 percent the previous year. Decreases in first-time graduate enrollment of temporary visa holders in other S&E fields ranged from 1 percent in psychology to 8 percent in earth, atmospheric, and ocean sciences.

Although the number of first-time graduate students with temporary visas decreased in 2002 for both men and women, men experienced declines in more fields, and their percentage losses were often greater than

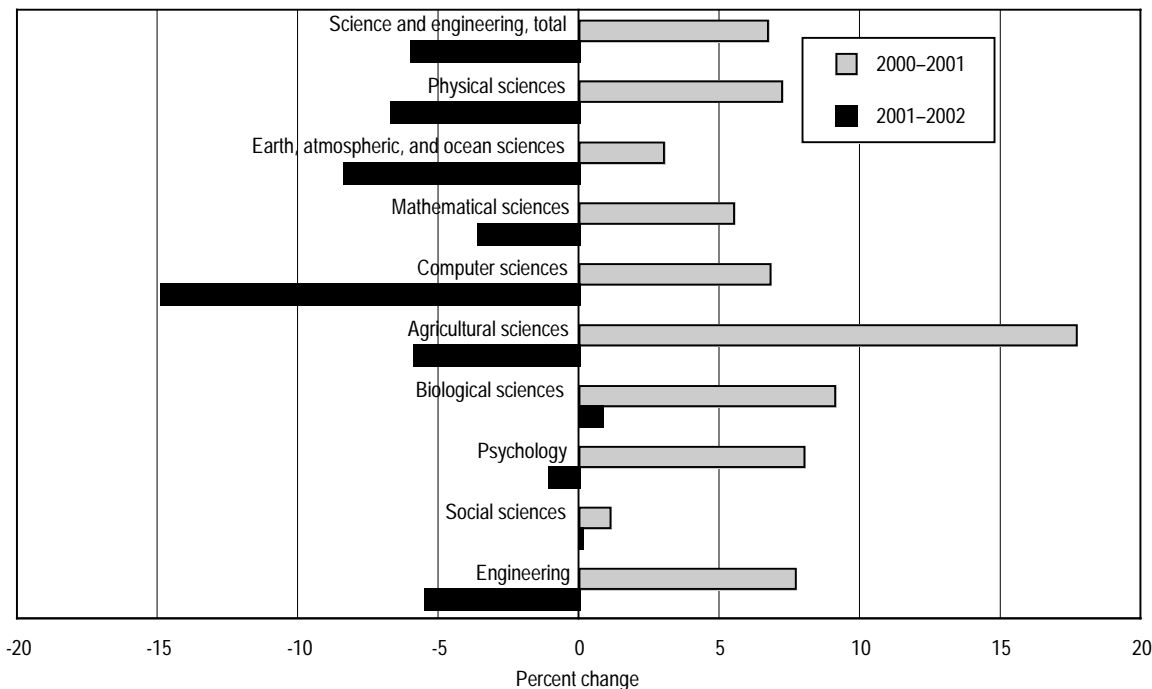
those for women. One of the largest percentage losses for both men and women with temporary visas occurred in nuclear engineering: a 37 percent decrease for men, from 68 first-time students in 2001 to 43 first-time students in 2002; a 65 percent decrease for women, from 20 to 7 first-time students.

Postdoctoral Appointees

Many postdocs in the United States assumed their postdoctoral appointments after completing doctoral programs in U.S. institutions. Therefore, one might expect little change in the number of postdocs on temporary visas one year after 9/11. In 2002 about 18,600 such postdocs were in U.S. higher education institutions, about 3 percent more than the number in 2001 (table 3). This gain is slightly less than that in 2001 but is roughly only a third of the gains recorded in 1999 and 2000 (9 and 8 percent, respectively).⁴ After declines from 1999 to 2001, the number of U.S. citizens and permanent residents holding postdoctoral positions in U.S.

⁴GSS data do not distinguish between new postdocs and continuing postdocs.

FIGURE 2. Percent change in full-time, first-time graduate student enrollment of temporary visa holders: 2000–2001 and 2001–2002



SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, 2002.

colleges and universities increased by 12 percent in 2002. The proportion of academic postdocs who were temporary visa holders declined from 60 percent in 2001 to 58 percent in 2002.

The number of postdocs in U.S. colleges and universities with temporary visas increased in most S&E major fields in 2002. The only numerical losses were in three fields that had few postdocs with temporary visas in earlier years: computer sciences, psychology, and social sciences. The share of postdocs with temporary visas, however, has declined in every major field, most notably in computer sciences (from 67 to 51 percent). Postdocs in both citizenship groups were concentrated, for the most part, in three major fields: biological sciences (a majority of postdocs in each group), physical sciences, and engineering.

Data Notes

Data presented here are from the fall 2002 Survey of Graduate Students and Postdoctorates in Science and

Engineering. Data were collected from approximately 12,000 departments at 481 institutions of higher education in the United States and outlying areas. The departmental response rate was 99 percent; however, 13 percent of the responding departments required partial imputation of missing data.

More detailed data are available in the forthcoming report “Graduate Students and Postdoctorates in Science and Engineering: Fall 2002,” which will be available at <http://www.nsf.gov/sbe/srs/gss/start.htm>.

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