WOMEN IN SCIENCE AND ENGINEERING IN CANADA

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1. Introduction

The under representation of women in the various fields of science and engineering has long been recognized, and is of concern to the Natural Sciences and Engineering Research Council of Canada (NSERC). In this report, a brief review of some of the available statistics on women in science and engineering in Canada will be presented. From pre-university to post graduation, the gender preferences for science and engineering education and careers will be highlighted. Although the reasons behind gender differences in education and career selection are extremely important to consider, these issues are not the focus of this report. The academic literature on this subject is vast and does not offer conclusive results. The following web site Women-Related Web Sites in Science/Technology offers a good compilation of research in this area. The subject matter has developed enough interest to sustain a journal in the area, the Journal of Women and Minorities in Science and Engineering.

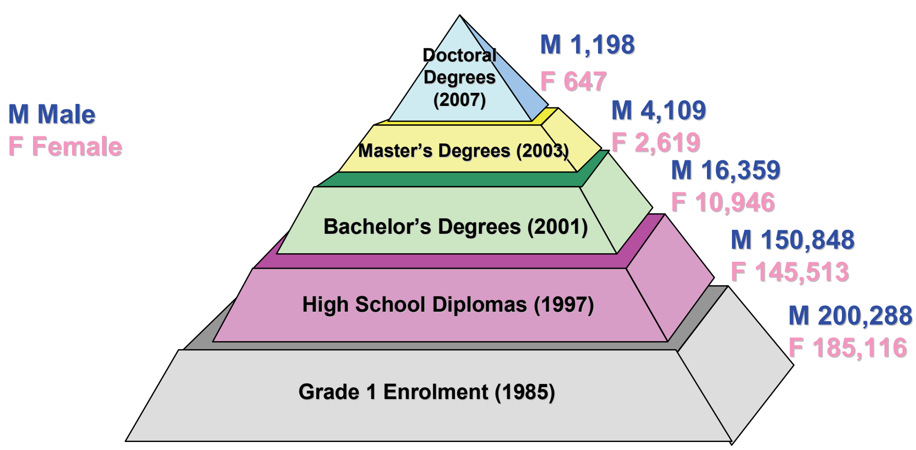
Section 2 of this report looks at the supply side of women in science and engineering through the education stream and immigration. Section 3 examines the career outcomes for women educated in science or engineering, with particular emphasis on academic and research careers. Section 4 presents an overview of NSERC funding to women and special programs or initiatives to help increase the number of women in science and engineering. Finally, Section 5 briefly reviews some current literature on the topic and presents a summary of the issues and possible solutions.

2. Education and Immigration

2.1 The Early Years

The supply pipeline for university graduates in science and engineering begins early on in elementary school when children are exposed to and form opinions about mathematics and science. Figure 2.1 presents the approximate flow of students from 1st grade to a Ph.D. in the sciences or engineering by gender. There is certainly no shortage of 1st graders of either sex who could enter the science and engineering world. But at each step along the supply chain fewer and fewer young people choose to study science or engineering, and the drop-off for women is considerably larger than that for men. The odds of a female child enrolled in 1st grade going on to receive a Ph.D. in the sciences or engineering are approximately 1 in 286 (the odds for a boy are 1 in 167). Today, in an average-sized Canadian elementary school, only 1 child will go on to receive that Ph.D., and it is likely to be a boy.

Figure 2.1
The Natural Science and Engineering Supply Chain



Source: Statistics Canada, NSERC estimates. University degrees shown are in the natural sciences and engineering for Canadians and permanent residents.

Interest in math and science education has spawned a number of international testing efforts to primarily gauge the knowledge of these subjects, but also the perceptions and attitudes of the students. A number of different international and national test results by gender for mathematics are presented in Table 2.1 and for science in Table 2.2. Overall, boys tend to outperform girls by only a slight margin for both mathematics and science (while not shown here, girls significantly outperform boys in reading).

Table 2.1
Various Mathematics Test Results by Gender

Subject/Test	Year	Location	Grade/Age	Average Score Boys	Average Score Girls	Statistically Significantly Different
TIMSS	2007	British Columbia	4th Grade	508	502	Y
		Alberta	4th Grade	510	500	Y
		Ontario	4th Grade	514	509	N
		Quebec	4th Grade	524	515	Y
		British Columbia	8th Grade	512	507	Y
		Ontario	8th Grade	522	513	Y
		Quebec	8th Grade	529	527	N
PCAP	2007	Canada	13-year-olds	501	501	N
PISA	2006	Canada	15-year-olds	534	520	Y
TIMSS	2003	Ontario	4th Grade	517	505	Y
		Quebec	4th Grade	509	502	Y
		Ontario	8th Grade	522	520	N
		Quebec	8th Grade	546	540	Y
PISA	2003	Canada	15-year-olds	541	530	Y
SAIP III	2001	Canada	13-year-olds	64.2	64.8	N
		Canada	16-year-olds	78.4	78.0	N
PISA	2000	Canada	15-year-olds	539	529	Y
TIMSS	1999	Canada	8th Grade	533	529	N
SAIP II	1997	Canada	13-year-olds	59.7	59.5	N
		Canada	16-year-olds	79.2	78.7	N
TIMSS	1995	Canada	8th Grade	520	522	N

PCAP: Pan-Canadian Assessment Program (CMEC), PISA: Programme for International Student Assessment (OCDE), SAIP: School Achievement Indicators Program (CMEC), TIMSS: Trends in International Mathematics and Science Study (IEA).

Table 2.2
Various Science Test Results by Gender

Subject/Test	Year	Location	Grade/Age	Average Score Boys	Average Score Girls	Statistically Significantly Different
TIMSS	2007	British Columbia	4th Grade	536	538	N
		Alberta	4th Grade	545	540	N
		Ontario	4th Grade	539	532	N
		Quebec	4th Grade	518	516	N
		British Columbia	8th Grade	529	523	Y
		Ontario	8th Grade	531	521	Y
		Quebec	8th Grade	511	503	N
PCAP	2007	Canada	13-year-olds	500	502	N
PISA	2006	Canada	15-year-olds	536	532	N
SAIP III	2004	Canada	13-year-olds	71.7	70.4	Y
		Canada	16-year-olds	86.1	87.3	Y
TIMSS	2003	Ontario	4th Grade	543	537	N
		Quebec	4th Grade	500	501	N
		Ontario	8th Grade	540	526	Y
		Quebec	8th Grade	540	522	Y
PISA	2003	Canada	15-year-olds	527	516	Y
PISA	2000	Canada	15-year-olds	529	531	N
TIMSS	1999	Canada	8th Grade	540	526	Y
SAIP II	1996	Canada	13-year-olds	70.9	73.3	Y
		Canada	16-year-olds	88.4	87.5	N
TIMSS	1995	Canada	8th Grade	521	508	Y

PCAP: Pan-Canadian Assessment Program (CMEC), PISA: Programme for International Student Assessment (OCDE), SAIP: School Achievement Indicators Program (CMEC), TIMSS: Trends in International Mathematics and Science Study (IEA).

In a detailed analysis of the PISA 2006 science results, in Canada no gender differences were observed on the combined science scale. Across all countries participating in PISA 2006, ten countries showed an advantage of boys over girls while thirteen countries showed an advantage of girls over boys. In Canada, although overall there were no gender differences on the combined science scale or on the subscale of using scientific evidence, there were substantial gender differences on the other two science sub-scales as summarized in Table 2.3. In Canada, boys out performed girls in the sub-domain of 'explaining phenomena scientifically'. Canadian boys outperformed girls by 17 score points while across all OECD countries boys outperformed girls by 15 score points. In contrast, in Canada, girls outperformed boys in the sub-domain 'identifying scientific issues'. The magnitude of this difference was 14 points for Canada overall, 17 points across all OECD countries.

Table 2.3
Summary of Gender Difference in Performance by Selected Characteristics

	Science					
	Combined Scale	**Using Scientific Evidence**	**Explaining Phenomena Scientifically**	**Identifying Scientific Issues**	**Reading**	**Mathematics**
Canada	○	○	■	✹	✹	■
Newfoundland and Labrador	✹	✹	○	✹	✹	○
Prince Edward Island	○	○	■	✹	✹	○
Nova Scotia	○	○	■	✹	✹	■
New Brunswick	○	○	■	✹	✹	○
Quebec	○	○	■	✹	✹	■
Ontario	○	○	■	✹	✹	■
Manitoba	○	○	■	✹	✹	■
Saskatchewan	○	✹	○	✹	✹	○
Alberta	○	○	■	✹	✹	■
British Columbia	○	○	■	✹	✹	■

Note: ■ = boys scored significally higher on the index.
✹ = girls scored significantly higher on the index.
○ = no significant difference.

Source: Measuring up: Canadian Results of the OECD PISA Study - The Performance of Canada's Youth in Science, Reading and Mathematics - 2006 First Results for Canadians Aged 15.

"The performance patterns on these two sub-scales suggest that boys and girls have very different levels of performance in different areas of science. It appears that boys demonstrate better performance at mastering scientific knowledge whereas girls demonstrate better performance at seeing the larger picture that enables them to identify scientific questions that arise from a given situation." [1]

From the 2003 PISA testing of 15-year-olds, "students' mathematics confidence, their perceived abilities in mathematics, and their beliefs in the value of mathematics for future work and education may have an important impact on their course selections, educational pathways and career choices. Differences exist between the mathematics engagement of Canadian boys and girls. For example, after controlling for mathematics performance, girls reported lower levels of confidence in their ability to solve specific mathematical problems, lower levels of their perceived ability to learn mathematics and higher levels of anxiety in dealing with mathematics. Girls were also less likely to believe that mathematics will be useful for their future employment and education and were more likely to report lower levels of interest and enjoyment in mathematics."[2]

The reasons for the gender gap are not fully understood, but self-perception appears to be a factor reported in the vast majority of countries participating in international math and science testing of children. In the last year of high school, a greater proportion of boys consistently report that they perceive themselves as doing well in mathematics and science, and that skills can be acquired through work. In comparison, the majority of girls tend to believe that success in math and science is a question of natural abilities. Furthermore, girls consistently dislike math, physics and chemistry more than boys, and have a greater affinity to life and earth sciences. A lack of female role models in science and engineering is commonly cited as a major reason contributing to attitudes and performance of high school girls in math and science. Data from the TIMSS program also suggest that girls are more influenced in their career choices by factors such as the level of parental education and the number of parents in the household.

To better understand the pipeline of students heading into a university education in science or engineering, Table 2.4 highlights the number of grade 12 (or grade 11 for Quebec) students enrolled or writing provincial exams in science and mathematics for selected provinces. For the most part, female students are much more active in biology, about even with men in mathematics and chemistry, and significantly below males in physics (except for Quebec). This gender pattern repeats itself upstream in undergraduate enrolment for the biological sciences and physics, but the high numbers of females at the high school level in chemistry and mathematics does not translate into similar representation at the undergraduate level. Overall, it would appear that the potential supply of females for undergraduate enrolment in the sciences and engineering is similar to their male counterparts. The transition from high school to university for females would warrant further investigation to understand their selection process surrounding science and engineering fields.

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1 Measuring up: Canadian Results of the OECD PISA Study - The Performance of Canada's Youth in Mathematics, Reading, Science and Problem Solving - 2006 First Findings for Canadians Aged 15, p. 37

2 Measuring up: Canadian Results of the OECD PISA Study - The Performance of Canada's Youth in Mathematics, Reading, Science and Problem Solving - 2003 First Findings for Canadians Aged 15, p. 37

Table 2.4
Number of Students Enrolled or Writing Grade 12/Grade 11 (Quebec) Exams in Science and Math

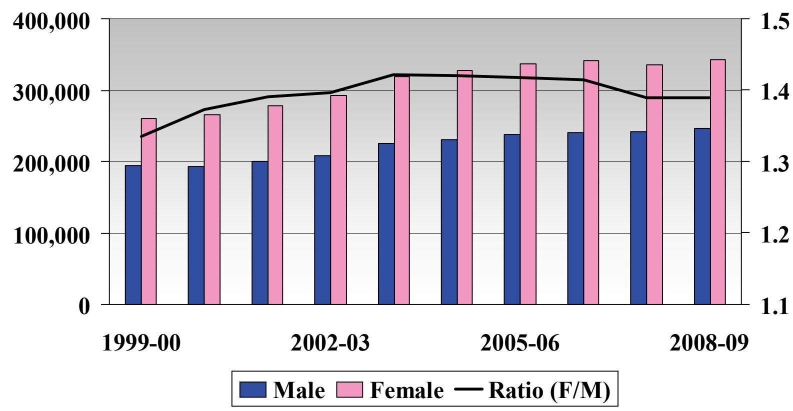
	2004-05		2005-06		2006-07		2007-08		2008-09		2009-10	
Province/ Subject	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
British Columbia												
Mathematics	8,986	8,077	9,098	8,234	8,105	7,368	6,717	6,014	3,515	2,980	n.a.	n.a.
Biology	5,863	10,453	5,995	10,553	5,136	9,116	3,823	6,592	1,855	2,900	n.a.	n.a.
Chemistry	6,221	6,148	6,337	6,109	5,556	5,154	4,355	3,957	2,061	1,770	n.a.	n.a.
Physics	5,082	2,186	5,403	2,290	4,715	1,958	3,692	1,553	1,925	719	n.a.	n.a.
Alberta												
Mathematics	n.a.	n.a.	11,848	12,471	10,743	11,527	10,990	11,517	10,907	11,622	10,741	11,456
Biology	n.a.	n.a.	7,925	13,390	7,729	13,026	7,880	13,187	7,657	13,026	7,921	13,167
Chemistry	n.a.	n.a.	8,826	9,814	8,085	9,213	8,556	9,503	8,307	9,531	8,236	9,375
Physics	n.a.	n.a.	7,030	4,288	6,594	4,108	6,873	4,187	6,583	3,926	6,309	3,923
Saskatchewan												
Mathematics	13,174	14,328	12,956	14,357	12,510	13,900	11,791	13,158	11,426	12,736	11,245	12,407
Biology	4,237	6,177	4,116	6,207	3,872	5,917	3,699	5,713	3,828	5,635	3,604	5,572
Chemistry	3,019	3,894	2,921	3,824	2,791	3,662	2,621	3,632	2,538	3,460	2,548	3,667
Physics	2,888	2,460	2,886	2,496	2,808	2,430	2,625	2,296	2,512	2,185	2,550	2,118
Ontario												
Mathematics	n.a.	n.a.	86,845	66,665	88,258	67,034	97,458	77,306	n.a.	n.a.	n.a.	n.a.
Biology	n.a.	n.a.	12,475	21,066	13,293	21,636	13,402	22,000	n.a.	n.a.	n.a.	n.a.
Chemistry	n.a.	n.a.	22,828	24,372	23,650	25,278	23,957	25,729	n.a.	n.a.	n.a.	n.a.
Physics	n.a.	n.a.	19,829	8,948	20,567	9,180	21,149	8,991	n.a.	n.a.	n.a.	n.a.
Quebec												
Mathematics	25,440	29,128	25,864	29,927	28,421	32,542	28,426	32,322	29,519	32,914	n.a.	n.a.
Biology	4,225	6,727	4,877	7,535	5,083	7,656	4,849	7,748	n.a.	n.a.	n.a.	n.a.
Chemistry	9,278	10,667	9,804	11,441	10,351	12,166	10,205	12,313	10,629	12,621	n.a.	n.a.
Physics	10,077	10,088	10,416	10,697	10,909	11,510	10,724	11,576	11,185	11,766	n.a.	n.a.
Nova Scotia												
Mathematics	6,799	6,993	6,679	6,661	n.a.	n.a.	6,260	6,157	n.a.	n.a.	n.a.	n.a.
Biology	2,167	3,547	2,108	3,314	n.a.	n.a.	1,787	3,182	n.a.	n.a.	n.a.	n.a.
Chemistry	1,587	2,135	1,539	2,047	n.a.	n.a.	1,432	2,029	n.a.	n.a.	n.a.	n.a.
Physics	1,361	949	1,235	815	n.a.	n.a.	1,149	708	n.a.	n.a.	n.a.	n.a.

Source: Provincial Ministries of Education.

2.2 University Enrolments and Degrees

The number of women (346,000) enrolled in Canadian universities at the bachelor's level is nearly 40% greater than males (246,000). Over the past decade, (see Figure 2.2), females have maintained this lead over male students. Therefore, the lack of women in the university system can not explain their under-representation in the natural sciences and engineering (NSE).

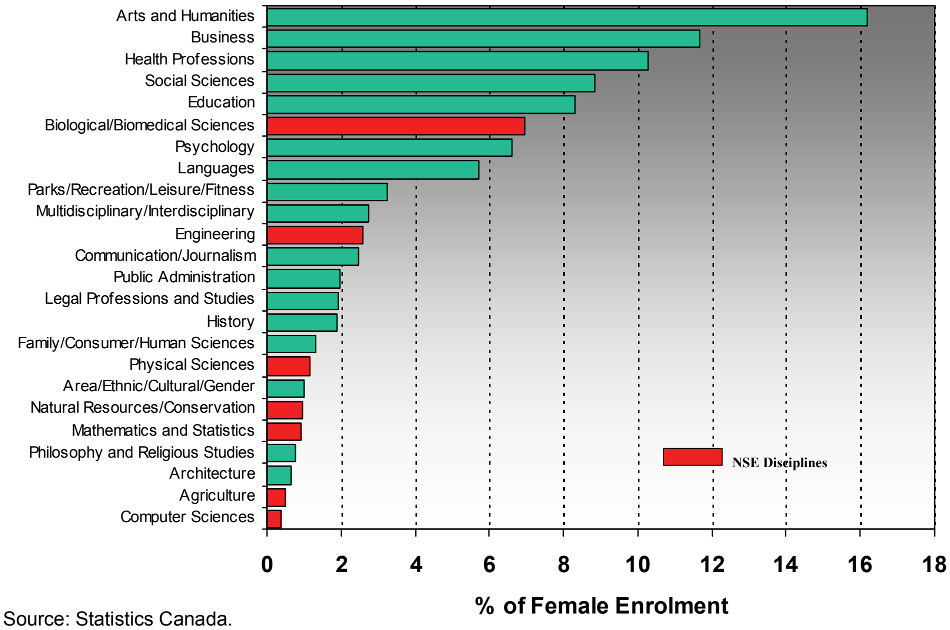
Figure 2.2
Full-time Bachelor's Enrolment



Source: Statistics Canada.

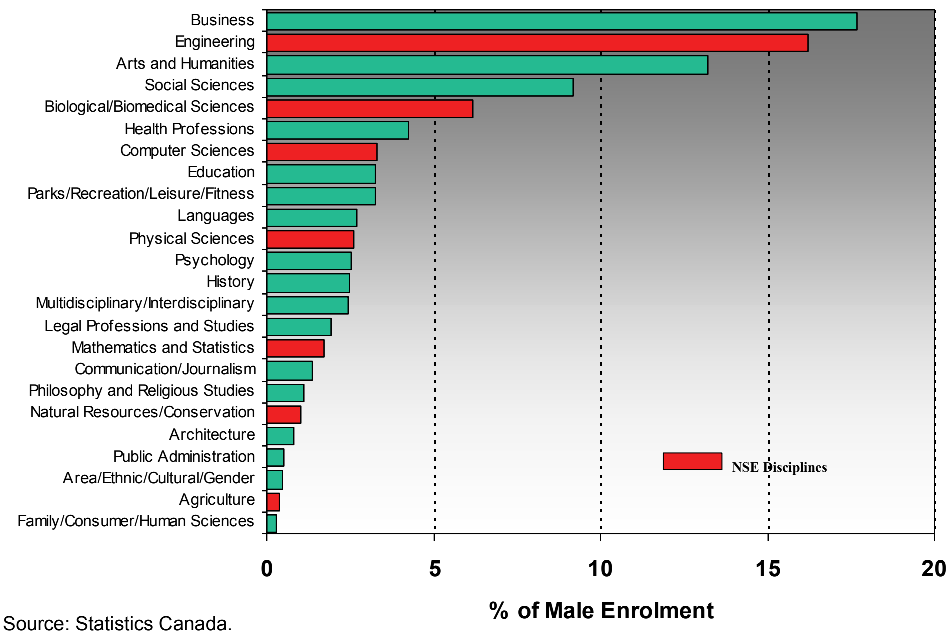
Females make different discipline choices as compared to males when entering university. Figures 2.3 and 2.4 present the bachelor's level enrolment distribution patterns for females and males, respectively. The NSE disciplines rank near the bottom as a discipline choice for women as compared to men. Figure 2.5 highlights the ratio of females to males for 2008-09 bachelor's enrolment. While women outnumber men in most non-NSE disciplines, the ratio drops off dramatically for the major NSE disciplines and is only above 1.0 for the life science disciplines.

Figure 2.3
Full-time Female Bachelor's Enrolment by Discipline, 2008-09



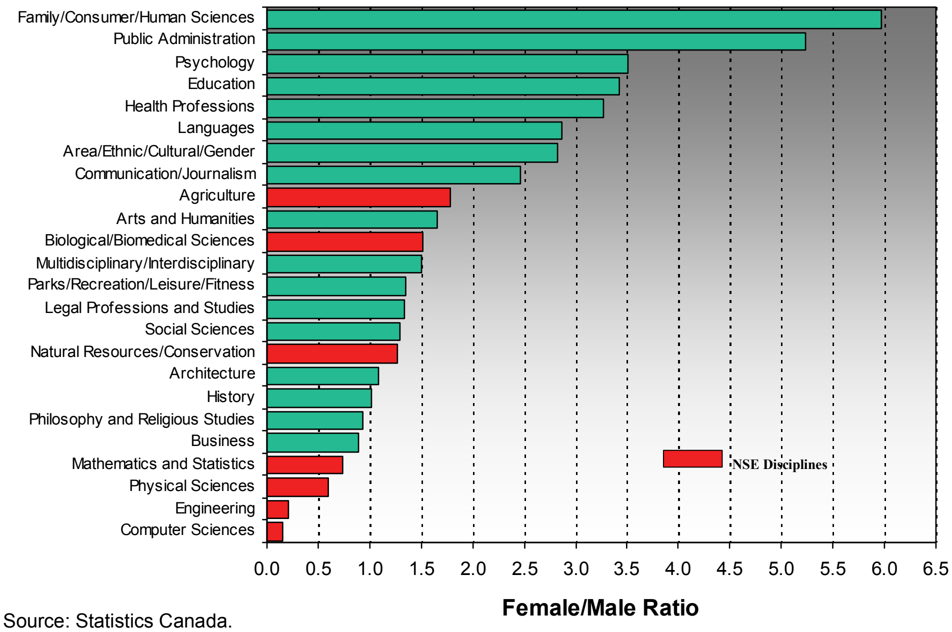
Source: Statistics Canada.

Figure 2.4
Full-time Male Bachelor's Enrolment by Discipline, 2008-09



Source: Statistics Canada.

Figure 2.5
Full-time Bachelor's Enrolment by Discipline – Female/Male Ratio, 2008-09

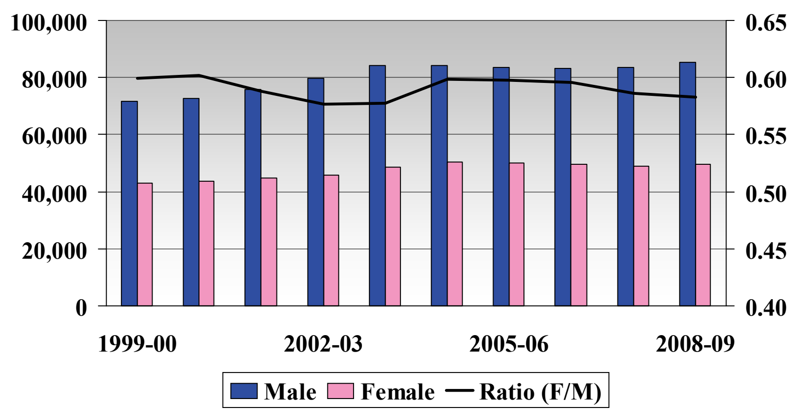


Source: Statistics Canada.

The number of males and females enrolled in full-time studies in the natural sciences and engineering (NSE) has grown in absolute numbers in the past decade as shown in Figure 2.6, although it has been relatively stable over the past six years. The ratio of women to men in the NSE at the bachelor's level has been relatively stable at approximately 0.6 over the past decade. Women make up approximately 37% of Canada's undergraduate students in science and engineering in 2008-09. A closer examination of bachelor's enrolment trends for Canadian citizens and permanent residents (see Table 2.5) reveals that a declining percentage of students going on to university are selecting NSE fields for both sexes (see Figure 2.7). Whether this trend is due to student selection and/or capacity limits at universities for NSE fields (judged by the high entrance requirements for many NSE disciplines), this is still to be determined. The emergence of the knowledge economy has not translated into a growing market share of NSE undergraduate students in Canada.

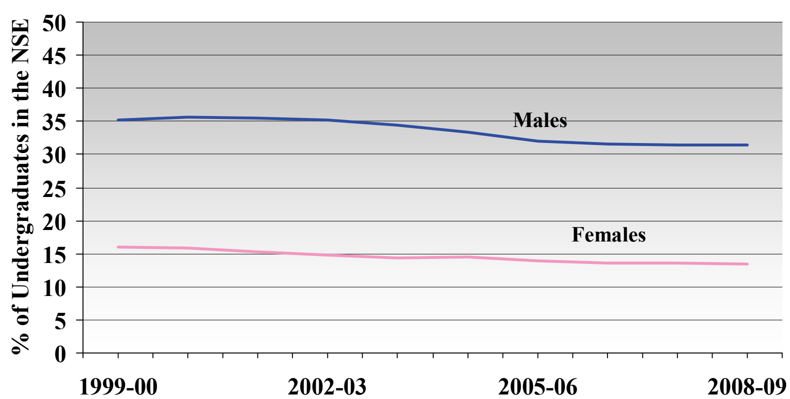
Enrolments by gender at the master's and doctoral levels are presented in Figures 2.8 and 2.9, and Tables 2.6 and Table 2.7, respectively. The ratio of women-to-men at the master's level is approximately 0.64, slightly higher than at the bachelor's level. Unfortunately, the ratio drops-off significantly at the doctoral level at roughly 0.48. The good news is that female master's enrolment in the NSE has increased by 55%, and doctoral NSE enrolment by 102% over the past decade. As at all degree levels, the under representation of female NSE students is most severe in engineering and computer sciences (see Figure 2.10).

Figure 2.6
Full-time Bachelor's Enrolment in the Natural Sciences and Engineering



Source: Statistics Canada.

Figure 2.7
Percentage of Undergraduates Who Choose to Study the Natural Sciences or Engineering by Gender (Canadian and Permanent Residents)



Source: Statistics Canada. Full-time enrolment at bachelor's level.

Table 2.5
Bachelor's Enrolment (Full-Time) in the Natural Sciences and Engineering[1] 1999-00 - 2008-09

Canadian and Permanent Residents:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	194,340	259,509	453,849	14,778	23,430	38,208	61.3	45,444	12,312	57,756	21.3	8,037	5,742	13,779	41.7	68,259	41,484	109,743	37.8
2000-01	193,428	265,563	458,991	14,274	23,820	38,094	62.5	46,980	12,816	59,796	21.4	7,722	5,493	13,215	41.6	68,976	42,129	111,105	37.9
2001-02	199,794	277,866	477,660	13,695	23,550	37,245	63.2	49,380	13,290	62,670	21.2	7,926	5,571	13,497	41.3	71,001	42,411	113,412	37.4
2002-03	209,085	292,098	501,183	13,905	24,369	38,274	63.7	51,414	13,059	64,473	20.3	8,397	5,940	14,337	41.4	73,716	43,368	117,084	37.0
2003-04	224,709	319,437	544,146	15,516	26,634	42,150	63.2	52,380	12,408	64,788	19.2	9,555	6,669	16,224	41.1	77,451	45,711	123,162	37.1
2004-05	230,436	327,162	557,598	17,304	29,100	46,404	62.7	49,983	11,091	61,074	18.2	9,777	7,059	16,836	41.9	77,064	47,250	124,314	38.0
2005-06	237,549	336,576	574,125	18,132	29,826	47,958	62.2	48,069	9,867	57,936	17.0	9,858	6,978	16,836	41.4	76,059	46,671	122,730	38.0
2006-07	240,936	340,785	581,721	18,858	29,919	48,777	61.3	46,890	9,444	56,334	16.8	10,209	6,966	17,175	40.6	75,957	46,329	122,286	37.9
2007-08	241,812	335,925	577,737	18,990	29,115	48,105	60.5	46,587	9,504	56,091	16.9	10,359	6,837	17,196	39.8	75,936	45,456	121,392	37.4
2008-09	246,456	342,288	588,744	19,716	29,754	49,470	60.1	47,013	9,567	56,580	16.9	10,581	6,840	17,421	39.3	77,310	46,161	123,471	37.4
Avg. Growth 99-08	2.7%	3.1%	2.9%	3.3%	2.7%	2.9%	-	0.4%	-2.8%	-0.2%	-	3.1%	2.0%	2.6%	-	1.4%	1.2%	1.3%	-

Foreign:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	8,034	7,476	15,510	354	537	891	60.3	2,667	681	3,348	20.3	321	231	552	41.8	3,342	1,449	4,791	30.2
2000-01	8,964	8,481	17,445	384	618	1,002	61.7	3,195	894	4,089	21.9	345	234	579	40.4	3,924	1,746	5,670	30.8
2001-02	10,872	10,467	21,339	495	762	1,257	60.6	4,017	1,155	5,172	22.3	468	330	798	41.4	4,980	2,247	7,227	31.1
2002-03	12,846	12,075	24,921	549	855	1,404	60.9	4,689	1,248	5,937	21.0	642	450	1,092	41.2	5,880	2,553	8,433	30.3
2003-04	15,675	14,922	30,597	705	1,059	1,764	60.0	5,328	1,287	6,615	19.5	891	684	1,575	43.4	6,924	3,030	9,954	30.4
2004-05	17,607	16,437	34,044	810	1,215	2,025	60.0	5,442	1,239	6,681	18.5	1,047	792	1,839	43.1	7,299	3,246	10,545	30.8
2005-06	19,371	17,871	37,242	915	1,317	2,232	59.0	5,379	1,062	6,441	16.5	1,176	876	2,052	42.7	7,470	3,255	10,725	30.3
2006-07	19,401	17,850	37,251	906	1,302	2,208	59.0	5,091	1,026	6,117	16.8	1,224	897	2,121	42.3	7,221	3,225	10,446	30.9
2007-08	19,878	18,333	38,211	903	1,389	2,292	60.6	5,352	1,137	6,489	17.5	1,248	906	2,154	42.1	7,503	3,432	10,935	31.4
2008-09	20,862	18,984	39,846	936	1,374	2,310	59.5	5,676	1,155	6,831	16.9	1,299	978	2,277	43.0	7,911	3,507	11,418	30.7
Avg. Growth 99-08	11.2%	10.9%	11.1%	11.4%	11.0%	11.2%	-	8.8%	6.0%	8.2%	-	16.8%	17.4%	17.1%	-	10.0%	10.3%	10.1%	-

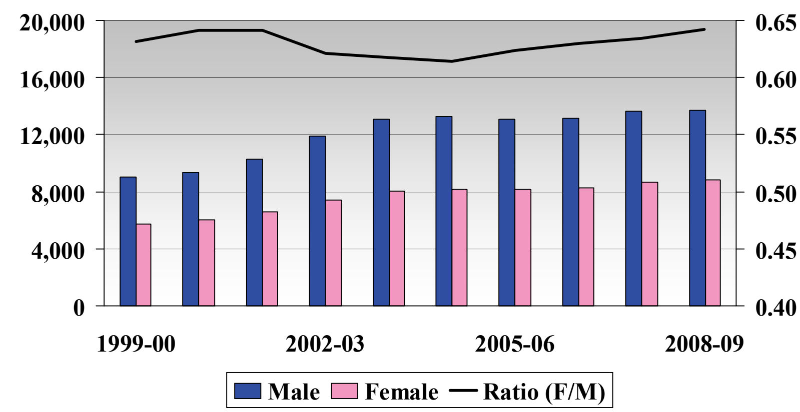
Total:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	202,374	266,985	469,359	15,132	23,967	39,099	61.3	48,111	12,993	61,104	21.3	8,358	5,973	14,331	41.7	71,601	42,933	114,534	37.5
2000-01	202,392	274,044	476,436	14,658	24,438	39,096	62.5	50,175	13,710	63,885	21.5	8,067	5,727	13,794	41.5	72,900	43,875	116,775	37.6
2001-02	210,666	288,333	498,999	14,190	24,312	38,502	63.1	53,397	14,445	67,842	21.3	8,394	5,901	14,295	41.3	75,981	44,658	120,639	37.0
2002-03	221,931	304,173	526,104	14,454	25,224	39,678	63.6	56,103	14,307	70,410	20.3	9,039	6,390	15,429	41.4	79,596	45,921	125,517	36.6
2003-04	240,384	334,359	574,743	16,221	27,693	43,914	63.1	57,708	13,695	71,403	19.2	10,446	7,353	17,799	41.3	84,375	48,741	133,116	36.6
2004-05	248,043	343,599	591,642	18,114	30,315	48,429	62.6	55,425	12,330	67,755	18.2	10,824	7,851	18,675	42.0	84,363	50,496	134,859	37.4
2005-06	256,920	354,447	611,367	19,047	31,143	50,190	62.1	53,448	10,929	64,377	17.0	11,034	7,854	18,888	41.6	83,529	49,926	133,455	37.4
2006-07	260,337	358,635	618,972	19,764	31,221	50,985	61.2	51,981	10,470	62,451	16.8	11,433	7,863	19,296	40.7	83,178	49,554	132,732	37.3
2007-08	261,690	354,258	615,948	19,893	30,504	50,397	60.5	51,939	10,641	62,580	17.0	11,607	7,743	19,350	40.0	83,439	48,888	132,327	36.9
2008-09	267,318	361,272	628,590	20,652	31,128	51,780	60.1	52,689	10,722	63,411	16.9	11,880	7,818	19,698	39.7	85,221	49,668	134,889	36.8
Avg. Growth 99-08	3.1%	3.4%	3.3%	3.5%	2.9%	3.2%	-	1.0%	-2.1%	0.4%	-	4.0%	3.0%	3.6%	-	2.0%	1.6%	1.8%	-

1. Only includes data for major fields reported by Statistics Canada. Other NSE fields supported by NSERC are not reported. Numbers do not add up due to rounding.

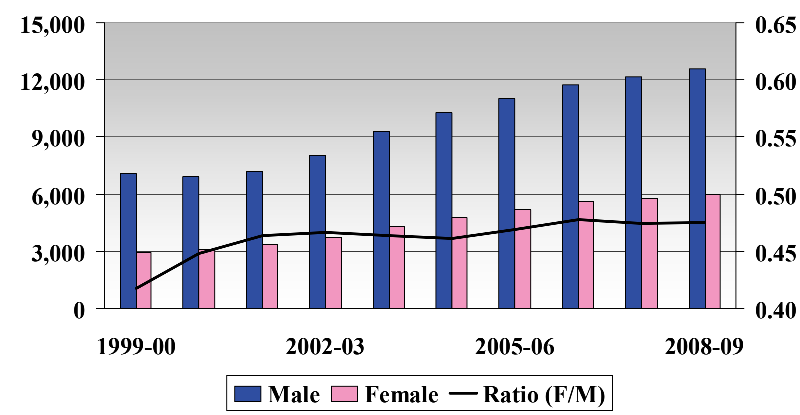
Source: Statistics Canada

Figure 2.8
Full-time Master's Enrolment in the Natural Sciences and Engineering



Source: Statistics Canada.

Figure 2.9
Full-time Doctoral Enrolment in the Natural Sciences and Engineering



Source: Statistics Canada.

Table 2.6

Master's Enrolment (Full-Time) in the Natural Sciences and Engineering[1] 1999-00 - 2008-09

Canadian and Permanent Residents:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	19,152	21,765	40,917	2,403	2,919	5,322	54.8	3,720	1,284	5,004	25.7	1,332	792	2,124	37.3	7,455	4,995	12,450	40.1
2000-01	19,158	21,759	40,917	2,394	2,988	5,382	55.5	3,921	1,356	5,277	25.7	1,290	825	2,115	39.0	7,605	5,169	12,774	40.5
2001-02	20,061	22,863	42,924	2,370	3,219	5,589	57.6	4,539	1,560	6,099	25.6	1,338	852	2,190	38.9	8,247	5,631	13,878	40.6
2002-03	22,119	24,765	46,884	2,490	3,435	5,925	58.0	5,586	1,893	7,479	25.3	1,404	906	2,310	39.2	9,480	6,234	15,714	39.7
2003-04	23,739	26,415	50,154	2,625	3,693	6,318	58.5	6,138	1,965	8,103	24.3	1,518	1,020	2,538	40.2	10,281	6,678	16,959	39.4
2004-05	24,291	28,332	52,623	2,679	3,873	6,552	59.1	5,964	1,821	7,785	23.4	1,632	1,035	2,667	38.8	10,275	6,729	17,004	39.6
2005-06	24,108	29,097	53,205	2,643	3,960	6,603	60.0	5,640	1,680	7,320	23.0	1,677	1,023	2,700	37.9	9,960	6,663	16,623	40.1
2006-07	24,738	30,570	55,308	2,799	4,074	6,873	59.3	5,373	1,569	6,942	22.6	1,701	1,059	2,760	38.4	9,873	6,702	16,575	40.4
2007-08	25,941	33,423	59,364	2,964	4,293	7,257	59.2	5,478	1,578	7,056	22.4	1,797	1,095	2,892	37.9	10,239	6,966	17,205	40.5
2008-09	26,448	34,962	61,410	2,988	4,383	7,371	59.5	5,406	1,560	6,966	22.4	2,078	1,110	3,188	34.8	10,472	7,053	17,525	40.2
Avg. Growth 99-08	3.7%	5.4%	4.6%	2.5%	4.6%	3.7% -		4.2%	2.2%	3.7% -		5.1%	3.8%	4.6% -		3.8%	3.9%	3.9% -	

Foreign:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	3,462	2,508	5,970	297	270	567	47.6	990	264	1,254	21.1	288	177	465	38.1	1,575	711	2,286	31.1
2000-01	3,756	2,706	6,462	318	312	630	49.5	1,128	330	1,458	22.6	297	180	477	37.7	1,743	822	2,565	32.0
2001-02	4,158	2,976	7,134	381	363	744	48.8	1,347	417	1,764	23.6	333	195	528	36.9	2,061	975	3,036	32.1
2002-03	4,737	3,477	8,214	387	417	804	51.9	1,653	507	2,160	23.5	384	240	624	38.5	2,424	1,164	3,588	32.4
2003-04	5,529	4,080	9,609	414	456	870	52.4	1,905	624	2,529	24.7	462	306	768	39.8	2,781	1,386	4,167	33.3
2004-05	6,216	4,380	10,596	477	507	984	51.5	2,019	597	2,616	22.8	489	315	804	39.2	2,985	1,419	4,404	32.2
2005-06	6,567	4,617	11,184	510	534	1,044	51.1	2,178	672	2,850	23.6	450	300	750	40.0	3,138	1,506	4,644	32.4
2006-07	6,561	4,734	11,295	498	525	1,023	51.3	2,298	735	3,033	24.2	471	318	789	40.3	3,267	1,578	4,845	32.6
2007-08	6,591	4,749	11,340	498	561	1,059	53.0	2,361	765	3,126	24.5	522	351	873	40.2	3,381	1,677	5,058	33.2
2008-09	6,867	4,878	11,745	507	621	1,128	55.1	2,541	777	3,318	23.4	217	372	589	63.2	3,265	1,770	5,035	35.2
Avg. Growth 99-08	7.9%	7.7%	7.8%	6.1%	9.7%	7.9%	-	11.0%	12.7%	11.4%	-	-3.1%	8.6%	2.7%	-	8.4%	10.7%	9.2%	-

Total:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	22,614	24,273	46,887	2,700	3,189	5,889	54.2	4,710	1,548	6,258	24.7	1,620	969	2,589	37.4	9,030	5,706	14,736	38.7
2000-01	22,914	24,465	47,379	2,712	3,300	6,012	54.9	5,049	1,686	6,735	25.0	1,587	1,005	2,592	38.8	9,348	5,991	15,339	39.1
2001-02	24,219	25,839	50,058	2,751	3,582	6,333	56.6	5,886	1,977	7,863	25.1	1,671	1,047	2,718	38.5	10,308	6,606	16,914	39.1
2002-03	26,856	28,242	55,098	2,877	3,852	6,729	57.2	7,239	2,400	9,639	24.9	1,788	1,146	2,934	39.1	11,904	7,398	19,302	38.3
2003-04	29,268	30,495	59,763	3,039	4,149	7,188	57.7	8,043	2,589	10,632	24.4	1,980	1,326	3,306	40.1	13,062	8,064	21,126	38.2
2004-05	30,507	32,712	63,219	3,156	4,380	7,536	58.1	7,983	2,418	10,401	23.2	2,121	1,350	3,471	38.9	13,260	8,148	21,408	38.1
2005-06	30,675	33,714	64,389	3,153	4,494	7,647	58.8	7,818	2,352	10,170	23.1	2,127	1,323	3,450	38.3	13,098	8,169	21,267	38.4
2006-07	31,299	35,304	66,603	3,297	4,599	7,896	58.2	7,671	2,304	9,975	23.1	2,172	1,377	3,549	38.8	13,140	8,280	21,420	38.7
2007-08	32,532	38,172	70,704	3,462	4,854	8,316	58.4	7,839	2,343	10,182	23.0	2,319	1,446	3,765	38.4	13,620	8,643	22,263	38.8
2008-09	33,315	39,840	73,155	3,495	5,004	8,499	58.9	7,947	2,337	10,284	22.7	2,295	1,482	3,777	39.2	13,737	8,823	22,560	39.1
Avg. Growth 99-08	4.4%	5.7%	5.1%	2.9%	5.1%	4.2%	-	6.0%	4.7%	5.7%	-	3.9%	4.8%	4.3%	-	4.8%	5.0%	4.8%	-

1. Only includes data for major fields reported by Statistics Canada. Other NSE fields supported by NSERC are not reported. Numbers do not add up due to rounding.

Source: Statistics Canada

Table 2.7
Doctoral Enrolment (Full-Time) in the Natural Sciences and Engineering[1] 1999-00 - 2008-09

Canadian and Permanent Residents:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	10,356	8,976	19,332	1,944	1,446	3,390	42.7	1,959	399	2,358	16.9	1,449	525	1,974	26.6	5,352	2,370	7,722	30.7
2000-01	10,140	9,162	19,302	1,944	1,569	3,513	44.7	1,896	402	2,298	17.5	1,413	528	1,941	27.2	5,253	2,499	7,752	32.2
2001-02	10,290	9,573	19,863	1,986	1,662	3,648	45.6	2,019	462	2,481	18.6	1,386	552	1,938	28.5	5,391	2,676	8,067	33.2
2002-03	10,902	10,155	21,057	2,055	1,767	3,822	46.2	2,334	585	2,919	20.0	1,410	588	1,998	29.4	5,799	2,940	8,739	33.6
2003-04	11,907	11,211	23,118	2,103	1,911	4,014	47.6	2,793	723	3,516	20.6	1,548	672	2,220	30.3	6,444	3,306	9,750	33.9
2004-05	12,918	12,210	25,128	2,229	2,067	4,296	48.1	3,222	834	4,056	20.6	1,626	711	2,337	30.4	7,077	3,612	10,689	33.8
2005-06	13,698	12,990	26,688	2,352	2,256	4,608	49.0	3,576	918	4,494	20.4	1,668	753	2,421	31.1	7,596	3,927	11,523	34.1
2006-07	14,853	14,145	28,998	2,496	2,484	4,980	49.9	3,963	1,023	4,986	20.5	1,839	816	2,655	30.7	8,298	4,323	12,621	34.3
2007-08	15,522	14,937	30,459	2,490	2,496	4,986	50.1	4,038	1,062	5,100	20.8	1,977	822	2,799	29.4	8,505	4,380	12,885	34.0
2008-09	15,933	15,687	31,620	2,550	2,535	5,085	49.9	4,110	1,047	5,157	20.3	2,061	885	2,946	30.0	8,721	4,467	13,188	33.9
Avg. Growth 99-08	4.9%	6.4%	5.6%	3.1%	6.4%	4.6%	-	8.6%	11.3%	9.1%	-	4.0%	6.0%	4.5%	-	5.6%	7.3%	6.1%	-

Foreign:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	2,799	1,545	4,344	471	261	732	35.7	756	156	912	17.1	507	171	678	25.2	1,734	588	2,322	25.3
2000-01	2,820	1,596	4,416	414	267	681	39.2	780	162	942	17.2	492	183	675	27.1	1,686	612	2,298	26.6
2001-02	2,982	1,701	4,683	426	297	723	41.1	873	180	1,053	17.1	513	186	699	26.6	1,812	663	2,475	26.8
2002-03	3,486	1,941	5,427	453	345	798	43.2	1,158	219	1,377	15.9	594	228	822	27.7	2,205	792	2,997	26.4
2003-04	4,314	2,328	6,642	531	405	936	43.3	1,569	303	1,872	16.2	753	294	1,047	28.1	2,853	1,002	3,855	26.0
2004-05	4,740	2,547	7,287	603	423	1,026	41.2	1,767	366	2,133	17.2	855	348	1,203	28.9	3,225	1,137	4,362	26.1
2005-06	5,016	2,679	7,695	654	471	1,125	41.9	1,857	408	2,265	18.0	930	372	1,302	28.6	3,441	1,251	4,692	26.7
2006-07	4,950	2,739	7,689	669	483	1,152	41.9	1,857	408	2,265	18.0	924	402	1,326	30.3	3,450	1,293	4,743	27.3
2007-08	5,238	2,880	8,118	687	525	1,212	43.3	2,052	459	2,511	18.3	942	417	1,359	30.7	3,681	1,401	5,082	27.6
2008-09	5,505	3,108	8,613	708	570	1,278	44.6	2,253	531	2,784	19.1	927	423	1,350	31.3	3,888	1,524	5,412	28.2
Avg. Growth 99-08	7.8%	8.1%	7.9%	4.6%	9.1%	6.4%	-	12.9%	14.6%	13.2%	-	6.9%	10.6%	8.0%	-	9.4%	11.2%	9.9%	-

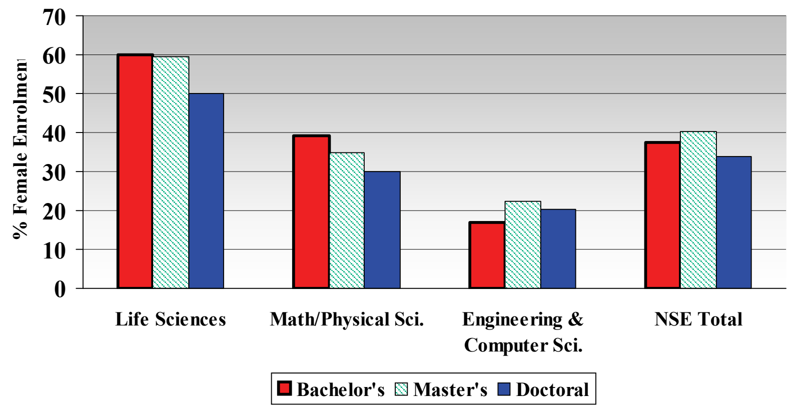
Total:

Academic	ALL FIELDS			Life Sci.			%	Eng. and Computer Sci.			%	Math. and Physical Sci.			%	NSE TOTAL			%
Year	Male	Female	Total	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female	Male	Female	Total	Female
1999-00	13,155	10,521	23,676	2,415	1,707	4,122	41.4	2,715	555	3,270	17.0	1,956	696	2,652	26.2	7,086	2,958	10,044	29.5
2000-01	12,960	10,758	23,718	2,358	1,836	4,194	43.8	2,676	564	3,240	17.4	1,905	711	2,616	27.2	6,939	3,111	10,050	31.0
2001-02	13,272	11,274	24,546	2,412	1,959	4,371	44.8	2,892	642	3,534	18.2	1,899	738	2,637	28.0	7,203	3,339	10,542	31.7
2002-03	14,388	12,096	26,484	2,508	2,112	4,620	45.7	3,492	804	4,296	18.7	2,004	816	2,820	28.9	8,004	3,732	11,736	31.8
2003-04	16,221	13,539	29,760	2,634	2,316	4,950	46.8	4,362	1,026	5,388	19.0	2,301	966	3,267	29.6	9,297	4,308	13,605	31.7
2004-05	17,658	14,757	32,415	2,832	2,490	5,322	46.8	4,989	1,200	6,189	19.4	2,481	1,059	3,540	29.9	10,302	4,749	15,051	31.6
2005-06	18,714	15,669	34,383	3,006	2,727	5,733	47.6	5,433	1,326	6,759	19.6	2,598	1,125	3,723	30.2	11,037	5,178	16,215	31.9
2006-07	19,803	16,884	36,687	3,165	2,967	6,132	48.4	5,820	1,431	7,251	19.7	2,763	1,218	3,981	30.6	11,748	5,616	17,364	32.3
2007-08	20,760	17,817	38,577	3,177	3,021	6,198	48.7	6,090	1,521	7,611	20.0	2,919	1,239	4,158	29.8	12,186	5,781	17,967	32.2
2008-09	21,438	18,795	40,233	3,258	3,105	6,363	48.8	6,363	1,578	7,941	19.9	2,988	1,308	4,296	30.4	12,609	5,991	18,600	32.2
Avg. Growth 99-08	5.6%	6.7%	6.1%	3.4%	6.9%	4.9%	-	9.9%	12.3%	10.4%	-	4.8%	7.3%	5.5%	-	6.6%	8.2%	7.1%	-

1. Only includes data for major fields reported by Statistics Canada. Other NSE fields supported by NSERC are not reported. Numbers do not add up due to rounding.

Source: Statistics Canada

Figure 2.10
Female Enrolment[1] in the Natural Sciences and Engineering as a % of Total NSE Enrolment by Degree Level and Discipline, 2008-09
(Canadian and Permanent Residents)

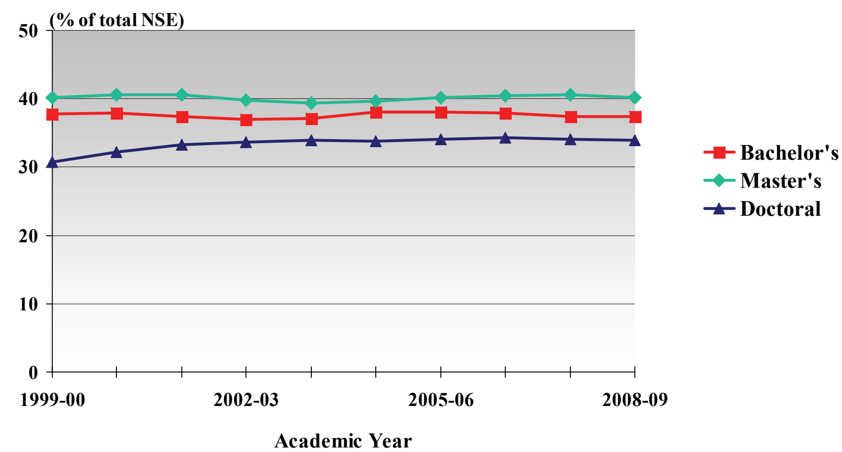


1. Full-Time.
Source: Statistics Canada.

Figure 2.11 indicates that over the past ten years the share of Canadian and permanent resident female students at the bachelor's level has fallen slightly, remained stable at the master's level, and increased modestly at the doctoral level. While the shares have remained flat, the good news is that the absolute numbers of Canadian and permanent resident females enrolled in the NSE at all degree levels have increased (see Tables 2.5, 2.6 and 2.7). At the bachelor's level enrolment for Canadians and permanent residents, the overall gender gap for the NSE is a shortage of 31,000 women. While there is no shortage of women enrolling in universities, with women holding a 58% share of undergraduate enrolment for all fields, the percentage of women choosing NSE fields is far below that of men (as shown in Figure 2.7). Gender equality in the NSE at the bachelor's level could be achieved if 10% of female undergraduates could be convinced to switch into an NSE field.

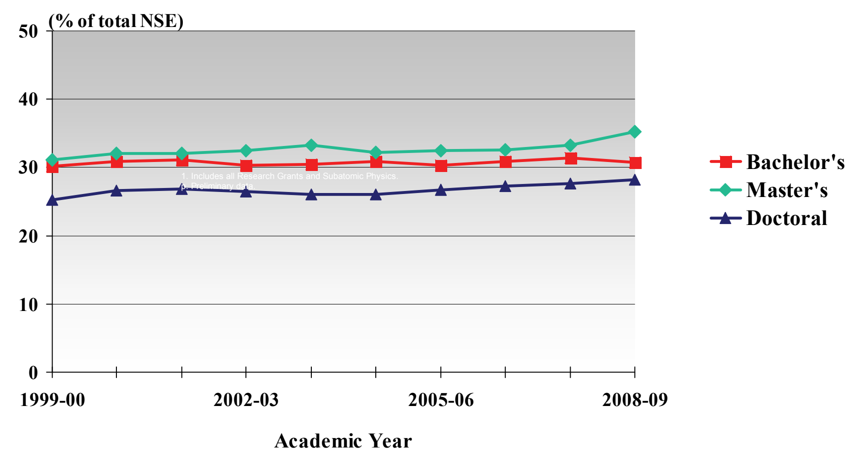
Foreign student enrolment at the master's and doctoral levels is an important component of enrolment in the NSE. As shown in Tables 2.6 and 2.7, and Figure 2.12, the percentage of foreign students in the NSE who are female is lower than that observed for Canadians and permanent residents. After a period of stagnation in the early part of the decade, foreign student numbers in the NSE for both sexes have been climbing, and for both sexes, reaching new records.

Figure 2.11
Female Enrolment[1] in the Natural Sciences and Engineering as a % of Total NSE Enrolment by Degree Level
(Canadian and Permanent Residents)



1. Full-Time.
Source: Statistics Canada.

Figure 2.12
Female Enrolment[1] in the Natural Sciences and Engineering as a % of Total NSE Enrolment by Degree Level
(Foreign Students)

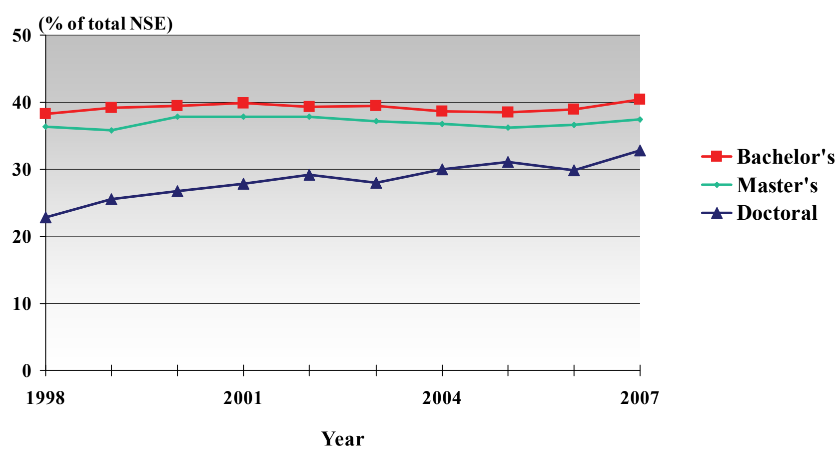


1. Full-Time.
Source: Statistics Canada.

Table 2.8 presents the number of degrees awarded in the NSE (unfortunately a breakdown between Canadian and permanent residents and foreign recipients is not available) for both sexes, while Figure 2.13 presents the percentage of NSE degrees awarded to women. The share of degrees awarded in the NSE to females has remained flat at the bachelor's and master's levels, but has increased significantly at the doctoral level from 22.9% in 1998 to 32.8% in 2007. The most important feature of Figure 2.13 is the decline in the share of degrees awarded in the NSE to females at higher degree levels. The drop-off from the bachelor's to master's level is fairly small, but increases significantly moving to the doctoral level. The declining representation of women in the NSE at higher degree levels has often been expressed as the "leaky pipeline." Figure 2.14 presents the percentage of degrees awarded to females in 2007 by major NSE field. A similar drop-off occurs at the doctoral level for all major NSE fields. This leaky pipeline will ultimately affect the number of women with careers in research, as discussed in Section 3.3.

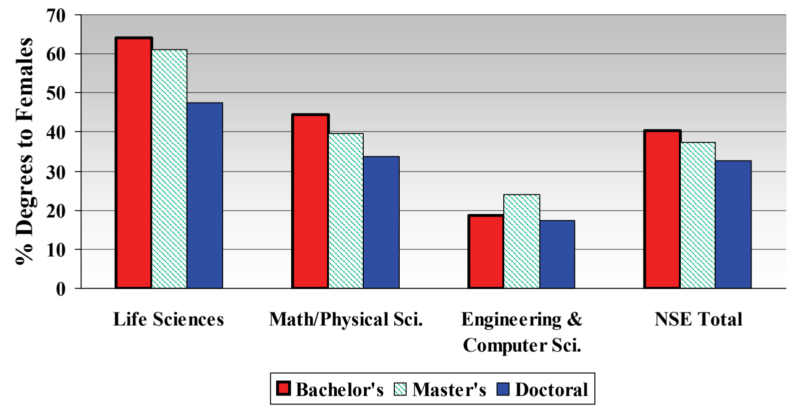
From the Statistics Canada *Earned Doctoral* survey, the time to completion (for those students receiving a doctoral degree) at the master's and doctoral levels by gender is presented in Figures 2.15 and 2.16, respectively. The times to completion at both levels are very similar for both females and males.

Figure 2.13
Degrees Granted to Females in the Natural Sciences and Engineering as a % of Total Granted in the NSE by Degree Level



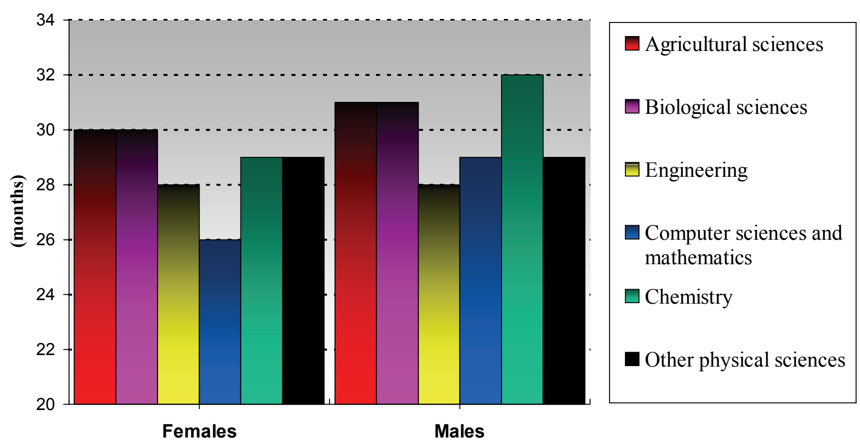
Source: Statistics Canada.

Figure 2.14
Degrees Granted to Females in the Natural Sciences and Engineering as a % of Total Granted in the NSE by Degree Level and Discipline, 2007



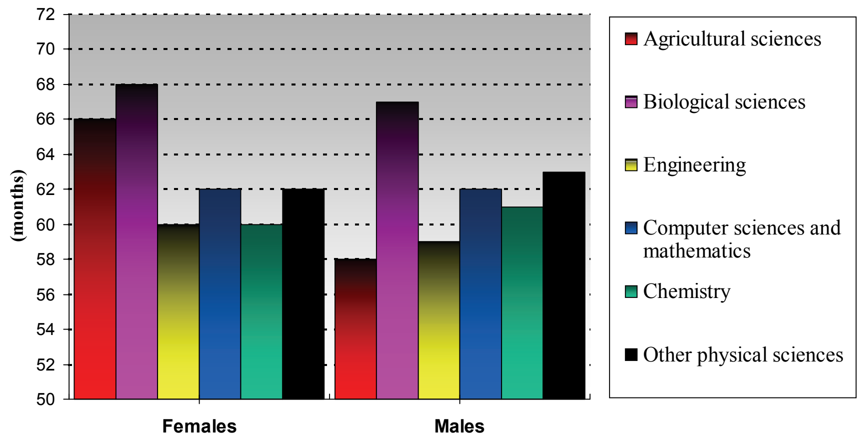
Source: Statistics Canada.

Figure 2.15
Average Time to Completion at the Master's Level by Field of Study



Source: Statistics Canada.

Figure 2.16
Average Time to Completion at the Doctoral Level by Field of Study



Source: Statistics Canada.

Table 2.8

Degrees[1] Granted in the Natural Sciences and Engineering[2] 1998 - 2007

Bachelor's and First Professional Degree:

	ALL FIELDS			Life Sci.				Eng. and Computer Sci.				Math. and Physical Sci.				NSE TOTAL			
Year	Male	Female	Total	Male	Female	Total	% Female	Male	Female	Total	% Female	Male	Female	Total	% Female	Male	Female	Total	% Female
1998	51,270	73,593	124,863	4,515	6,084	10,599	57.4	9,129	2,292	11,421	20.1	2,433	1,602	4,035	39.7	16,077	9,978	26,055	38.3
1999	51,363	75,072	126,435	4,473	6,483	10,956	59.2	9,537	2,361	11,898	19.8	2,238	1,635	3,873	42.2	16,248	10,479	26,727	39.2
2000	52,056	76,512	128,568	4,497	6,501	10,998	59.1	10,398	3,018	13,416	22.5	2,199	1,605	3,804	42.2	17,094	11,124	28,218	39.4
2001	51,390	77,850	129,240	4,113	6,648	10,761	61.8	11,022	3,069	14,091	21.8	2,025	1,611	3,636	44.3	17,160	11,328	28,488	39.8
2002	52,251	81,783	134,034	3,846	6,414	10,260	62.5	11,700	3,405	15,105	22.5	2,013	1,548	3,561	43.5	17,559	11,367	28,926	39.3
2003	54,789	86,103	140,892	3,717	6,681	10,398	64.3	12,576	3,714	16,290	22.8	2,085	1,614	3,699	43.6	18,378	12,009	30,387	39.5
2004	57,522	91,029	148,551	3,885	6,735	10,620	63.4	12,990	3,645	16,635	21.9	2,202	1,605	3,807	42.2	19,077	11,985	31,062	38.6
2005	58,590	93,285	151,875	3,771	6,630	10,401	63.7	12,288	3,120	15,408	20.2	2,292	1,719	4,011	42.9	18,351	11,469	29,820	38.5
2006	61,581	99,426	161,007	4,116	7,299	11,415	63.9	12,459	2,853	15,312	18.6	2,388	1,911	4,299	44.5	18,963	12,063	31,026	38.9
2007	66,669	108,696	175,365	4,779	8,535	13,314	64.1	12,465	2,850	15,315	18.6	2,457	1,968	4,425	44.5	19,701	13,353	33,054	40.4
Avg. Growth																			
98-07	3.0%	4.4%	3.8%	0.6%	3.8%	2.6%	-	3.5%	2.5%	3.3%	-	0.1%	2.3%	1.0%	-	2.3%	3.3%	2.7%	-

Master's:

	ALL FIELDS			Life Sci.				Eng. and Computer Sci.				Math. and Physical Sci.				NSE TOTAL			
Year	Male	Female	Total	Male	Female	Total	% Female	Male	Female	Total	% Female	Male	Female	Total	% Female	Male	Female	Total	% Female
1998	10,512	11,514	22,026	762	885	1,647	53.7	1,857	570	2,427	23.5	564	360	924	39.0	3,183	1,815	4,998	36.3
1999	11,217	12,054	23,271	834	987	1,821	54.2	1,941	573	2,514	22.8	594	315	909	34.7	3,369	1,875	5,244	35.8
2000	11,391	12,837	24,228	885	1,029	1,914	53.8	1,893	663	2,556	25.9	588	360	948	38.0	3,366	2,052	5,418	37.9
2001	11,877	13,023	24,900	921	1,104	2,025	54.5	2,088	717	2,805	25.6	570	363	933	38.9	3,579	2,184	5,763	37.9
2002	12,489	13,836	26,325	855	1,191	2,046	58.2	2,412	771	3,183	24.2	603	396	999	39.6	3,870	2,358	6,228	37.9
2003	13,887	15,108	28,995	918	1,272	2,190	58.1	2,925	978	3,903	25.1	675	423	1,098	38.5	4,518	2,673	7,191	37.2
2004	15,681	16,737	32,418	927	1,329	2,256	58.9	3,522	1,209	4,731	25.6	711	459	1,170	39.2	5,160	2,997	8,157	36.7
2005	15,921	17,061	32,982	972	1,365	2,337	58.4	3,708	1,194	4,902	24.4	693	486	1,179	41.2	5,373	3,045	8,418	36.2
2006	16,032	18,042	34,074	969	1,467	2,436	60.2	3,609	1,101	4,710	23.4	795	531	1,326	40.0	5,373	3,099	8,472	36.6
2007	16,035	18,750	34,785	945	1,479	2,424	61.0	3,405	1,077	4,482	24.0	786	516	1,302	39.6	5,136	3,072	8,208	37.4
Avg. Growth																			
98-07	4.8%	5.6%	5.2%	2.4%	5.9%	4.4%	-	7.0%	7.3%	7.1%	-	3.8%	4.1%	3.9%	-	5.5%	6.0%	5.7%	-

Doctoral:

	ALL FIELDS			Life Sci.				Eng. and Computer Sci.				Math. and Physical Sci.				NSE TOTAL			
Year	Male	Female	Total	Male	Female	Total	% Female	Male	Female	Total	% Female	Male	Female	Total	% Female	Male	Female	Total	% Female
1998	2,541	1,437	3,978	471	252	723	34.9	636	81	717	11.3	480	138	618	22.3	1,587	471	2,058	22.9
1999	2,409	1,557	3,966	438	282	720	39.2	534	84	618	13.6	408	108	516	20.9	1,380	474	1,854	25.6
2000	2,277	1,584	3,861	456	297	753	39.4	546	93	639	14.6	372	114	486	23.5	1,374	504	1,878	26.8
2001	2,124	1,584	3,708	450	279	729	38.3	447	75	522	14.4	372	135	507	26.6	1,269	489	1,758	27.8
2002	2,127	1,605	3,732	456	306	762	40.2	492	102	594	17.2	354	129	483	26.7	1,302	537	1,839	29.2
2003	2,247	1,617	3,864	462	330	792	41.7	519	96	615	15.6	375	102	477	21.4	1,356	528	1,884	28.0
2004	2,334	1,827	4,161	483	357	840	42.5	594	114	708	16.1	381	153	534	28.7	1,458	624	2,082	30.0
2005	2,352	1,848	4,200	441	369	810	45.6	621	120	741	16.2	342	144	486	29.6	1,404	633	2,037	31.1
2006	2,520	1,932	4,452	432	378	810	46.7	711	132	843	15.7	399	144	543	26.5	1,542	654	2,196	29.8
2007	2,676	2,151	4,827	522	474	996	47.6	819	171	990	17.3	387	198	585	33.8	1,728	843	2,571	32.8
Avg. Growth																			
98-07	0.6%	4.6%	2.2%	1.1%	7.3%	3.6%	-	2.8%	8.7%	3.6%	-	-2.4%	4.1%	-0.6%	-	1.0%	6.7%	2.5%	-

1. Degrees granted to full-time and part-time students. Numbers do not add up due to rounding.

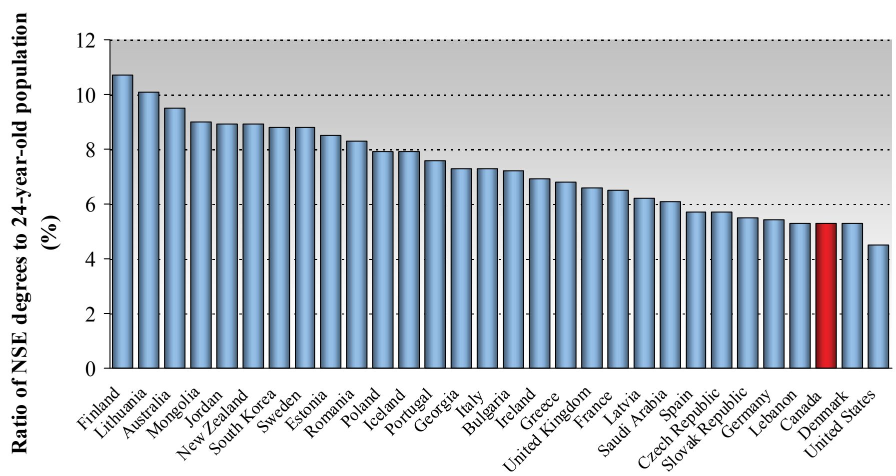
2. Only includes data for major fields reported by Statistics Canada. Other NSE fields supported by NSERC are reported under "ALL FIELDS."

Source: Statistics Canada

2.3 International Comparisons

The lower number of women studying in the NSE and obtaining degrees in the NSE is not a phenomenon unique to Canada. Virtually all countries in the world, to varying levels, have fewer women than men studying in the NSE. Figure 2.17 and Table 2.9 presents the number of first university degrees awarded in the NSE as a percentage of the 24-year-old population for selected countries by gender. As the table indicates, Canada ranks poorly with respect to both sexes in NSE degree output, with production especially poor on the male side. However, the number of females obtaining their first degree in the NSE for all countries is relatively low.

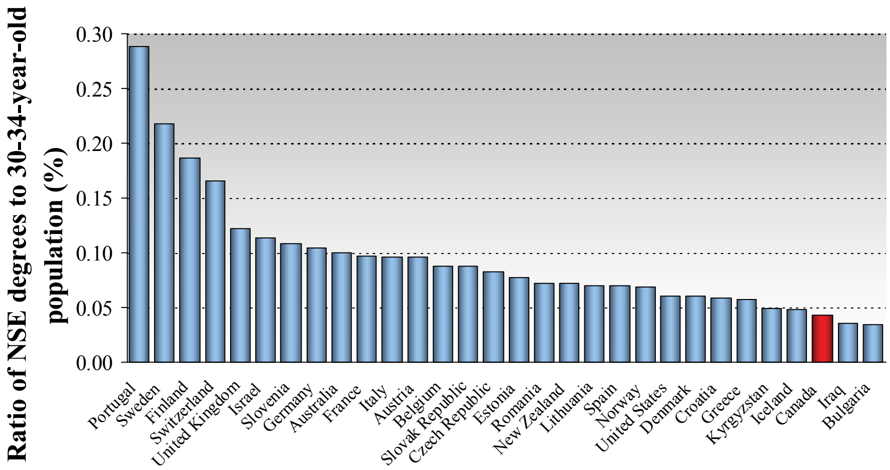
Figure 2.17
Ratio of Natural Science and Engineering First Degrees to 24-year-old Female Population, 2006



Source: U.S. National Science Foundation.

A similar comparison for doctoral degree attainment by gender is presented in Figure 2.18 and Table 2.10. Once again, female Ph.D. production is considerably lower than for males for all countries. Canada's performance is equally dismal for both sexes, lagging far behind the leading countries in NSE Ph.D. production.

Figure 2.18
Ratio of Natural Science and Engineering Doctoral Degrees to 30-34 year-old Female Population, 2006



Source: U.S. National Science Foundation.

Table 2.9
First University Degree in the NSE and Ratio to 24-Year-Old Population, by Sex and Country: 2006 or Most Recent Year

Rank	Country	First Degrees All fields	First Degrees NSE	% NSE	No. of 24-year-olds	NSE as % 24-year-olds	Country	First Degrees All fields	First Degrees NSE	% NSE	No. of 24-year-olds	NSE as % 24-year-olds
			Females						**Males**			
1	Finland	24,072	3,525	14.6	32,826	10.7	Finland	13,876	8,317	59.9	34,312	24.2
2	Lithuania	19,854	2,407	12.1	23,796	10.1	South Korea	137,827	70,042	50.8	383,588	18.3
3	Australia	101,548	13,069	12.9	137,545	9.5	Lithuania	9,990	4,404	44.1	24,560	17.9
4	Mongolia	14,367	2,301	16.0	25,612	9.0	Australia	70,034	24,557	35.1	141,502	17.4
5	Jordan	20,118	4,776	23.7	53,465	8.9	Sweden	16,678	8,128	48.7	53,870	15.1
6	New Zealand	19,443	2,419	12.4	27,119	8.9	New Zealand	12,294	4,035	32.8	27,659	14.6
7	South Korea	132,719	32,138	24.2	365,821	8.8	Jordan	18,610	8,090	43.5	58,011	13.9
8	Sweden	30,812	4,525	14.7	51,643	8.8	Japana	318,812	108,914	34.2	807,972	13.5
9	Estonia	5,058	829	16.4	9,711	8.5	France	128,194	52,498	41.0	391,856	13.4
10	Romania	95,377	13,513	14.2	163,708	8.3	United Kingdom	138,170	49,190	35.6	380,929	12.9
11	Poland	183,626	25,755	14.0	325,526	7.9	Poland	109,419	42,743	39.1	334,942	12.8
12	Iceland	1,928	167	8.7	2,120	7.9	Netherlands	41,893	12,247	29.2	96,342	12.7
13	Portugal	33,839	5,759	17.0	75,335	7.6	Georgia	13,573	4,184	30.8	32,985	12.7
14	Georgia	14,556	2,506	17.2	34,272	7.3	Czech Republic	19,977	9,812	49.1	77,956	12.6
15	Italy	158,922	24,295	15.3	334,476	7.3	Ireland	10,672	4,493	42.1	36,047	12.5
16	Bulgaria	24,459	3,883	15.9	54,226	7.2	Italy	114,529	42,855	37.4	347,729	12.3
17	Ireland	15,193	2,432	16.0	35,115	6.9	Iceland	866	264	30.5	2,183	12.1
18	Greece	25,521	5,222	20.5	76,398	6.8	Romania	65,163	20,486	31.4	171,087	12.0
19	United Kingdom	181,090	24,750	13.7	373,955	6.6	Denmark	11,131	3,393	30.5	30,336	11.2
20	France	157,044	24,857	15.8	384,292	6.5	Slovak Republic	12,028	4,846	40.3	47,389	10.2
21	Latvia	16,588	1,008	6.1	16,313	6.2	Germany	115,983	49,585	42.8	485,047	10.2
22	Saudi Arabia	47,753	11,751	24.6	192,741	6.1	Portugal	16,827	7,900	46.9	77,552	10.2
23	Spain	116,205	18,383	15.8	320,799	5.7	Switzerland	12,479	4,541	36.4	44,999	10.1
24	Czech Republic	25,249	4,225	16.7	74,516	5.7	Latvia	6,545	1,694	25.9	16,883	10.0
25	Slovak Republic	18,488	2,492	13.5	45,465	5.5	Norway	9,440	2,667	28.3	27,672	9.6
26	Germany	151,614	25,597	16.9	470,203	5.4	Austria	11,113	5,007	45.1	52,189	9.6
27	Lebanon	13,636	1,982	14.5	37,238	5.3	Spain	75,973	32,068	42.2	336,221	9.5
28	**Canada**	**109,053**	**11,463**	**10.5**	**215,515**	**5.3**	Lebanon	11,060	3,471	31.4	36,693	9.5
29	Denmark	18,918	1,574	8.3	29,788	5.3	Bulgaria	17,017	5,203	30.6	57,250	9.1
30	United States	866,363	92,715	10.7	2,046,583	4.5	Estonia	2,082	882	42.4	10,034	8.8
31	Palestine	9,850	1,264	12.8	28,433	4.4	**Canada**	**67,857**	**19,596**	**28.9**	**223,266**	**8.8**
32	Panama	11,586	1,161	10.0	26,776	4.3	United States	636,559	149,478	23.5	2,133,131	7.0

Source: National Science Foundation, http://www.nsf.gov/statistics/seind10/pdf/at.pdf, and United Nations http://esa.un.org/unpd/wpp2008/all-wpp-indicators_components.htm.

Table 2.10
Doctoral Degrees in the NSE and Ratio to Population, by Sex and Country: 2006 or Most Recent Year

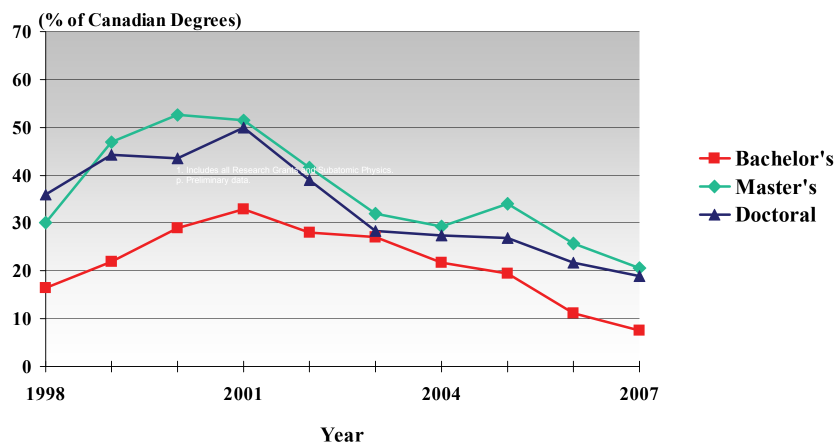
Rank	Country	Ph.D. Degrees All fields	Ph.D. Degrees NSE	% NSE	No. of 30-34-year-olds	NSE as % 30-34-year-olds	Country	Ph.D. Degrees All fields	Ph.D. Degrees NSE	% NSE	No. of 30-34-year-olds	NSE as % 30-34-year-olds
			Females						Males			
1	Portugal	3,213	1,188	37.0	412,352	0.288	Sweden	2,142	1,389	64.8	314,414	0.442
2	Sweden	1,639	664	40.5	304,512	0.218	Switzerland	2,072	1,049	50.6	260,657	0.402
3	Finland	893	280	31.4	149,988	0.187	Finland	1,005	593	59.0	156,929	0.378
4	Switzerland	1,309	438	33.5	263,794	0.166	Portugal	2,129	1,135	53.3	414,620	0.274
5	United Kingdom	7,140	2,560	35.9	2,093,801	0.122	United Kingdom	9,380	5,100	54.4	2,071,816	0.246
6	Israel	617	274	44.4	240,376	0.114	Germany	14,662	6,281	42.8	2,623,346	0.239
7	Slovenia	196	78	39.8	71,840	0.109	Austria	1,262	659	52.2	292,068	0.226
8	Germany	10,284	2,637	25.6	2,539,439	0.104	Australia	2,817	1,432	50.8	756,080	0.189
9	Australia	2,459	765	31.1	763,427	0.100	Czech Republic	1,301	771	59.3	430,802	0.179
10	France	4,067	2,061	50.7	2,129,953	0.097	France	5,751	3,777	65.7	2,135,198	0.177
11	Italy	4,965	2,193	44.2	2,282,990	0.096	Belgium	1,062	586	55.2	359,204	0.163
12	Austria	896	281	31.4	292,767	0.096	Norway	525	257	49.0	170,305	0.151
13	Belgium	656	309	47.1	351,746	0.088	Denmark	513	282	55.0	194,203	0.145
14	Slovak Republic	576	182	31.6	207,586	0.088	Slovenia	199	105	52.8	75,023	0.140
15	Czech Republic	722	339	47.0	412,731	0.082	South Korea	6,281	2,909	46.3	2,092,831	0.139
16	Estonia	82	36	43.9	46,769	0.077	Slovak Republic	642	293	45.6	213,531	0.137
17	Romania	1,487	604	40.6	836,045	0.072	Greece	804	603	75.0	444,881	0.136
18	New Zealand	319	104	32.6	145,547	0.071	Israel	593	325	54.8	245,540	0.132
19	Lithuania	191	85	44.5	121,027	0.070	United States	27,039	13,734	50.8	10,469,750	0.131
20	Spain	3,347	1,250	37.3	1,800,728	0.069	New Zealand	319	166	52.0	133,937	0.124
21	Norway	357	115	32.2	167,319	0.069	Georgia	487	165	33.9	146,599	0.113
22	United States	25,816	6,236	24.2	10,274,196	0.061	**Canada**	**2,352**	**1,254**	**53.3**	**1,121,128**	**0.112**
23	Denmark	397	115	29.0	191,985	0.060	Italy	4,639	2,590	55.8	2,338,136	0.111
24	Croatia	213	86	40.4	147,746	0.058	Iraq	3,434	957	27.9	998,421	0.096
25	Greece	444	237	53.4	417,512	0.057	Spain	3,812	1,627	42.7	1,918,540	0.085
26	Kyrgyzstan	340	95	27.9	194,512	0.049	Romania	1,693	708	41.8	859,789	0.082
27	Iceland	8	5	62.5	10,382	0.048	Morocco	1,768	828	46.8	1,072,313	0.077
28	**Canada**	**1,848**	**474**	**25.6**	**1,101,092**	**0.043**	Netherlands	1,836	426	23.2	581,003	0.073
29	Iraq	1,622	340	21.0	964,910	0.035	Estonia	61	32	52.5	46,446	0.069
30	Bulgaria	255	95	37.3	277,219	0.034	Armenia	255	52	20.4	79,258	0.066

Source: National Science Foundation, http://www.nsf.gov/statistics/seind10/pdf/at.pdf, and United Nations http://esa.un.org/unpd/wpp2008/all-wpp-indicators_components.htm.

2.4 Immigration

One possible solution to increasing the number of women in the NSE in Canada is by importing that talent through immigration. Future skilled labour force growth in Canada will be heavily dependant on immigration. The number of skilled immigrant women coming to Canada with degrees in the NSE peaked in 2001 and has fallen considerably in recent years (see Table 2.11). At the master's and doctoral levels, skilled female immigrants supplement female degree output in Canada by 20% today (see Figure 2.19). However, male skilled immigrants with degrees in the NSE far outnumber that of women, and create and even greater gender gap in this area in the country.

Figure 2.19
Skilled Female Immigrants to Canada with NSE Degrees versus Degrees Granted to Females in Canada in the NSE by Degree Level



Source: Statistics Canada, Citizenship and Immigration Canada.

Table 2.11
Immigration to Canada by Education Level and Occupation, 1980-2009 Skilled Immigrant Classification (Applicant - Female), Professional Occupations in Natural and Applied Sciences[1]

	---------------- Level of Education----------------			
Year	Bachelor's	Master's	Doctorate	Total
1980	67	18	10	95
1981	108	33	13	154
1982	143	38	16	197
1983	39	11	12	62
1984	33	10	12	55
1985	14	9	10	33
1986	33	14	12	59
1987	159	45	14	218
1988	189	47	19	255
1989	123	41	27	191
1990	152	56	32	240
1991	174	63	39	276
1992	268	64	38	370
1993	476	136	58	670
1994	585	259	81	925
1995	848	359	138	1,345
1996	1,225	491	160	1,876
1997	1,459	663	191	2,313
1998	1,638	547	169	2,354
1999	2,303	879	210	3,392
2000	3,214	1,079	219	4,512
2001	3,742	1,122	244	5,108
2002	3,178	982	209	4,369
2003	3,255	856	150	4,261
2004	2,596	881	171	3,648
2005	2,228	1,036	170	3,434
2006	1,338	799	142	2,279
2007	1,010	637	160	1,807
2008	813	688	145	1,646
2009	635	532	114	1,281

1. Excludes architects, urban planners, and land surveyors.
Source: Citizenship & Immigration Canada, RDM, Facts and Figures 2009

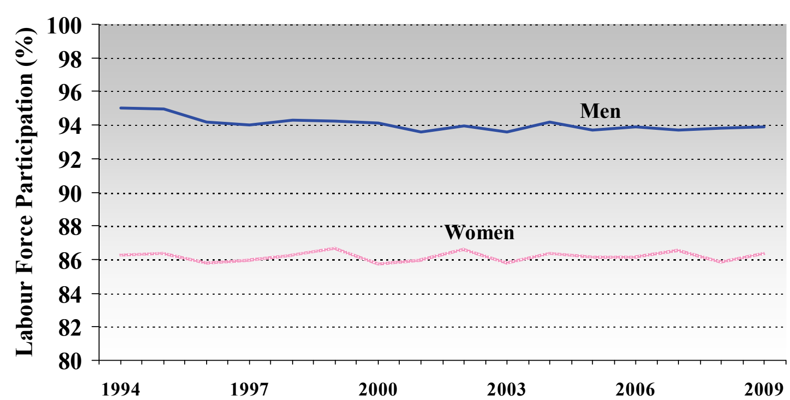
3. Career Outcomes

Perhaps more important than the distribution of female and male university enrolments and degrees is the latter stage careers that graduates eventually attain. Lower female representation at the university level can be compensated by increased discipline-related career outcomes for women. In this section, examples of career outcomes for women and men with degrees in the NSE will be explored.

3.1 Labour Force Participation

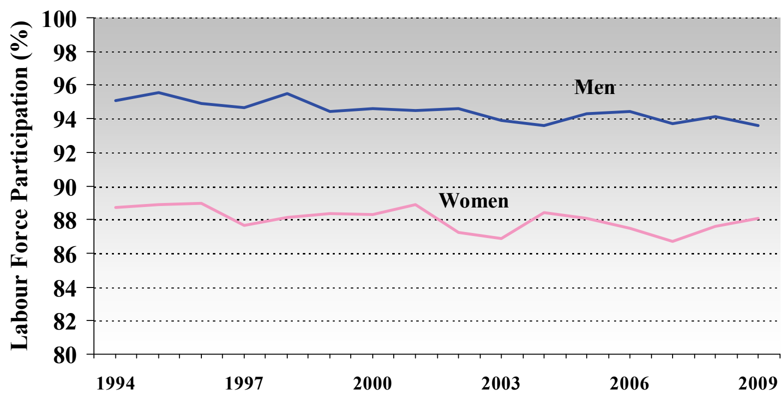
Unfortunately, ongoing labour force surveys by Statistics Canada do not capture detailed degree level and field of study information of the workforce. General labour force participation rates for women and men with a bachelor's degree or higher are presented in Figures 3.1 and 3.2, respectively. As can be seen in the two figures, labour force participation rates of men are consistently higher than that of women. The lower labour force participation rates for women will eventually translate into fewer women in NSE-related occupations. Only 3% of women have an occupation in the natural sciences and engineering versus 10.5% for men, see Figure 3.3. Figure 3.4 presents the number and percentage of women occupying a natural science or engineering related occupation. As of 2009, women represented 22% of the of NSE labour force, up marginally from 19.8% in 1994. This compares to the 40% share of bachelors degrees held by women in the NSE (see Table 2.8). The unemployment rates for women and men in NSE occupations are presented in Figure 3.5. The higher unemployment rates for women observed in the early part of the decade have disappeared in the most recent year.

Figure 3.1
Labour Force Participation Rates by Gender
25-54 Year-Old Population, Bachelor's Degree Holders



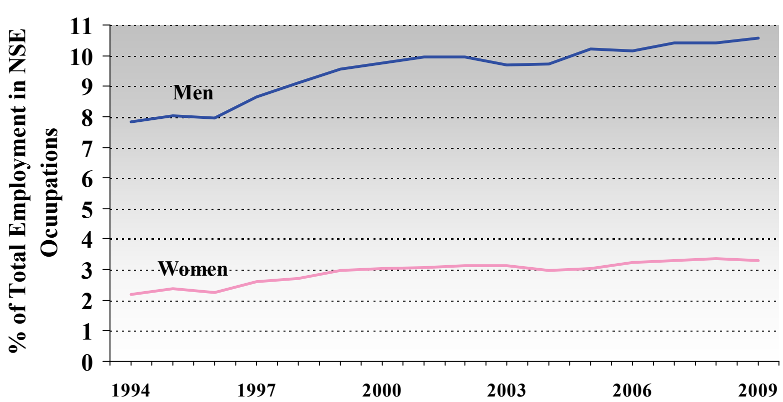
Source: Statistics Canada.

Figure 3.2
Labour Force Participation Rates by Gender
25-54 Year-Old Population, Above Bachelor's Degree Holders



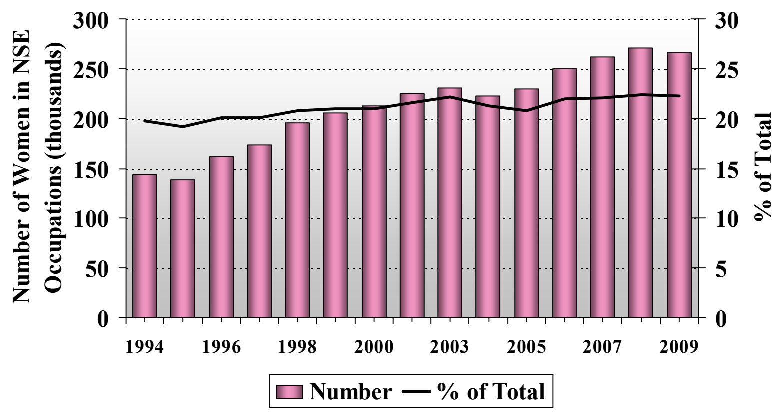
Source: Statistics Canada.

Figure 3.3
Percentage of Total Employed by Gender in Natural Sciences and Related Occupations



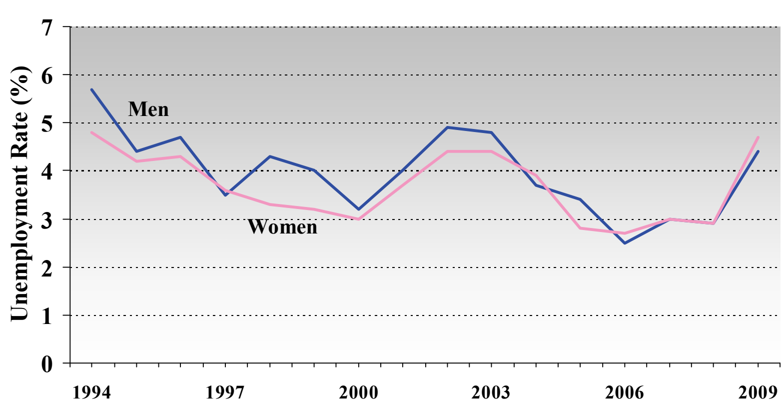
Source: Statistics Canada.

Figure 3.4
Number of Women in Natural Sciences and Related Occupations



Source: Statistics Canada.

Figure 3.5
Unemployment Rate by Gender
Natural Sciences and Related Occupations



Source: Statistics Canada.

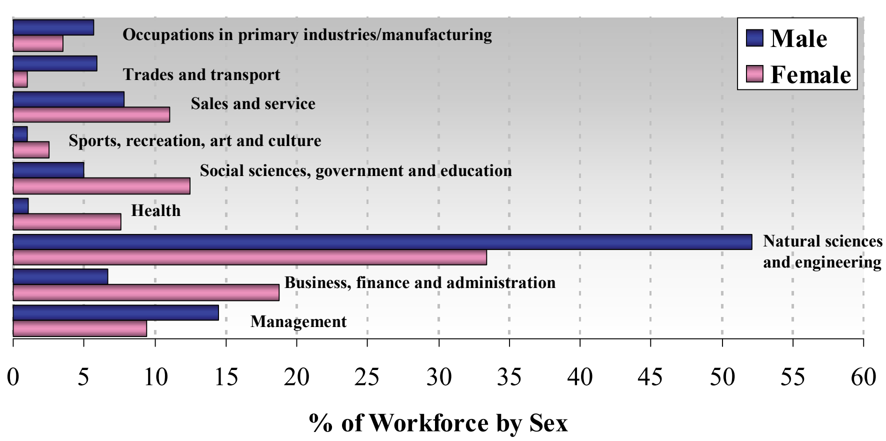
3.2 Occupations of University Graduates in the NSE

A more detailed analysis of the career outcomes of women and men can be undertaken with census data, which do capture university degree level qualifications and field of study information. The latest census was conducted in 2006 and captures data for the year 2005. In addition, a closer examination of a younger cohort, in the 25 to 44 year-old range, would give a better indication of more recent labour force outcomes. Figures 3.6 to 3.7 present the occupation distributions for women and men with bachelor's, master's and doctoral degree qualifications in the NSE, respectively. Tables 3.1 to 3.3 present similar data at an even finer breakdown for the three major NSE fields. Some common trends emerge for both women and men at all degree levels, namely:

- A greater percentage of women, as compared to men, with degrees in the NSE have occupations in the areas of social science, education, and government service,, health and business, finance and administration.
- Men tend to occupy positions more heavily in management, and natural and applied sciences.
- The above trends are also observed within the three major NSE fields of agriculture and biological sciences, math and physical sciences, and engineering and applied sciences.

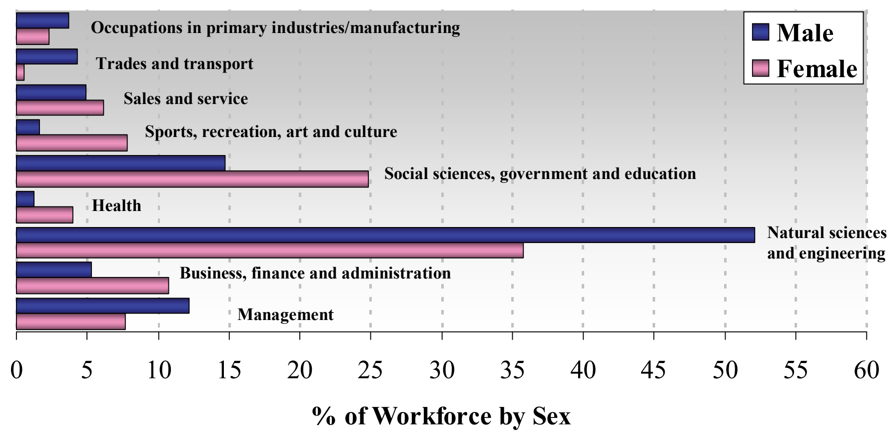
The data would indicate that there exists a higher "leakage rate" out of NSE-related occupations for women as compared to men.

Figure 3.6
Occupations in Canada for 25-44 Year Old Bachelor's Degree Holders in the NSE by Gender, 2005



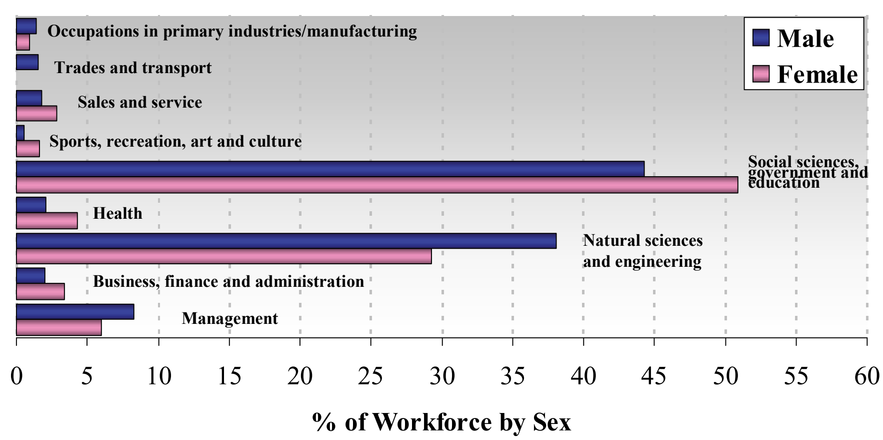
Source: Statistics Canada

Figure 3.7
Occupations in Canada for 25-44 Year Old Master's Degree Holders in the NSE by Gender, 2005



Source: Statistics Canada

Figure 3.8
Occupations in Canada for 25-44 Year Old Doctoral Degree Holders in the NSE by Gender, 2005



Source: Statistics Canada

Table 3.1
Occupations of Bachelor's Graduates (25-44 Years Old) in the NSE, 2005

Occupation	Physical and Life Sci. Female	Physical and Life Sci. Male	Engineering Female	Engineering Male	Math. And Computer Sci. Female	Math. And Computer Sci. Male	NSE Total Female	NSE Total Male
Total - Occupation	**54,760**	**55,935**	**28,665**	**130,010**	**22,430**	**56,945**	**105,855**	**242,890**
Management occupations	4,995	8,705	2,740	19,230	2,245	7,250	9,980	35,185
Business, finance and administration occupations	10,310	5,210	4,480	6,725	5,135	4,350	19,925	16,285
Natural and applied sciences and related occupations	11,795	17,210	13,975	73,315	9,610	36,115	35,380	126,640
Health occupations	7,175	2,050	670	480	250	190	8,095	2,720
Occupations in social science, education, government service and religion	9,075	6,040	1,780	3,500	2,360	2,565	13,215	12,105
Occupations in art, culture, recreation and sport	1,685	1,145	520	820	460	585	2,665	2,550
Sales and service occupations	6,900	7,480	2,865	8,375	1,875	3,130	11,640	18,985
Trades, transport and equipment operators and related occupations	400	3,015	495	9,820	135	1,595	1,030	14,430
Occupations unique to primary industry	910	2,695	70	900	10	130	990	3,725
Occupations unique to processing, manufacturing and utilities	1,425	2,315	1,055	6,850	285	1,050	2,765	10,215
% of Total	Female	Male	Female	Male	Female	Male	Female	Male
Management occupations	9.1	15.6	9.6	14.8	10.0	12.7	9.4	14.5
Business, finance and administration occupations	18.8	9.3	15.6	5.2	22.9	7.6	18.8	6.7
Natural and applied sciences and related occupations	21.5	30.8	48.8	56.4	42.8	63.4	33.4	52.1
Health occupations	13.1	3.7	2.3	0.4	1.1	0.3	7.6	1.1
Occupations in social science, education, government service and religion	16.6	10.8	6.2	2.7	10.5	4.5	12.5	5.0
Occupations in art, culture, recreation and sport	3.1	2.0	1.8	0.6	2.1	1.0	2.5	1.0
Sales and service occupations	12.6	13.4	10.0	6.4	8.4	5.5	11.0	7.8
Trades, transport and equipment operators and related occupations	0.7	5.4	1.7	7.6	0.6	2.8	1.0	5.9
Occupations unique to primary industry	1.7	4.8	0.2	0.7	0.0	0.2	0.9	1.5
Occupations unique to processing, manufacturing and utilities	2.6	4.1	3.7	5.3	1.3	1.8	2.6	4.2

Source: Statistics Canada

Table 3.2
Occupations of Master's Graduates (25-44 Years Old) in the NSE, 2005

Occupation	Physical and Life Sci. Female	Physical and Life Sci. Male	Engineering Female	Engineering Male	Math. And Computer Sci. Female	Math. And Computer Sci. Male	NSE Total Female	NSE Total Male
Total - Occupation	**18,920**	**19,435**	**9,725**	**36,435**	**9,330**	**14,665**	**37,975**	**70,535**
Management occupations	1,275	2,210	865	5,015	800	1,380	2,940	8,605
Business, finance and administration occupations	1,750	1,110	925	1,610	1,370	1,010	4,045	3,730
Natural and applied sciences and related occupations	5,745	7,180	5,155	20,915	2,695	8,665	13,595	36,760
Health occupations	1,345	610	135	180	35	35	1,515	825
Occupations in social science, education, government service and religion	6,545	5,115	1,420	3,600	1,470	1,635	9,435	10,350
Occupations in art, culture, recreation and sport	460	250	185	265	2,310	615	2,955	1,130
Sales and service occupations	1,170	1,220	685	1,605	445	630	2,300	3,455
Trades, transport and equipment operators and related occupations	70	700	90	1,890	20	415	180	3,005
Occupations unique to primary industry	150	300	0	125	10	10	160	435
Occupations unique to processing, manufacturing and utilities	320	720	260	1,215	125	265	705	2,200
% of Total	Female	Male	Female	Male	Female	Male	Female	Male
Management occupations	6.7	11.4	8.9	13.8	8.6	9.4	7.7	12.2
Business, finance and administration occupations	9.2	5.7	9.5	4.4	14.7	6.9	10.7	5.3
Natural and applied sciences and related occupations	30.4	36.9	53.0	57.4	28.9	59.1	35.8	52.1
Health occupations	7.1	3.1	1.4	0.5	0.4	0.2	4.0	1.2
Occupations in social science, education, government service and religion	34.6	26.3	14.6	9.9	15.8	11.1	24.8	14.7
Occupations in art, culture, recreation and sport	2.4	1.3	1.9	0.7	24.8	4.2	7.8	1.6
Sales and service occupations	6.2	6.3	7.0	4.4	4.8	4.3	6.1	4.9
Trades, transport and equipment operators and related occupations	0.4	3.6	0.9	5.2	0.2	2.8	0.5	4.3
Occupations unique to primary industry	0.8	1.5	0.0	0.3	0.1	0.1	0.4	0.6
Occupations unique to processing, manufacturing and utilities	1.7	3.7	2.7	3.3	1.3	1.8	1.9	3.1

Source: Statistics Canada

Table 3.3
Occupations of Doctoral Graduates (25-44 Years Old) in the NSE, 2005

	Physical and Life Sci.		Engineering		Math. And Computer Sci.		NSE Total	
Occupation	Female	Male	Female	Male	Female	Male	Female	Male
Total - Occupation	**6,015**	**11,845**	**1,320**	**7,015**	**560**	**2,310**	**7,895**	**21,170**
Management occupations	355	950	85	655	35	150	475	1,755
Business, finance and administration occupations	155	255	85	115	25	50	265	420
Natural and applied sciences and related occupations	1,710	4,300	450	3,120	155	645	2,315	8,065
Health occupations	315	390	25	20	0	30	340	440
Occupations in social science, education, government service and religion	3,120	5,445	595	2,580	300	1,355	4,015	9,380
Occupations in art, culture, recreation and sport	110	55	10	25	10	20	130	100
Sales and service occupations	155	220	35	135	30	25	220	380
Trades, transport and equipment operators and related occupations	0	115	10	190	0	15	10	320
Occupations unique to primary industry	10	35	10	40	0	15	20	90
Occupations unique to processing, manufacturing and utilities	30	85	20	125	0	0	50	210
% of Total by Sex	Female	Male	Female	Male	Female	Male	Female	Male
Management occupations	5.9	8.0	6.4	9.3	6.3	6.5	6.0	8.3
Business, finance and administration occupations	2.6	2.2	6.4	1.6	4.5	2.2	3.4	2.0
Natural and applied sciences and related occupations	28.4	36.3	34.1	44.5	27.7	27.9	29.3	38.1
Health occupations	5.2	3.3	1.9	0.3	0.0	1.3	4.3	2.1
Occupations in social science, education, government service and religion	51.9	46.0	45.1	36.8	53.6	58.7	50.9	44.3
Occupations in art, culture, recreation and sport	1.8	0.5	0.8	0.4	1.8	0.9	1.6	0.5
Sales and service occupations	2.6	1.9	2.7	1.9	5.4	1.1	2.8	1.8
Trades, transport and equipment operators and related occupations	0.0	1.0	0.8	2.7	0.0	0.6	0.1	1.5
Occupations unique to primary industry	0.2	0.3	0.8	0.6	0.0	0.6	0.3	0.4
Occupations unique to processing, manufacturing and utilities	0.5	0.7	1.5	1.8	0.0	0.0	0.6	1.0

Source: Statistics Canada

3.3 Academic and Research Careers

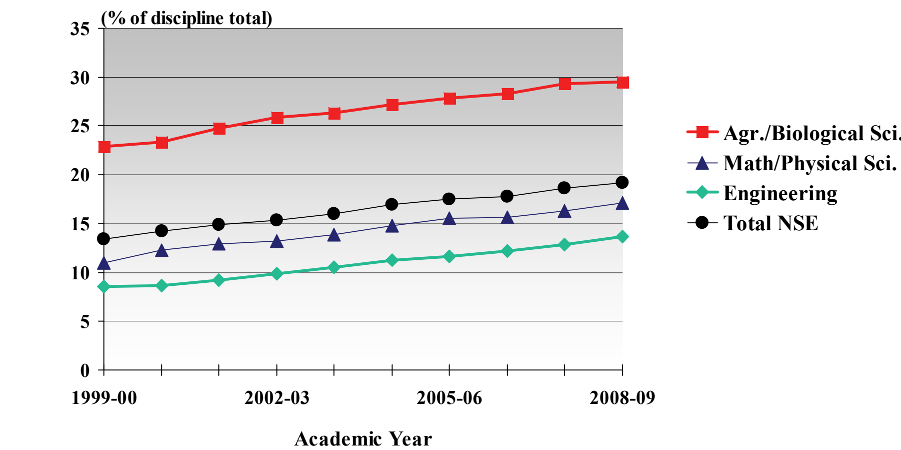
Of particular interest to NSERC are careers of NSE postgraduates in research, especially the outcomes for doctoral degree holders. The vast majority of research careers of doctoral degree holders in the NSE are in the academic stream. Of the approximately 20,000 research positions held by doctoral degree graduates in the NSE in Canada, roughly 65% are in the academic sector, 20% in the private sector, and 15% in the government sector. A brief analysis of research careers by gender for each sector is presented below.

Academic Sector

As shown in Figure 3.9 and Table 3.4, the proportion of university women faculty in the NSE disciplines is low. At a total of 19% for the NSE as a whole, it is slightly more than one-half the proportion of women faculty in all fields and one-third of the proportion in the national workforce. The breakdown by gender and discipline emphasizes the particular pattern of women in the NSE disciplines. Table 3.4 includes all ranks in order to show the general evolution in academe. Over the period, the average growth of female NSE faculty was higher than that of male faculty, 6.6% versus 1.7% for men. The superior growth of women may be an indication of the success of the wide variety of employment equity measures. The highest average female growth rate over the period has been 8.7% in engineering and applied sciences, even though engineering has the smallest proportion of women faculty. Women represented more than one-quarter (29.5%) of faculty in agriculture and biological sciences in 2008-09. As illustrated, representation of women varies dramatically across disciplines.

Upon closer examination of faculty positions by rank, the distribution of women faculty is skewed towards the lowest academic ranks. Women make up only 12.2% of all full professors in NSE disciplines versus 27.8% at the assistant professor level (see Figure 3.10). The greatest growth in women's rank has occurred at the full professor level, nearly doubling over the past ten years. Figure 3.11 illustrates the percentage of female faculty by rank in the NSE and major discipline. The representation of women at all ranks is highest in agricultural and biological sciences. Two reasons are generally put forward to explain this situation. First, the participation of women in faculty would be relatively recent and second, it would take longer for women to be promoted to the highest ranks. This assertion requires further analysis to be validated.

Figure 3.9
Female Faculty[1] in the Natural Sciences and Engineering as a % of Total NSE Faculty by Discipline



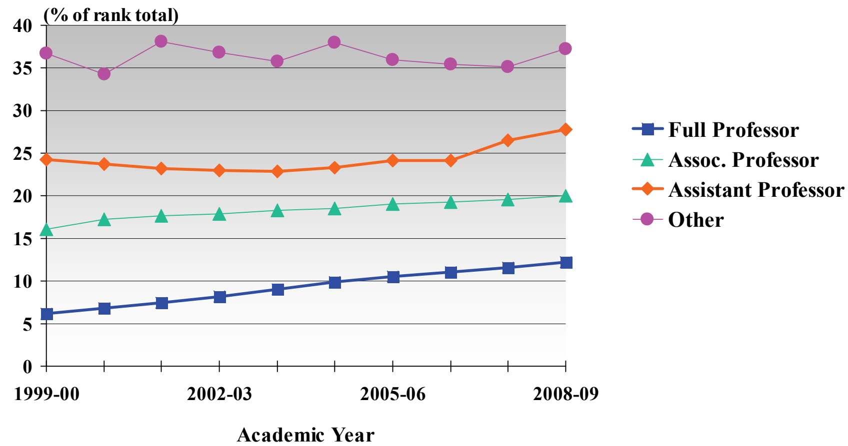
1. Full-Time.
Source: Statistics Canada.

Table 3.4
Faculty (Full-Time) in the Natural Sciences and Engineering[1], 1999-00 - 2008-09

Academic Year	ALL FIELDS Male	ALL FIELDS Female	ALL FIELDS Total	Agr. and Biological Sci. Male	Agr. and Biological Sci. Female	Agr. and Biological Sci. Total	% Female	Eng. and Applied Sci. Male	Eng. and Applied Sci. Female	Eng. and Applied Sci. Total	% Female	Math. and Physical Sci. Male	Math. and Physical Sci. Female	Math. and Physical Sci. Total	% Female	NSE TOTAL Male	NSE TOTAL Female	NSE TOTAL Total	% Female
1999-00	24,645	9,153	33,798	1,944	576	2,520	22.9	2,535	240	2,775	8.6	3,858	477	4,335	11.0	8,337	1,293	9,630	13.4
2000-01	24,729	9,630	34,359	2,028	621	2,649	23.4	2,595	246	2,841	8.7	3,930	552	4,482	12.3	8,553	1,419	9,972	14.2
2001-02	24,930	10,182	35,112	1,959	645	2,604	24.8	2,712	276	2,988	9.2	4,029	597	4,626	12.9	8,700	1,518	10,218	14.9
2002-03	25,272	10,779	36,051	1,995	696	2,691	25.9	2,841	312	3,153	9.9	4,080	621	4,701	13.2	8,916	1,629	10,545	15.4
2003-04	25,704	11,499	37,203	2,022	723	2,745	26.3	2,934	345	3,279	10.5	4,203	681	4,884	13.9	9,159	1,749	10,908	16.0
2004-05	26,283	12,291	38,574	2,076	777	2,853	27.2	3,039	387	3,426	11.3	4,248	735	4,983	14.8	9,363	1,899	11,262	16.9
2005-06	26,676	12,939	39,615	2,109	813	2,922	27.8	3,051	402	3,453	11.6	4,299	786	5,085	15.5	9,459	2,001	11,460	17.5
2006-07	27,009	13,557	40,566	2,154	849	3,003	28.3	3,120	432	3,552	12.2	4,335	801	5,136	15.6	9,609	2,082	11,691	17.8
2007-08	27,186	14,121	41,307	2,133	882	3,015	29.3	3,177	468	3,645	12.8	4,332	846	5,178	16.3	9,642	2,196	11,838	18.6
2008-09	27,342	14,613	41,955	2,175	909	3,084	29.5	3,183	507	3,690	13.7	4,332	891	5,223	17.1	9,690	2,307	11,997	19.2
Avg. Growth 99-08	1.2%	5.3%	2.4%	1.3%	5.2%	2.3%	-	2.6%	8.7%	3.2%	-	1.3%	7.2%	2.1%	-	1.7%	6.6%	2.5%	-

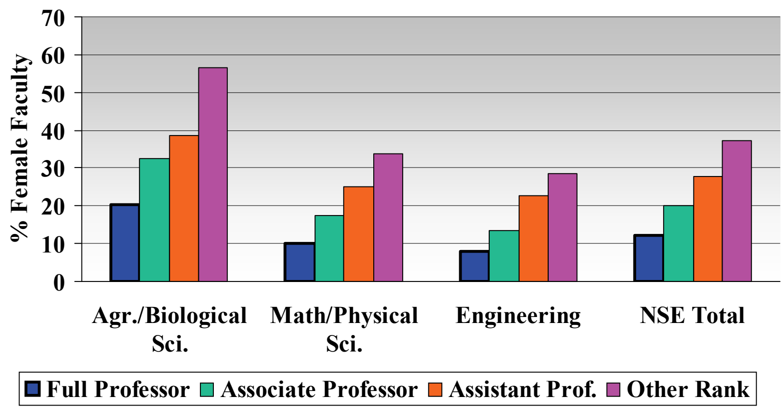
1. Only includes data for major fields reported by Statistics Canada. Other NSE fields supported by NSERC are reported under "ALL FIELDS."
Source: Statistics Canada

Figure 3.10
Female Faculty[1] in the Natural Sciences and Engineering as a % of Total NSE Faculty by Rank



1. Full-Time.
Source: Statistics Canada.

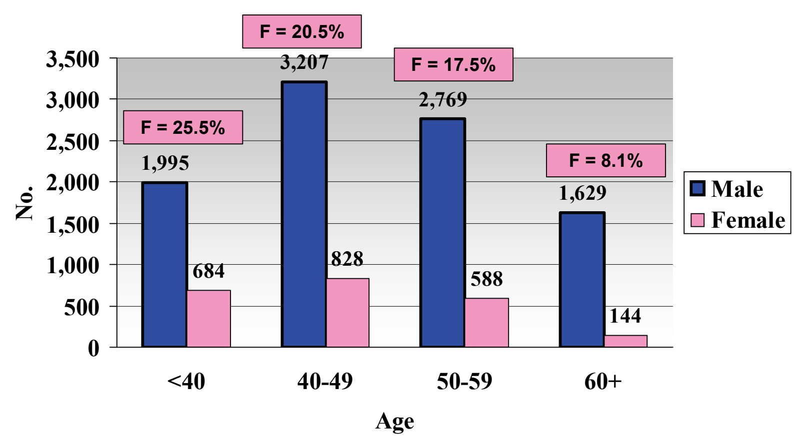
Figure 3.11
Percentage of Female Faculty in the Natural Sciences and Engineering as a % of Total NSE Faculty by Discipline and Rank, 2008-09



Source: Statistics Canada.

In summary, the hiring statistics present a rather slow and steady improvement for women. There has been progress over the last decade according to the data presented here, but gender equality remains a distant possibility. This fact alone raises the issue of whether employment equity programs have contributed to removing the barriers for women. On the positive side, expected hiring requirements over the coming decade should increase due to retiring faculty and other forms of attrition (see Figure 3.12). The retirement of mainly older male faculty members will open the door to more female hiring and will most likely slowly increase the representation of females in most NSE fields.

Figure 3.12
Age Distribution of Full-time Faculty in the NSE by Gender, 2008-09

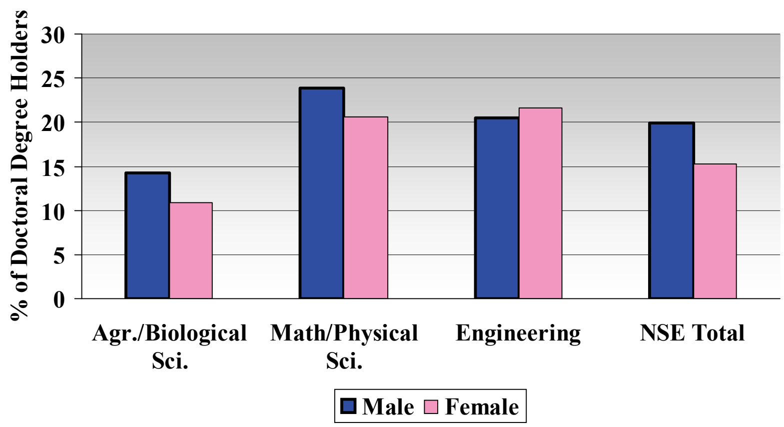


Source: Statistics Canada.

The "leaky pipeline" previously discussed in which proportionally fewer women than men go on to postgraduate studies in the NSE is certainly part of the problem. In fact, the proportion of women decreases significantly after the master's degree as illustrated in Figures 2.10 and 2.13. These supply constraints make it that much more difficult to generate meaningful increases in female representation in the NSE academic community.

The academic career is an extremely competitive environment. A macro level examination of the stock of Ph.D. graduates versus academic positions in the NSE in Canada reveals that the gender differences are modest (see Figure 3.13). Roughly one-fifth of Ph.D. graduates in the NSE are university professors in the NSE in Canada. The differences between women and men are at most 5% points, and in one case the situation slightly favours women (engineering). The high level of male Ph.D. immigration to Canada certainly affects this ratio and the problems for Canadian educated women in the NSE still exist.

Figure 3.13
Percentage of Doctoral Degree Holders in the NSE Who Are Full-Time Faculty in Universities in the NSE, 2005-06



Source: Statistics Canada.

In short, the path to a better gender equity in the NSE requires higher enrolment for women, a higher number of earned doctoral degrees by women, and equity employment measures in faculty. Only then will it be possible to close the gap between the number of Ph.D. students and the number of professors.

Private Sector

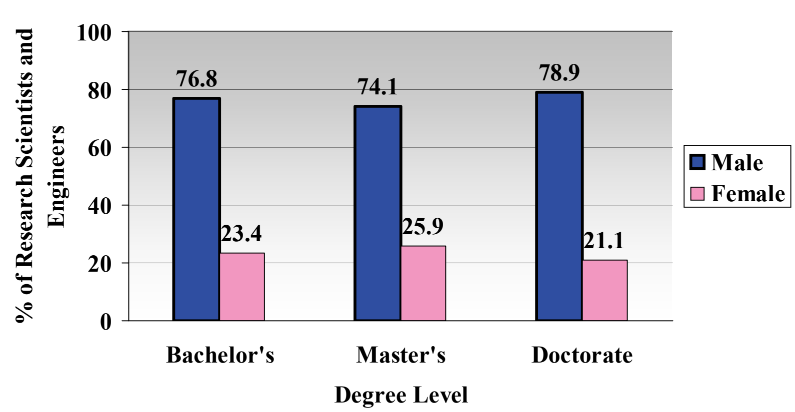
Canadian industries hire the largest number of research personnel and the second highest number of Ph.D. graduates to conduct research (after the academic market). Table 3.5 below presents the number (both sexes) of professional personnel engaged in R&D by degree level. A sample of firms provided gender data for 2003, and an estimate of the gender breakdown by degree level for professional personnel in industry is shown in Figure 3.14. At all degree levels in industry, women make-up a small percentage of professional R&D personnel. At the doctoral level, the 21.1% female representation in industry is slightly higher than the approximate 17% stock of available female NSE Ph.D. graduates in the country.

Table 3.5
Professional Personnel Engaged in R&D in Industry, by Degree Level, 2003 to 2007

Year	Bachelors	Masters	Doctorates	Total
2003	58,370	12,589	5,642	76,601
2004	61,455	14,101	5,777	81,333
2005	64,283	14,315	5,801	84,399
2006	66,547	14,289	5,745	86,581
2007	67,105	13,727	5,536	86,368

Source: Statistics Canada

Figure 3.14
Estimate of Percentage of Research Scientists and Engineers in Industry by Gender and Degree Level, 2003



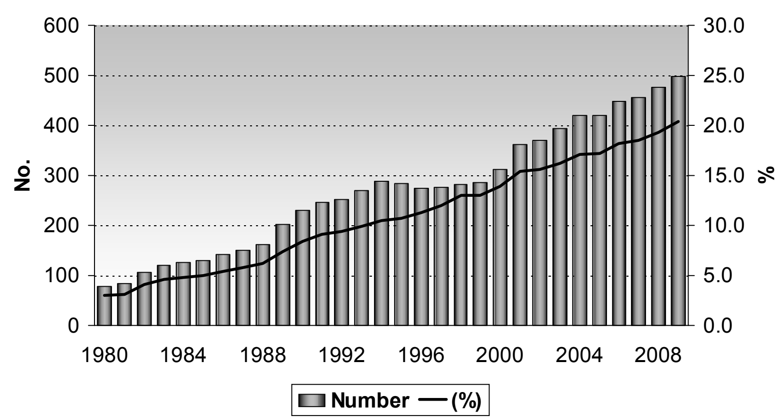
Source: Statistics Canada. Includes research scientists and engineers and senior R&D managers.

Government Sector

The government sector is the smallest of the three sectors as measured by research personnel or research personnel with a Ph.D. The federal government is the largest employer of research scientists and engineers in the government sector, far outnumbering their provincial counterparts.

Unfortunately, data on degrees held by government researchers does not exist. In previous work by NSERC, a rough approximation of 2,500 to 3,000 Ph.D. graduates work in government labs. However, good data does exist on the gender distribution of federal government employees by job classification, although the classifications are unique to the government. The number of women research scientists and engineers, for two of the largest job classifications in this area, in the federal government is presented in Figure 3.15. As of 2009, women represented 20.4% of federal research scientists and engineers, a vast improvement over the 3% share in 1980.

Figure 3.15
Number of Female Research Scientists and Engineers in the Federal Government



Source: Treasury Board of Canada. Includes scientific research and defence scientific service classifications.

Summary

For the most part, women's participation in research occupations in Canada is fairly representative when compared to the available pool of Ph.D. graduates in the NSE, as shown below. Although more detailed analysis is necessary, the solution to increasing female representation in NSE research occupations would seem to be to increase the pool of women with the necessary qualifications.

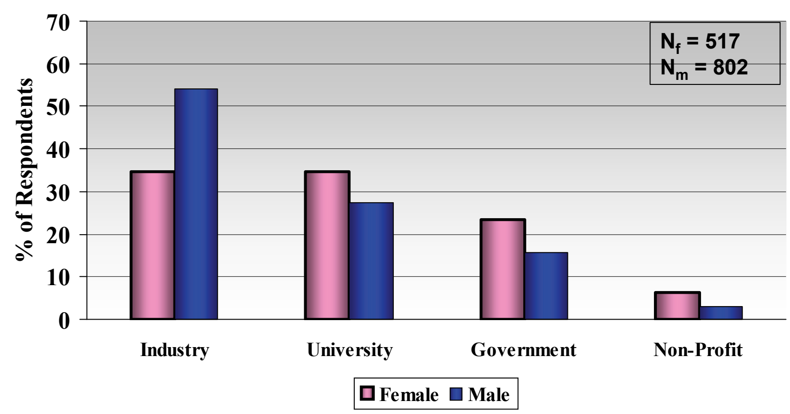
Sector	Female Share
Labour Force, Ph.D. NSE (2005)	16.7%
Academic (2008)	19.2%
Industry (2003)	21.1%
Government (2009)	20.4%

3.4 NSERC Career Surveys

NSERC conducts surveys of former scholarship holders nine years after their award to collect some basic information on the scholar's current career. Figures 3.16 presents the sector of employment for the respondents to the surveys conducted from 1997 to 2009. Overall, the female respondents work at a higher percentage in all sectors, except for the industrial sector, as compared to men. When asked about their activities on the job, see Figure 3.17, a higher percentage of women reported working in the health sciences, whereas, a slightly higher percentage of men reported duties related to teaching, R&D, consulting, management, consulting, product development and sales/marketing. As shown in Figure 3.18, both sexes feel equally appreciative of the training they received as it relates to their careers.

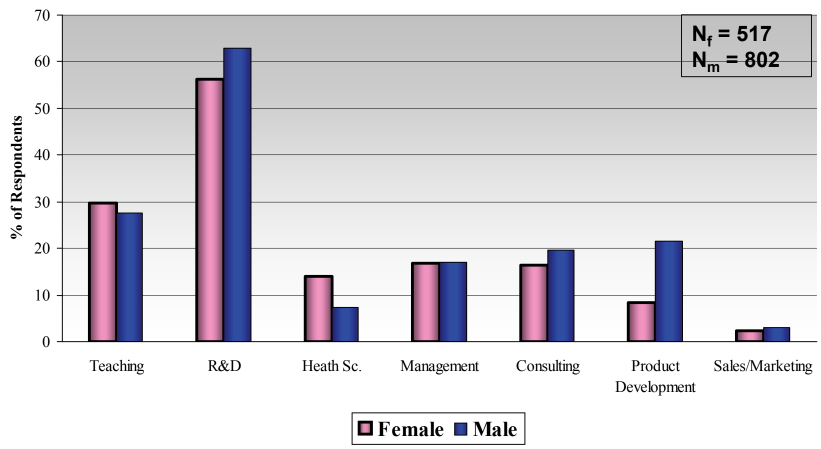
NSERC also surveys former postdoctoral fellowship holders seven years after their award. Survey data from 1999 to 2009 for the sector of employment, on the job activities, and importance of training to their career are presented in Figures 3.19, 3.20 and 3.21 respectively. Once again men tend to work more often in the industrial sector, but women have a higher likelihood of having teaching and R&D duties. Both sexes agree in equal proportions on the importance of their training to their careers. However, men are slightly more willing to recommend to a young person to follow in their career path (see Figure 3.20).

Figure 3.16
NSERC Postgraduate Scholarship Career Outcomes[1]
(Sector of Employment)



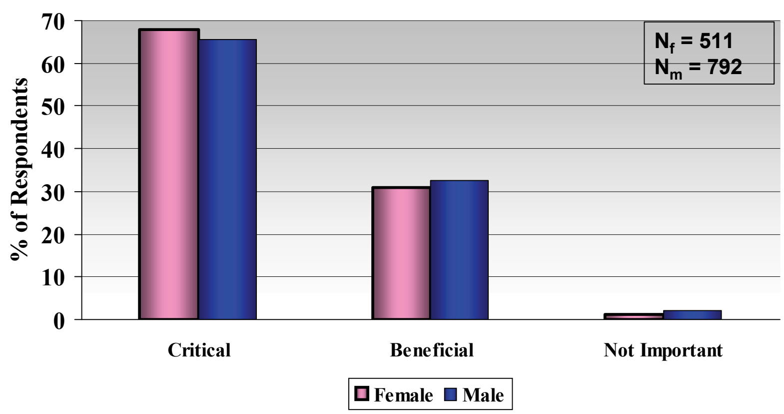
1. NSERC Postgraduate Scholarship winner surveyed nine years after award.
Source: NSERC Career surveys from 1997 to 2009.

Figure 3.17
NSERC Postgraduate Scholarship Career Outcomes[1]
(Activities on the Job)



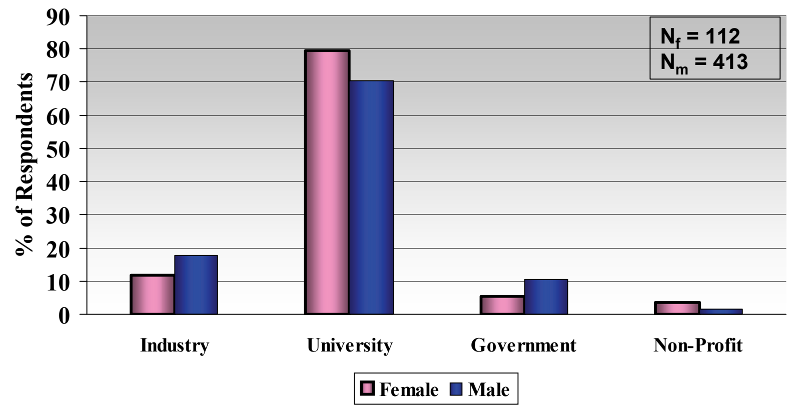
1. NSERC Postgraduate Scholarship winner surveyed nine years after award.
Source: NSERC Career surveys from 1997 to 2009.

Figure 3.18
NSERC Postgraduate Scholarship Career Outcomes[1]
(Importance of Training to Career)



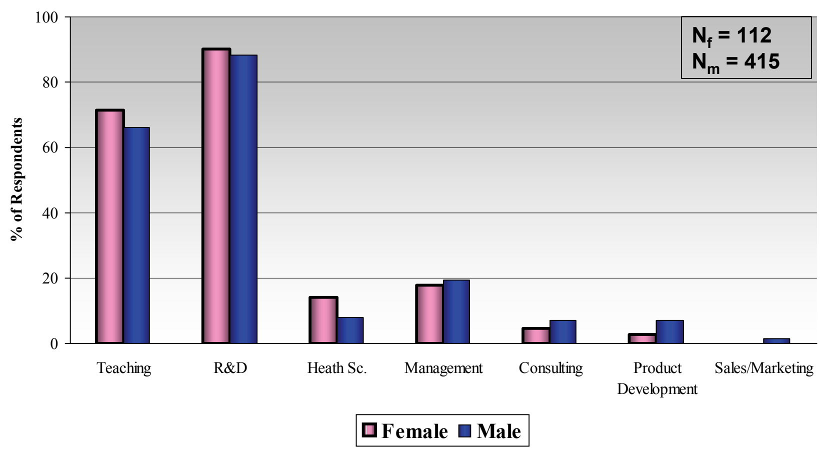
1. NSERC Postgraduate Scholarship winner surveyed nine years after award.
Source: NSERC Career surveys from 1997 to 2009.

Figure 3.19
NSERC Postdoctoral Fellowship Career Outcomes[1]
(Sector of Employment)



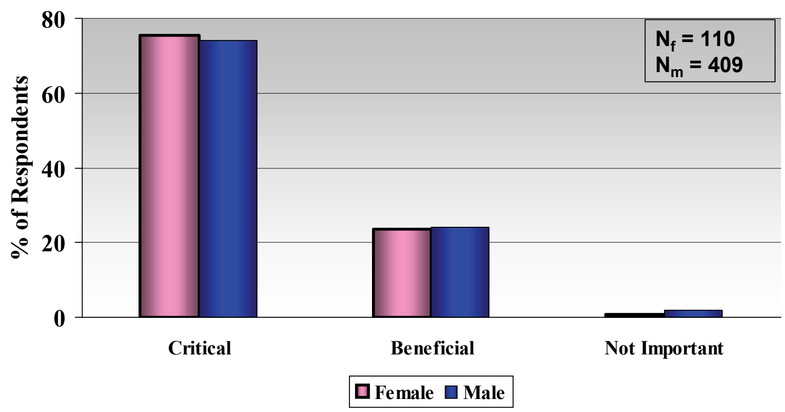
1. NSERC Postdoctoral Fellowship winners surveyed seven years after award.
Source: NSERC Career surveys from 1999 to 2009.

Figure 3.20
NSERC Postdoctoral Fellowship Career Outcomes[1]
(Activities on the Job)



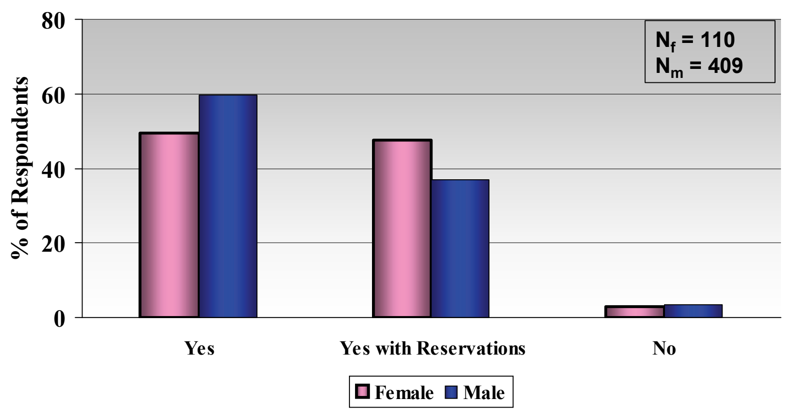
1. NSERC Postdoctoral Fellowship winners surveyed seven years after award.
Source: NSERC Career surveys from 1999 to 2009.

Figure 3.21
NSERC Postdoctoral Fellowship Career Outcomes[1]
(Importance of Training to Career)



1. NSERC Postdoctoral Fellowship winners surveyed seven years after award.
Source: NSERC Career surveys from 1999 to 2009.

Figure 3.22
NSERC Postdoctoral Fellowship Career Outcomes[1]
(Would Encourage a Young Person to Chose Same Career Path)



1. NSERC Postdoctoral Fellowship winners surveyed seven years after award.
Source: NSERC Career surveys from 1999 to 2009.

4. NSERC Gender Statistics

In this section, gender statistics collected by NSERC for a variety of its programs will be presented to shed some light on a variety of issues such as motivation, representation, progression, retention, mobility and excellence.

4.1 NSERC Program Statistics

In addition to specific NSERC programs aimed at increasing the participation of women in the NSE, an analysis of female participation in NSERC's major training and grant programs is presented in this section. NSERC is a major funder of the academic and student communities in the NSE. Therefore, NSERC program statistics are a good barometer of activity by gender. The participation of women in selected NSERC programs is presented in Table 4.1. NSERC's undergraduate and postgraduate programs have very good female participation, but as the "leaky pipeline" would imply, representation decreases at the postdoctoral and faculty levels (Discovery Grants).

Table 4.1
Number of NSERC Awards Held by Females, Various Programs

Fiscal	Undergraduate Awards (USRA)		Postgraduate Scholarships[2]		Postdoctoral Fellowships		Discovery Grants[3]	
Year	(No.)	(%)[1]	(No.)	(%)[1]	(No.)	(%)[1]	(No.)	(%)[1]
2000-01	1,412	46.6%	1,220	40.5%	121	26.1%	1,082	13.4%
2001-02	1,396	45.1%	1,277	42.0%	116	27.8%	1,066	14.0%
2002-03	1,537	45.8%	1,433	43.4%	116	27.4%	1,149	14.3%
2003-04	1,840	45.1%	1,820	43.5%	156	30.1%	1,238	14.7%
2004-05	1,892	45.1%	1,661	43.8%	140	28.9%	1,269	15.0%
2005-06	1,870	45.0%	1,691	42.8%	145	27.8%	1,467	15.6%
2006-07	1,796	44.1%	1,668	41.0%	130	27.9%	1,566	16.1%
2007-08	1,809	44.3%	1,820	40.8%	139	28.6%	1,691	16.9%
2008-09	2,195	42.5%	1,993	41.3%	144	29.9%	1,766	17.5%
2009-10	1,601	41.2%	2,031	40.9%	162	32.6%	1,743	17.6%

1. Percentage of awards to females, excludes unknown sex (typically less than 5%).
2. Includes Postgraduate Scholarships, Industrial Postgraduate Scholarships and Canada Graduate Scholarships.
3. Includes Individual and Individual Subatomic Physics Discovery Grants.

The Discovery Grants program is NSERC's largest program. The average grant for women in 2009-10 was $28,500 versus an average of $31,800 for men. Although the average grant is slightly below that for men, once discipline and age differences are controlled for, there is virtually no difference in the average grant.

For NSERC programs with annual competitions, the success rates for men and women are presented in Table 4.2. For the most part, women are just as successful as men in receiving an award for the programs presented.

Table 4.2
Success Rates[1] by Sex, Various Programs

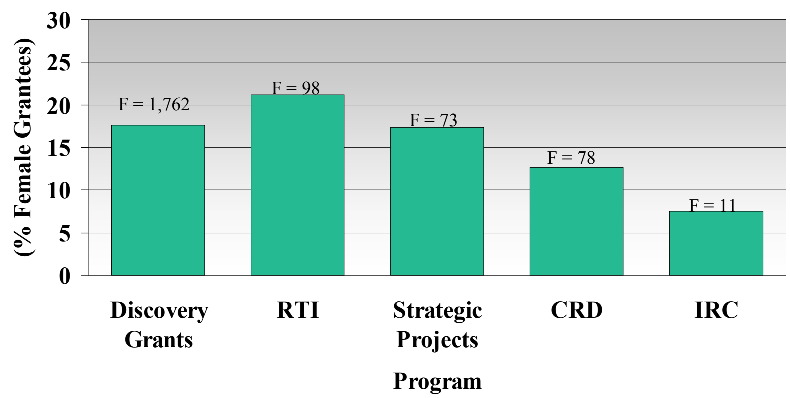
Competition	Postgraduate Scholarships[2]		Postdoctoral Fellowships		Discovery Grants[3]		Strategic Projects[4]	
Year	Females	Males	Females	Males	Females	Males	Females	Males
2000	66.8%	69.6%	27.2%	36.1%	67.2%	71.0%	50.0%	45.1%
2001	65.0%	64.6%	36.0%	37.9%	70.7%	76.3%	42.9%	30.1%
2002	72.1%	68.6%	29.7%	38.0%	74.4%	79.7%	26.7%	35.4%
2003	61.7%	58.8%	32.9%	31.6%	72.3%	76.0%	15.4%	26.9%
2004	71.8%	69.7%	24.9%	30.7%	68.3%	69.2%	33.3%	26.9%
2005	74.0%	70.3%	27.7%	30.2%	67.2%	67.9%	14.5%	25.1%
2006	63.6%	62.5%	23.4%	26.5%	61.9%	66.9%	29.3%	31.5%
2007	68.5%	69.1%	22.2%	24.1%	63.8%	58.1%	44.2%	49.3%
2008	71.0%	69.8%	22.5%	21.1%	59.0%	64.0%	41.5%	38.7%
2009	72.5%	70.1%	19.4%	22.0%	55.4%	56.4%	24.7%	26.2%
2010	74.2%	70.0%	18.9%	22.1%	51.1%	57.4%	---	---

1. Number of awards divided by the number of applications
2. Includes Postgraduate Scholarships and Canada Graduate Scholarships.
3. Includes only new applicants for Individual Discovery Grants, and Individual Subatomic Physics Discovery Grants were included since 2005.
4. Includes only principal investigators.

Figure 4.1 presents further details of the proportion of awards held by females for NSERC's major research programs in 2009-10. Female representation tends to fall off in programs where, typically, more senior applicants are awarded grants. Female faculty representation at senior ranks is also much lower, as shown in Figure 3.10. A similar figure for NSERC's major scholarship and fellowship programs is highlighted in Figure 4.2. Females have a good representation at the undergraduate and postgraduate levels, but their proportion falls at the postdoctoral level and those programs involving industry.

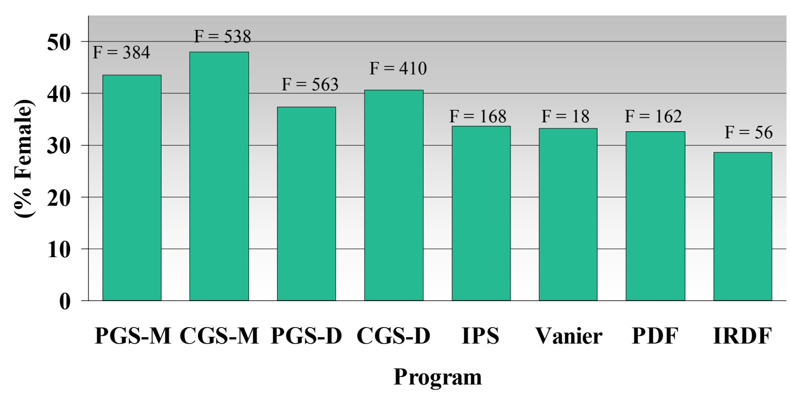
Figure 4.3 presents NSERC funding versus certain population benchmarks, such as enrolment and faculty numbers, and reveals that NSERC funding typically exceeds the female population levels for student support and only slightly below at the postdoctoral and faculty levels.

Figure 4.1
Number of Awards Held by Females for Selected NSERC Research Programs, 2009-10



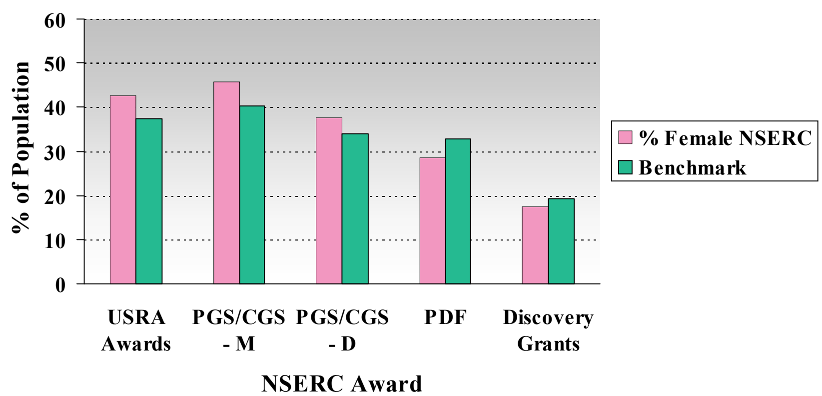
RTI: Research Tools and Instruments, CRD: Collaborative Research and Development Grants, IRC: Industrial Research Chairs, F: Number of female principal investigators.

Figure 4.2
Number of Scholarships and Fellowships Held by Females for Selected NSERC Programs, 2009-10



PGS: Postgraduate Scholarship, M: Master's, D: Doctorate, CGS: Canada Graduate Scholarships IPS: Industrial Postgraduate Scholarships, Vanier: Vanier Scholarships, PDF: Postdoctoral Fellowships, IRDF: Industrial R&D Fellowships, F: Number of female recipients.

Figure 4.3
NSERC Awards to Females vs. Benchmarks



Source: NSERC data and Statistics Canada. USRA benchmark is Canadian and permanent resident female undergraduate enrolment in the NSE in 2008-09. PGS/CGS M&D awards are for 2008-09, and benchmarks are Canadian and permanent resident female enrolments in the NSE at the master's and Ph.D. levels for 2008-09. PDF awards are for 2007-08, and benchmark is doctoral degrees awarded to females in 2007. Discovery Grants is percentage of awards to women in 2008-09 and the benchmark is female faculty in the NSE in 2008-09.

4.2 Motivation

NSERC has implemented a number of initiatives over the past decade to increase the representation of women in the NSE in Canada and some of these will be highlighted. Through our PromoScience program, NSERC provides funding to organizations which bring science experiences to under-represented groups and to those that promote interest in science among girls. In 2009-10, the PromoScience budget was $2.8M of which 75% had a component to increase the representation or interest of girls in science and engineering. One such grant is highlighted below.

PromoScience Recipient
Society for Canadian Women in Science and Technology (SCWIST)

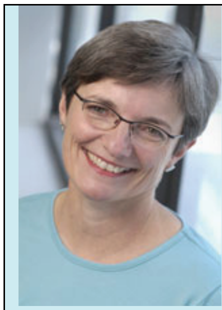
The Society for Canadian Women in Science and Technology (SCWIST), a non-profit organization, runs the *ms infinity* (math + science = infinite options) program that connects young women with positive female role models who are pursuing dynamic careers and education in S&T and encourages them to continue studying math, science and technology throughout secondary school to broaden their career opportunities. As a result of NSERC funding, 728 girls from across British Columbia participated in hands-on workshops, tele-mentoring, networking and community group science days throughout 2008. Through the varied activities, the participants learned many valuable lessons about schooling and career options and had the opportunity to connect their dreams with a role model.

Several policy actions have been undertaken by NSERC to help reduce barriers to women participating in NSE fields. Provisions for a paid parental leave have been implemented for holders of graduate and postdoctoral NSERC awards, and for those paid from research grants. Deferral of take-up, or unpaid interruption of, scholarship and fellowship awards for reasons of maternity and family responsibilities are permitted for up to three years. Tenure of scholarships and fellowships on a part-time basis is now possible for reasons of family responsibilities. NSERC monitors the participation and success rate of women in its scholarships and fellowships programs on an ongoing basis and ensures that women are well-represented on its policy and selection committees.

The principal NSERC program with the goal of increasing the participation of women in science and engineering and to provide role models for women active in and considering careers in these fields is the Women in Science and Engineering (WISE) Chair program. This program was launched in 1996 with the establishment of five regional chairs. NSERC funding must be matched by cash contributions from corporate sponsors. NSERC will match private-sector cash contributions of up to $70,000 per year for each of five years towards the creation of individual chairs. Chairs are tenable at any Canadian university within a designated region. The objectives of the program are to:

Develop, implement, and communicate strategies to raise the level of participation of women in science and engineering as students and as professionals, specifically to:

- encourage female students in elementary and secondary schools to consider careers in science and engineering;
- increase the enrolment of women in undergraduate and graduate programs in science and engineering in all Canadian universities and colleges;
- increase the profile and retention rate of women in science and engineering positions;
- eliminate barriers for women who wish to pursue careers in science and engineering; and
- promote the integration of female students and professionals both within and outside academia.
- provide female role models who are accomplished, successful, and recognized researchers in science and engineering.
- develop and implement a communication and networking strategy to ensure a regional and national impact on opportunities for women in science and engineering.



Valerie Davidson
School of Engineering
University of Guelph

NSERC/RIM Chair for Women in Science and Engineering - Ontario Region

The NSERC/RIM Chair is the Ontario-region Chair for Women in Science and Engineering (CWSE). The goals of the NSERC CWSE program address both the "supply" side of women's labour force participation, by encouraging girls and women into science and engineering careers, and the "demand" side of retaining women as valuable contributors to science and engineering.

The Ontario CWSE program includes outreach activities to encourage interest in science and engineering and to help women make informed decisions at a number of stages – from secondary and post-secondary education through to careers.

Valerie Davidson, P.Eng., is a professor in the School of Engineering. She has established a strong interdisciplinary research program in food and biological engineering with an emphasis on the applications of fuzzy mathematics and statistical methods to process control and decision-support systems.

Research In Motion is supporting the Ontario Chair through annual cash contributions and in-kind support such as collaborations on outreach activities related to computer technologies. The Ontario program also benefits from significant financial support from the University of Guelph and contributions by faculty, staff and students.

Julita Vassileva
Department of Computer Science
University of Saskatchewan

NSERC/Cameco Chair for Women in Science and Engineering – Prairies

This Chair will identify barriers that deter females from pursuing careers in science and engineering, as well as supporting and mentoring young women to persist and succeed in these fields.

As a successful computer scientist, Julita Vassileva has balanced career and family to become an international leader in her field. She has developed ways of building rewards into software supporting on-line communities to motivate different types of users to participate. She will determine what female-specific incentives can be integrated into an on-line community to make it interesting and exciting. This community will enable women and girls to share information, discuss issues, read life stories of prominent role models and get advice on challenges such as juggling family and career or how to move up the career ladder in a largely male-dominated set of professions. The on-line aspect is critical, as women have few peers of their gender close at hand with whom to network.

Working with colleagues in sociology, native studies, and women's and gender studies, Julita Vassileva will investigate the attitudes of girls, their parents and their teachers at the high school level in Saskatoon, as well as in rural Saskatchewan and Manitoba. She especially wants to connect with Aboriginal women.

The five-year, $1.16 million appointment is supported by $350,000 from Saskatoon-based Cameco Corporation as part of its gift to the University of Saskatchewan's Thinking the World of Our Future campaign. This is matched with $350,000 from NSERC, with the balance made up by the university.

NSERC routinely conducts exit surveys of scholarship and fellowship award holders. The surveys contain questions related to activities and/or people that motivated the individuals to pursue an education in the NSE. Tables 4.3 to 4.5 present a gender analysis of the responses to a variety of statements for Undergraduate Student Research Award (USRA) holders, Postgraduate Scholarship (PGS) winners, and Postdoctoral Fellowship (PDF) recipients, respectively. The USRA and PGS exit surveys indicate that females tend to have more encouragement from family teachers and professors to pursue an NSE education, and more exposure to R&D activities (science camps and R&D at the university). At the postdoctoral level there were no significant differences in the responses.

Table 4.3
Results from NSERC's Undergraduate Student Research Award (USRA) Exit Survey, 2006-2009

Statement	No. Respondents		No. Agree with Statement		% Agree with Statement		Statistical Difference
	Male	Female	Male	Female	Male	Female	Y/N
I am enjoying my undergraduate student life	5,664	4,764	4,270	3,730	75.4	78.3	Y
I participated in science camps and/or science fairs during my elementary and/or high school years	5,664	4,764	1,572	1,544	27.8	32.4	Y
So far, I have accumulated a high debt during my undergraduate education	5,664	4,764	1,211	1,015	21.4	21.3	N
My family encouraged me to pursue undergraduate studies in science/engineering	5,664	4,764	2,415	2,254	42.6	47.3	Y
A high school teacher I had encouraged me to pursue undergraduate studies in science/engineering	5,664	4,764	1,793	1,783	31.7	37.4	Y
Graduate studies will be an important element of my career goals	5,664	4,764	3,861	3,207	68.2	67.3	N
I would recommend my field of study to others	5,664	4,764	3,782	3,518	66.8	73.8	Y
My friends are pursuing graduate degrees	5,664	4,764	2,267	2,124	40.0	44.6	Y

Table 4.4
Results from NSERC's Postgraduate Scholarship Exit Surveys, 2005-2009

Statement	No. Respondents		No. Agree with Statement		% Agree with Statement		Statistical Difference
	Male	Female	Male	Female	Male	Female	Y/N
I enjoyed my undergraduate student life	3,450	2,947	2,531	2,235	73.4	75.8	N
I was exposed to research during my undergraduate years	3,450	2,947	2,349	2,209	68.1	75.0	Y
I accumulated a high debt during my undergraduate degree	3,450	2,947	526	521	15.2	17.7	N
My friends are pursuing graduate degrees	3,449	2,946	987	966	28.6	32.8	Y
My family encouraged me to pursue graduate studies	3,449	2,946	1,355	1,321	39.3	44.8	Y
A professor I had encouraged me to pursue graduate studies	3,450	2,947	2,051	1,920	59.4	65.2	Y
Graduate studies are an important element of my career goals	3,450	2,947	2,639	2,212	76.5	75.1	N
I would recommend my field of study to others	3,450	2,947	2,150	1,930	62.3	65.5	Y
I would have gone on to or stayed in graduate school even without NSERC support	3,450	2,947	1,700	1,609	49.3	54.6	Y
I do not want to go into debt for graduate education	3,449	2,946	2,837	2,495	82.3	84.7	Y
It is difficult to find a job in my field without a graduate degree	3,450	2,947	1,341	1,465	38.9	49.7	Y

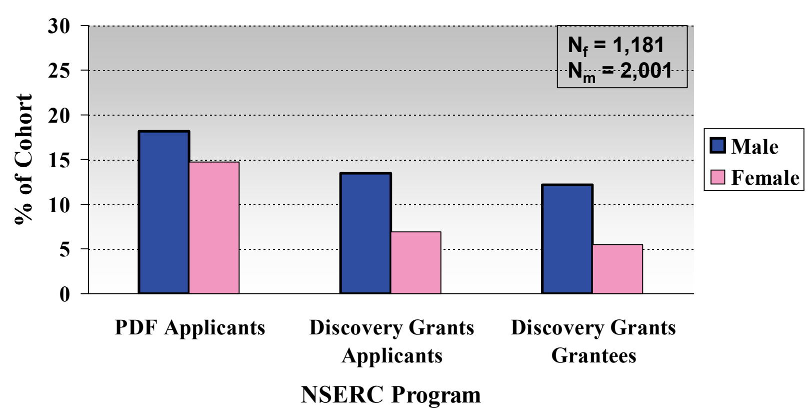
Table 4.5
Results from NSERC's Postdoctoral Fellowship Exit Surveys, 2005-2009

Statement	No. Respondents		No. Agree with Statement		% Agree with Statement		Statistical Difference
	Male	Female	Male	Female	Male	Female	Y/N
I enjoyed my undergraduate student life	367	156	244	104	66.5	66.7	N
I was exposed to research during my undergraduate years	367	156	231	110	62.9	70.5	N
I accumulated a high debt during my undergraduate and postgraduate education	367	156	79	28	21.5	17.9	N
My postgraduate experience prepared me well for postdoctoral work	367	156	299	122	81.5	78.2	N
A professor I had encouraged me to pursue a postdoctoral position	367	156	232	98	63.2	62.8	N
Postdoctoral work is an important element of my career goals	367	156	295	116	80.4	74.4	N
I would recommend my field of study to others	367	156	226	95	61.6	60.9	N
I would have taken a postdoctoral experience even without NSERC support	367	156	200	80	54.5	51.3	N
It is difficult to find a job in my field without postdoctoral experience	367	156	305	130	83.1	83.3	N
I find it is taking a long time to reach my career goals	367	156	212	73	57.8	46.8	N

4.3 Progression

The following figures and tables attempt to look at the progression of women within NSERC programs. Figure 4.4 presents the results for a cohort of NSERC scholarship winners from 1993 to 1997 and their subsequent applications for postdoctoral fellowships (PDF) and Discovery Grants. A larger percentage of men from the cohort go on to apply for an NSERC PDF or Discovery award, and also obtain a Discovery grant. As mentioned before, there is significantly more attrition for women than for men in the transition from a master's degree to doctoral enrolment and subsequent employment as a professor.

Figure 4.4
Progression of 1993-97 Cohort of NSERC Postgraduate Scholarship Recipients[1]



1. Postgraduate Scholarship recipients in the PGS1 and PGSA categories from 1993 to 1997. Number of female winners was 1,181 and the number of male recipients was 2,001.

Another analysis looked at the number of new applicants to NSERC's Discovery grants program as compared to doctoral degree output in Canada. NSERC captures the education history of its applicants and can estimate the number of Ph.D. graduates that go on to apply for NSERC grants. Since most new faculty hires apply for NSERC funding, it may be a good indicator of the transition from Ph.D. graduation to an academic appointment. As Table 4.6 indicates, the percentage of female Ph.D. graduates in the NSE in Canada that go on to apply for an NSERC Discovery Grant is lower than that for males. It appears that some losses are occurring at the Ph.D. to academic appointment step for females.

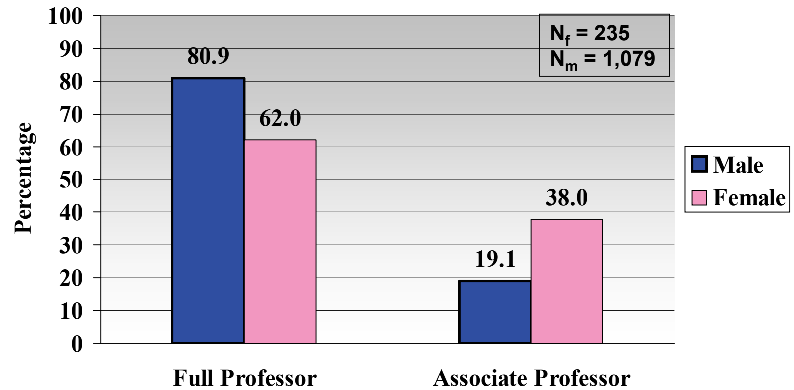
Table 4.6
NSERC New Applicant to Doctoral Degree Output Comparison

Year of	New Applicants (NA)[1]		Doctoral Degrees (DD)[2]		%NA to DD	
Ph.D.	Female	Male	Female	Male	Female	Male
1998	28	76	350	1,079	8.00	7.04
1999	27	95	367	964	7.36	9.85
2000	53	139	393	994	13.49	13.98
2001	65	164	378	921	17.20	17.81
2002	58	166	428	989	13.55	16.78
2003	53	173	423	1,024	12.53	16.89
2004	48	142	501	1,104	9.58	12.86
2005	40	100	507	1,051	7.89	9.51
2006	28	71	515	1,117	5.44	6.36
2007	26	59	647	1,198	4.02	4.92
Total	**426**	**1,185**	**4,509**	**10,441**	**9.45**	**11.35**

1. New appliants to Discovery Grants from 1998 to 2007, who are Canadian citizens who earned a Ph.D. in Canada.
2. Estimate of doctoral degrees awarded to Canadians in Canada in the NSE.

An examination of the rank that women and men held after 15 years of holding a Discovery grant was also undertaken. Figure 4.5 presents data for this indicator and it clearly shows that women do not progress to full professor at the same rate as men. The lack of progression of women in academic ranks has been a widely studied topic and of concern to institutions.

Figure 4.5
Distribution of the 1990-94 Cohort of New Grantees in Discovery Grants at the Assistant Professor Level and Who Applied for a Discovery Grant after 15 Years

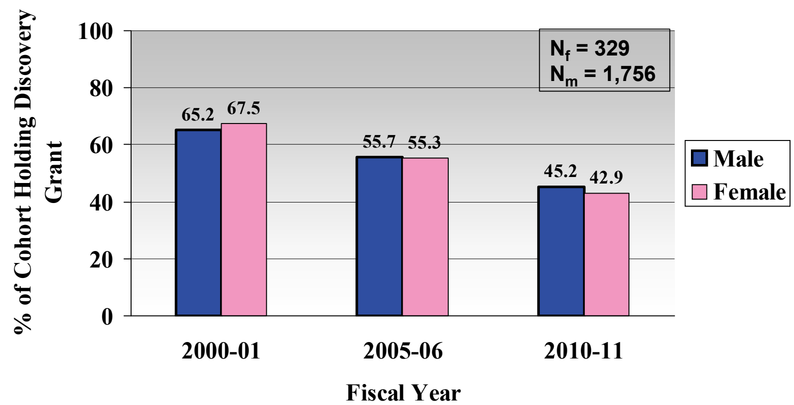


Nf and Nm are the number of females and males, respectively, in the cohort.

4.4 Retention

Once women pass the barrier of becoming a faculty member, they tend to perform rather well in maintaining an NSERC grant. Figure 4.6 followed a cohort of first time grantees to NSERC's Discovery Grants program from 1990 to 1994 and their subsequent ability to hold on to an award in 2000-01, 2005-06, and 2010-11. A slightly smaller percentage of the female versus the male cohort are still receiving a Discovery Grant more than 15 years later. The retention of female grantees in NSERC's major program is a positive indicator.

Figure 4.6
Percentage of 1990-94 Cohort of New Grantees in Discovery Grants Who Held a Discovery Grant in Subsequent Years

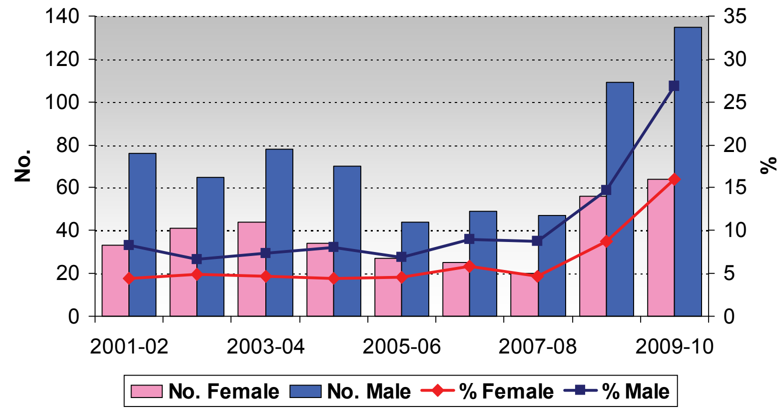


Nf and Nm are the number of males and females, respectively, in the cohort.

4.5 Mobility

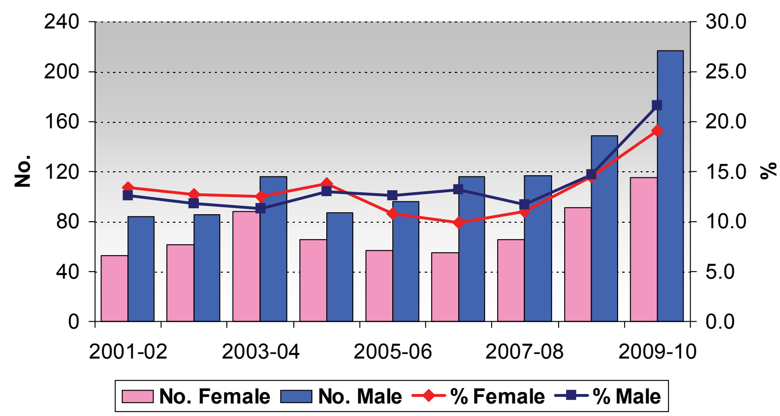
Issues around mobility and gender have been raised in the past to explain the diversity of experience that may hold back women in obtaining an academic appointment. Figures 4.7 to 4.9 present the number and percentage of scholarship and fellowship recipients who take their award abroad. Fewer females at the master's level take their award abroad as compared to men, but the gap is fairly small at the doctoral and postdoctoral levels. Figure 4.10 presents an estimate of the number of NSERC grantees who came from abroad. Men are slightly more likely to come from abroad than women for NSERC grantees, but this difference is even more pronounced for the Canada Research Chairs program (see Figure 4.11). Table 4.7 presents the number of women and men who are NSERC grantees and earned a Ph.D. from a prestigious U.S. university. Male NSERC grantees are slightly more likely to earn a Ph.D. from a prestigious U.S. university compared to women as compared to their representation in the NSERC system. However, females who earned a doctoral degree from a prestigious U.S. university are considerably younger than their male counterparts.

Figure 4.7
Number and Percentage of NSERC Postgraduate Scholarships at the Master's Level Taken Abroad by Gender



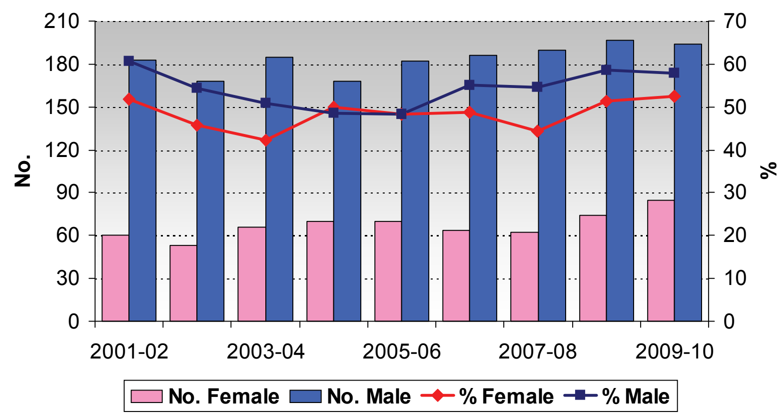
Excluding Alexander Graham Bell Canada Graduate Scholarships.

Figure 4.8
Number and Percentage of NSERC Postgraduate Scholarships at the Doctoral Level Taken Abroad by Gender



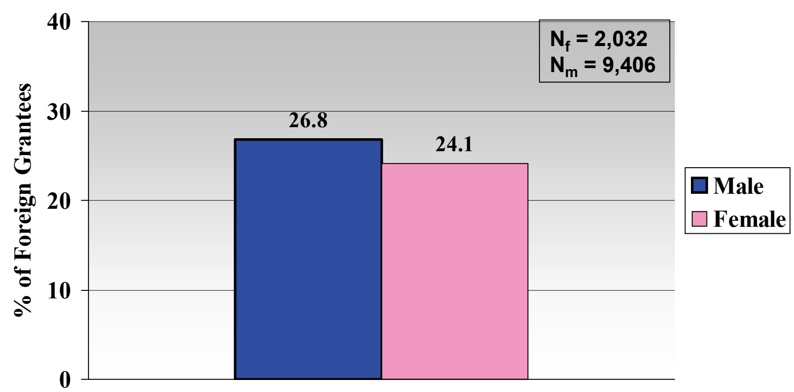
Excluding Alexander Graham Bell Canada Graduate Scholarships.

Figure 4.9
Number and Percentage of NSERC Postdoctoral Fellowships Taken Abroad by Gender



Excluding Alexander Graham Bell Canada Graduate Scholarships.

Figure 4.10
Percentage of NSERC Grantees with Degrees Earned Outside Canada by Gender, 2009-10



Nm and Nf are the number of male and female grantees in the population.

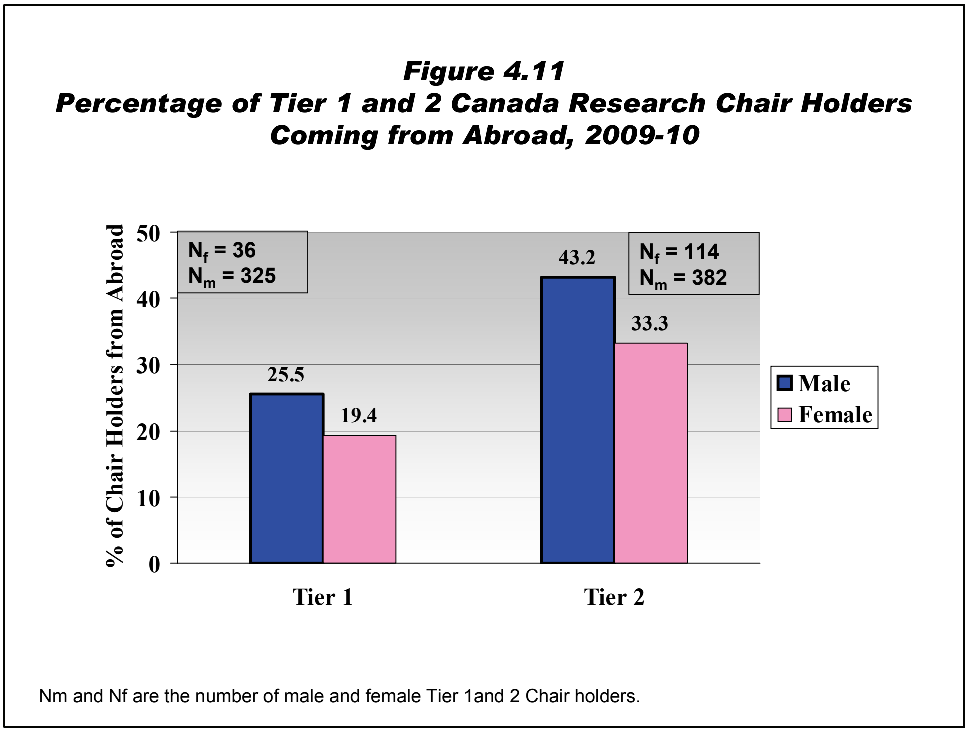


Table 4.7
NSERC Grantees with a Ph.D. from Top U.S. Universities, 2008-09

University	Male		Female		Average Age	
	Number	%	Number	%	Male	Female
Harvard Univ	70	84.3	13	15.7	51	39
Stanford Univ	84	81.6	19	18.4	46	42
Univ California - Berkeley	113	86.9	17	13.1	49	42
Massachusetts Inst Tech (MIT)	126	87.5	18	12.5	49	36
California Inst Tech	50	87.7	7	12.3	49	36
Columbia Univ	19	79.2	5	20.8	54	42
Princeton Univ	91	89.2	11	10.8	50	42
Univ Chicago	37	82.2	8	17.8	49	41
Yale Univ	51	81.0	12	19.0	55	40
Cornell Univ	83	79.8	21	20.2	49	43
Univ California - Los Angeles	19	86.4	3	13.6	45	47
Univ California - San Diego	25	86.2	4	13.8	51	42
Univ Pennsylvania	26	89.7	3	10.3	53	52
Univ Washington - Seattle	68	84.0	13	16.0	48	43
Univ Wisconsin - Madison	51	77.3	15	22.7	52	45
Total	**913**	**84.4**	**169**	**15.6**	**50**	**41**

4.6 Excellence

Female representation in the academic community in the NSE is a problem as a whole, but especially acute at the very top echelons. The percentage of women at the very top of NSERC programs (as measured by grant size) falls-off considerably. Table 4.8 presents the gender distribution for the top 25 and 50 grantees by priority area for the Discovery Grants program (as measured by the dollar value of their Discovery Grant). As shown in the table, female representation in both groups is considerably smaller than female representation in the program as a whole (17.5%).

Table 4.8
Top Discovery Grants Recipients by Gender and Priority Area, 2008-09

	Top 25 Grantees				Top 50 Grantees			
	Male		Female		Male		Female	
Priority Area	Number	%	Number	%	Number	%	Number	%
Natural Resources and Energy	23	92.0	2	8.0	47	94.0	3	6.0
Information and Communications Technologies (ICT)	25	100.0	0	0.0	49	98.0	1	2.0
Environmental Sciences and Technologies	25	100.0	0	0.0	48	96.0	2	4.0
Manufacturing	24	96.0	1	4.0	46	92.0	4	8.0
Health and Related Life Sciences and Technologies	25	100.0	0	0.0	47	94.0	3	6.0
Total Priority Areas	**122**	**97.6**	**3**	**2.4**	**237**	**94.8**	**13**	**5.2**
Other Areas	23	92.0	2	8.0	47	94.0	3	6.0
Total	**145**	**96.7**	**5**	**3.3**	**284**	**94.7**	**16**	**5.3**

Similarly low female representation is observed for the Tier I Canada Research Chairs (CRC) program. However, women represent a larger share of the Tier II Canada Research Chairs as would be expected from the NSERC representation (see Table 4.9). NSERC's Industrial Research Chairs program exhibits a similar gender distribution profile as the Tier I CRC program (see table 4.10).

Table 4.9
NSERC Canada Research Chairs by Gender and Priority Area, 2008-09

	Tier 1 Chairs				Tier 2 Chairs			
	Male		Female		Male		Female	
Priority Area	Number	%	Number	%	Number	%	Number	%
Natural Resources and Energy	40	90.9	4	9.1	33	75.0	11	25.0
Information and Communications Technologies (ICT)	68	94.4	4	5.6	61	82.4	13	17.6
Environmental Sciences and Technologies	52	96.3	2	3.7	70	73.7	25	26.3
Manufacturing	56	90.3	6	9.7	68	84.0	13	16.0
Health and Related Life Sciences and Technologies	37	80.4	9	19.6	62	68.1	29	31.9
Total Priority Areas	**253**	**91.0**	**25**	**9.0**	**294**	**76.4**	**91**	**23.6**
Other Areas	83	90.2	9	9.8	83	83.0	17	17.0
Total	**336**	**90.8**	**34**	**9.2**	**377**	**77.7**	**108**	**22.3**

Table 4.10
NSERC Industrial Research Chairs by Gender and Priority Area, 2008-09

	Male		Female	
Priority Area	**Number**	**%**	**Number**	**%**
Natural Resources and Energy	48	94.1	3	5.9
Information and Communications Technologies (ICT)	19	100.0	0	0.0
Environmental Sciences and Technologies	14	82.4	3	17.6
Manufacturing	25	100.0	0	0.0
Health and Related Life Sciences and Technologies	7	87.5	1	12.5
Total Priority Areas	**113**	**94.2**	**7**	**5.8**
Other Areas	12	80.0	3	20.0
Total	**125**	**92.6**	**10**	**7.4**

The gender distribution for NSERC's Discovery Grants Accelerator Supplement awards is presented in Table 4.11. The outcome for women is quite good, with slightly higher representation than the overall percentage of female Discovery grantees.

Table 4.11
NSERC Discovery Accelerator Supplements, 2009-10

	Male		Female	
Priority Area	**Number**	**%**	**Number**	**%**
Natural Resources and Energy	24	80.0	6	20.0
Information and Communications Technologies (ICT)	41	80.4	10	19.6
Environmental Sciences and Technologies	31	81.6	7	18.4
Manufacturing	24	88.9	3	11.1
Health and Related Life Sciences and Technologies	32	68.1	15	31.9
Total Priority Areas	**152**	**78.8**	**41**	**21.2**
Other Areas	33	91.7	3	8.3
Total	**185**	**80.8**	**44**	**19.2**

NSERC recently introduced a new review system for its Discovery Grant program and applicants are rated on a common scale. Figure 4.12 presents the outcome for the 2010 competition and illustrates that proportionally more men than women are ranked in the exceptional to very strong categories. Figure 4.13 presents the number of Steacie winners by gender for the past 4 decades and demonstrates the progress women have made in receiving this prestigious NSERC award. The number of female nominations for NSERC's Herzberg Gold Medal (see Figure 4.14) has not changed appreciably over the past decade and remains at very low levels.

Figure 4.12
Distribution of Discovery Grantees by Ranking, 2010

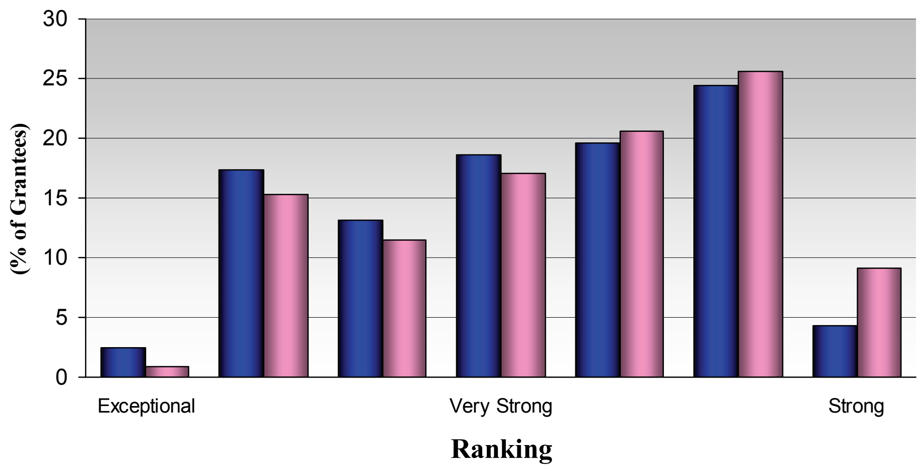


Figure 4.13
Number of NSERC Steacie Recipients by Gender

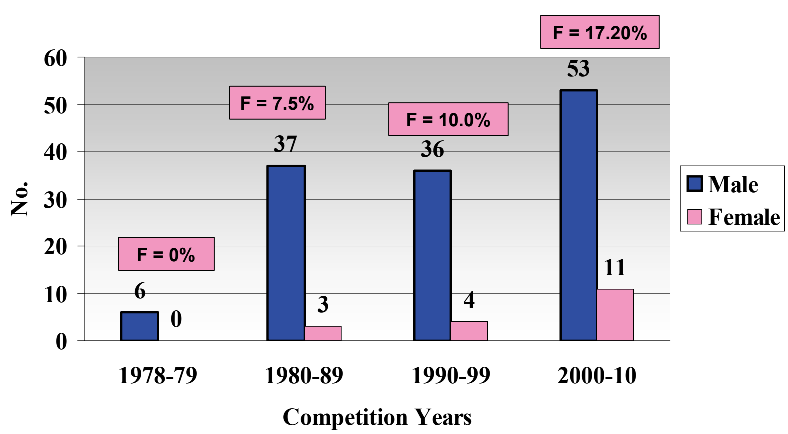
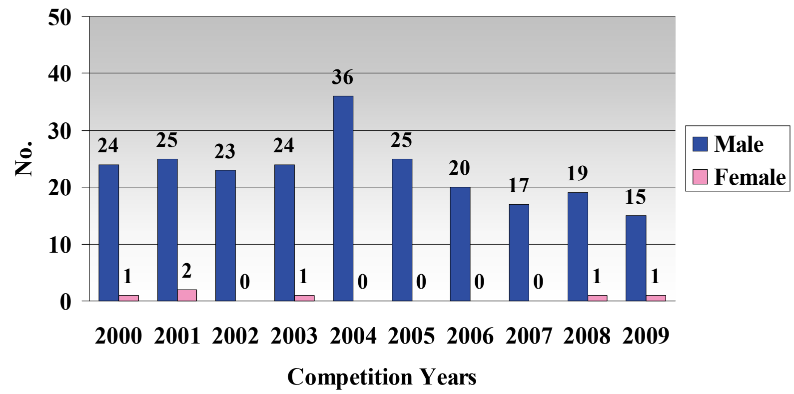


Figure 4.14
Number of Nominations for the NSERC Herzberg Gold Medal by Gender



5. Literature Review

A literature review of articles written over the past five years was conducted to generate a list of what authors felt were some of the reasons behind the lack of female representation in the NSE and possible measures to help increase the participation of women in the NSE. A summary of the findings is presented below.

5.1 Issues and Possible Measures

Issues

A number of reasons for female under-representation in the NSE cited in some recent research papers have been summarized below:

a) “stereotypes can lower girls' aspirations for science and engineering careers over time.”, “Not only are people more likely to associate math and science with men than with women, people often hold negative opinions of women in "masculine" positions, like scientists or engineers.”, “Poor or underdeveloped spatial skills may deter girls from pursuing math or science courses or careers,”, “socio cultural factors”, “girls assess their mathematical ability lower than do boys … girls hold themselves to a higher standard in subjects like math”, “when a girl believes that she can become smarter and learn what she needs to know in STEM subjects - as opposed to believing that a person is either born with science and math ability or not - she is more likely to succeed in a STEM field.”[3]
b) “boys do have a more positive attitude towards science than girls … These attitudes may be explained by the gender bias in textbooks and television where few women are depicted as engineers.”, “as the women progressed in their degree they expressed feelings of isolation and intimidation as well as a drop in self-confidence.”, “female students are discouraged by perceived lifestyle of senior female academics in their chosen field.”[4]
c) “the majority of incoming engineering students in this study perceive many issues as problematic for women pursuing careers in SEM, including conflicts between career and family, the length of preparation required, the perception of women in these fields as unfeminine, lack of confidence that they can handle the work, and lack of social encouragement to pursue these fields.”[5]
d) “females are less likely to engage in informal interactions with peers given their minority status in STEM majors. Lack of engagement in these areas may contribute to less satisfaction overall and lead to female departures from STEM degree programs.”, “Experiences on teams and informal study groups as well as the degree to which women

[3] Hill, C., Corbett C., and St. Rose A. (2010), “Why So Few?”, Women in Science, Technology, Engineering, and Mathematics. Washington, D.C.: AAUW, <http://www.aauw.org/learn/research/upload/whysofew.pdf>.
[4] Vrcelj Z. and Krishnan S. (2008), “Gender Differences in Student Attitudes Toward Engineering and Academic Careers”, Australian Journal of Engineering Education, 14(2): 43-55.
[5] Hartman H. and Hartman M. (2008), “How Undergraduate Engineering Students Perceive Women’s (and Men’s) Problems in Science, Math and Engineering”, Sex Roles, 58: 251-265.

are comfortable with their minority status, shape whether females see themselves working in an engineering field long-term."[6]

e) "An extensive literature has examined the causes of the persisting under-representation of women in science and engineering, attributing the under-representation to a complex set of factors, including: (1) social constructions of what is regarded as appropriate work for women, and thus issues of social and gender identity; (2) an educational "pipeline" that starts early in life and forms a sequence of study; (3) perceived barriers for women in science, compared to other fields; and (4) inequitable resources and opportunities offered to women compared to men in both education and employment in science/engineering."[7]

f) "women's lower level of self-confidence in mathematics and lower internal sense of ability or potential for scientific achievement can be seen as barriers to pursuing careers in these fields", "science and engineering teaching environments that may isolate students from social concerns, portray science and engineering as highly competitive, masculine domains, and tend to "weed-out" students in the curricular process."[8]

g) "1.Biological differences between men and women. 2. Girls' lack of academic preparation for a science major/career. 3.Girls' poor attitude toward science and lack of positive experiences with science in childhood. 4. The absence of female scientists/engineers as role models. 5.Science curricula are irrelevant to many girls. 6. The pedagogy of science classes favors male students. 7.A 'chilly climate' exists for girls/women in science classes. 8. Cultural pressure on girls/women to conform to traditional gender roles. 9. An inherent masculine worldview in scientific epistemology."[9]

h) "Women's heightened academic standards could be causing higher stress levels than those exhibited by men. If women had the same initial academic expectations as men, possibly more women would be inclined to enter an engineering degree program; and while in their major, more women would persist in their engineering degree if they encountered academic hurdles (such as retaking a class or getting a 'C')."[10]

i) "They develop sex-specific skills and interests, which drive girls away from science and technology fields", "Girls and women opt out of educational and career opportunities in SET because the masculine image of these fields conflicts with prevailing stereotypes of femininity", "Binary between femininity and masculinity in which women are domestic,

[6] Amelink C. and Creamer E. (2010), "Gender Differences in Elements of the Undergraduate Experience that Influence Satisfaction with the Engineering Major and the Intent to Pursue Engineering as a Career", Journal of Engineering Education, 99(1): 81-92.

[7] Sonnert G., Fox M., and Adkins K. (2007), "Undergraduate Women in Science and Engineering: Effects of Faculty, Fields, and Institutions Over Time", Social Science Quarterly, 88(5):1333-1356.

[8] Fox, M.F., Sonnert, G., and Nikiforova, I. (2009), "Successful Programs for Undergraduate Women in Science and Engineering: Adapting versus Adopting the Institutional Environment", Research in Higher Education, 50(4): 333-353.

[9] Blickenstaff J. (2005), "Women and Science Careers: Leaky Pipeline or Gender Filter?", Gender and Education, 17(4): 369-386.

[10] Concannon J.and Barrow L. (2009)., "Men's and Women's Intentions to Persist in Undergraduate Engineering Degree Programs", Journal of Science Education and Technology, 19(2): 133-145.

[9]Phipps, A, (2007), "Re-inscribing gender binaries: Deconstructing the dominant discourse around women's equality in science, engineering, and technology", The Sociological Review, 44(4): 768-787.

passive, and emotional while men are rational, individualistic, competitive, confident, and technically skilled." [11]

j) "Women who do enter the workforce are less likely to advance than men", "Women are more likely to lose self-confidence and feel less satisfied", "During their 20s and 30s - just when their career demands the most time - women need to make decisions about childbearing", "Women scientists tend to perfectionism, which can manifest itself in setting unreasonable expectations, more than men." [12]

k) "Scientific enquiry has until very recently been almost entirely conducted by men, the most fundamental aspects of systematic theory in the natural sciences have been pervaded by masculine perspectives deriving from masculine experiences", "The salient characteristic of SET culture has been the intertwining of masculinity and technology so that technical competence has come to constitute an integral part of masculine gender identity and conversely, a particular kind of masculinity has become central to the working practices of technology."[13]

l) "Evidence exists that in the high-school years, though well-meaning, science and math teachers fail to challenge young women as much as they should."[14]

m) "Young women tend to lose confidence in their ability to "do science," regardless of how well they are actually doing, when: they have insufficient independence in their learning styles, decision making, and judgments about their own abilities: to survive denial of motivational support and performance reassurance by faculty, the refusal of male peers to acknowledge that they belong in science."[15]

n) "Male-normed classrooms, often dubbed "chilly" climates for women, have generally been described in the literature as competitive, weed-out systems that are hierarchically structured with impersonal professors. These characteristics are acknowledged as customary, even respectable, teaching practices in traditional research university science, mathematics, and engineering classrooms. It is also these classrooms that have caused self-doubt in women, perhaps resulting in their attrition from science, mathematics, and engineering (SME)," "In engineering classrooms, social dynamics may cause women to feel more vulnerable to negative assessments by professors or peers. For example, Trow's landmark work (1973) stated that when a group is underrepresented in a higher educational system, then that system is elitist. In this case, the elite group has been, and continues to be, male; thus, females might feel out of place", "Women reported struggling for acceptance because they often perceived fewer opportunities to interact with other engineering students or professors (e.g., help-seeking and peer learning). Further, women reported feeling the need to work harder under more pressure (i.e., effort) to achieve the same ends as male engineering students. However, they were not

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[12]Burke, R.J. and M.C. Mattis, *Women and minorities in science, technology, engineering and mathematics: Upping the numbers* (Cheltenham: Edward Elgar Publishing Limited, 2007), 379.

[13] Siann G. and Callghan, M. (2001), "Choices and Barriers: factors influencing women's choice of higher education in science, engineering and technology", Journal of Further and Higher Education, 25(1): 85-95.

[14] Leslie, LL., Gregory T. McClure, and Ronald L. Oaxaca. (1998), "Women and minorities in science and engineering: a life sequence analysis." Journal of Higher Education, 69(3) 239+

[15] Seymour, E. (1995), "The Loss of Women from Science, Mathematics, and Engineering Undergraduate Majors: An Explanatory Account." Science Education, 79(4) 437-473.

always as comfortable with experimenting with the course material (i.e., critical thinking) in the same ways that men were", "Women often reported feeling intimidated by professors and peers and being less confident, it was further predicted that women would not seek help as readily from them as men", and "Because they may feel out of place in predominantly male classrooms, female students might be particularly uncomfortable, vulnerable, and humiliated in situations where their understanding is continually challenged."[16]

o) "1. Lack of early preparation. In junior high and high school, women's interest in math and science declines, and they take significantly fewer math and science courses than men. This differential course-taking prevents many women from majoring in science in college; 2. Lack of parental encouragement. For the most part, parents continue to discourage daughters from pursuing majors and careers in science; 3. Concerns about balancing career with family. Many women resist the pursuit of science because they perceive an SME career as incompatible with raising a family. In fact, research has shown that women's science career attainment and productivity tend to be compromised during child bearing and early child-rearing years. This period for most women occurs during the crucial early stages of their career; 4. Negative perceptions about the life of a scientist. Also influencing women's disinterest in science is an image of science careers as lonely, excessively demanding, and relatively unconnected to the improvement of society; 5. Limited access to role models and mentors. Due to the under representation of women in scientific careers, women students encounter fewer potential role models and same-sex mentors than men do; 6. Unwelcoming pedagogy in science. Compared with other faculty, science faculty are less likely to employ teaching styles preferred by women, such as class discussions, cooperative learning techniques, and student-selected topics, and are more likely to rely on lecturing and to enforce competitive grading practices."[17]

p) "Women with an interest in science are more likely to enter fields such as psychology and the biological and agricultural sciences."[18]

q) "Engineering in the United States continues to be perceived as a masculine domain where female presence is experienced as transgressive", "Women who wish to answer the call for increased participation in engineering experience a cultural space enmeshed in a web of conflicting threads of possibility and frustration", "Women who confront the traditional masculine norms shaping engineering must simultaneously respond to the conflicting feminine role expectations arising from the heterosexual social imperative", and "Women are faced with negotiating both an educational and life experience within two competing discourses: "Engineering is Men's Work" but "Women can (and must) do Engineering." As a result, women are precariously positioned in often simultaneous

[16] Vogt C.M., Hocevar D., and Hagedorn L.S. (2007), "A Social Cognitive Construct Validation: Determining Women's and Men's Success in Engineering Programs." The Journal of Higher Education, 78(3), 337-364.

[17] Sax, L.J. (2001), "Undergraduate Science Majors: Gender Differences in Who Goes to Graduate School." The Review of Higher Education, 24(2), 153-172.

[18] Little, A.J. and Leon de la Barra, B.A. (2009), "Attracting girls to science, engineering and technology: an Australian perspective." European Journal of Engineering Education, 34(5), 439-445.

compliance and resistance to the norms of hegemonic heterosexual femininity embodied in wife, mother, and nurturer."[19]

r) "Gender differences in children's and adolescents' perceptions of their mathematics and science abilities are robust. These gender differences in self-perceptions of skill and values related to mathematics and science are parallel to traditional academic stereotypes: Girls report greater self-competence in verbal domains, whereas boys report greater self-competence in and valuing of mathematics and science", "It is clear that many parents and teachers believe that boys are more capable in mathematics and science than girls, and some evidence indicates that adult stereotypes influence children's self-perceptions of ability and decisions about mathematics-related education and careers", and "By the time they reach high school, many girls have turned away from mathematics and the physical sciences as areas that are unimportant to their sense of self."[20]

s) "Women have a tendency to overcompensate for being in a male-dominated field, a phenomenon referred to as the "Madame Curie effect," meaning that women believe they must become more qualified and develop exceptional ability to compete with men in male-dominated science", "Disciplinary cultures and the nature of precollege and collegiate educational experiences combine to hinder women's persistence in SMET fields", "The cultural values played out in SMET fields also conflict with the preferred learning styles of many women", and "The masculine image of SMET fields also influences the early socialization of women students and is thought to diminish the interest of and academic achievement of young women in science and math courses in high school."[21]

t) "Because female students are not aware of female mathematicians and scientists, they may internalize a belief that mathematics is not appropriate for women."[22]

u) "Based on interviews with recipients of NSF's POWRE grants, Rosser finds that the greatest institutional barrier to their full participation in STEM is the failure of universities to respond effectively to women's need for balancing family and career."[23]

[19] Foor, C.E. and Walden, S.E. (2009), ""Imaginary Engineering" or "Re-imagined Engineering": Negotiating Gendered Identities in the Borderland of a College of Engineering." Feminist Formations, 21(2), 41-64.

[20] Kurtz-Costes B., Rowley S.J., and Harris-Britt, A. (2008), "Gender Stereotypes about Mathematics and Science and Self-Perceptions of Ability in Late Childhood and Early Adolescence." Merrill Palmer Quarterly, 54(3), 386-409.

[21] Zhao C.M., Carini R.M., and Kuh, G.D. (2005), "Searching for the Peach Blossom Shangri-La: Student Engagement of Men and Women SMET Majors." The Review of Higher Education, 28(4), 503-525.

[22] Wiest, L.R. (2009) "Female Mathematicians as Role Models for All Students." Feminist Teacher, 19(2), 162-167.

[23] Bystydzienski, J.M. (2004), "(Re)Gendering Science Fields: Transforming Academic Science and Engineering." Feminist Formations, 16(1), viii-xii.

Possible Measures

To increase the number of women enrolled in NSE fields, some possible measures were identified in recent works, and are listed below:

a) "If girls grow up in an environment that enhances their success in science and math with spatial skills training, they are more likely to develop their skills as well as their confidence and consider a future in a STEM field.", "To diversify the STEM fields we must take a hard look at the stereotypes and biases that still pervade our culture.", "Spread the word about girls' and women's achievements in math and science", "Teach girls that intellectual skills, including spatial skills, are acquired"[24]
b) "Address the leaky pipeline by supporting and getting involved in mentoring programs, outreach, and promoting positive role models", "Increasing the number and visibility of women role models at high levels in both academia and industry could also increase the number of women who advance from the BS to the MS and PhD levels, and eventually into successful careers in academia and industry...the number of women faculty members at an institution has a direct impact on the success of women students" [25]
c) "Building supportive programs that connect the students to the larger environment and involve collaboration and alliances: … partnerships with industry … centres for career development … "hands-on" engineering or technological activities"[26]
d) "For policies or programs to support female undergraduates in these disciplines, it may therefore be advisable to take field differences into account and to tailor efforts and initiatives to the situation in specific fields.", "to improve the participation of women undergraduates in the sciences and engineering: the level of individual fields and departments appears to matter much more than the level of the whole institution"[27]
e) "exposure to professional engineering experiences reduces the seriousness with which some problems are perceived, especially by women", "Particularly important are mentoring programs with role models who can demonstrate the people-helping facets of careers in the sciences and technology, a concern voiced by many students in SEM fields "[28]
f) "positive role models may provide a valuable support network, particularly in order to manage workplace cultures within male dominated fields"[29]

[24] Hill, C., Corbett C., and St. Rose A. (2010), "Why So Few?", Women in Science, Technology, Engineering, and Mathematics. Washington, D.C.: AAUW, <http://www.aauw.org/learn/research/upload/whysofew.pdf>.
[25] Chesler, N.C., Barabino, G., Bhatia, S.N., and Richards-Kortum, R. (2010), "The Pipeline Still Leaks and More Than You Think: A Status Report on Gender Diversity in Biomedical Engineering", Annals of Biomedical Engineering, 38(5): 1928-1935.
[26] Fox, M.F., Sonnert, G., and Nikiforova, I. (2009), "Successful Programs for Undergraduate Women in Science and Engineering: Adapting versus Adopting the Institutional Environment", Research in Higher Education, 50(4): 333-353.
[27] Sonnert G., Fox M., and Adkins K. (2007), "Undergraduate Women in Science and Engineering: Effects of Faculty, Fields, and Institutions Over Time", Social Science Quarterly, 88(5):1333-1356.
[28] Hartman H. and Hartman M. (2008), "How Undergraduate Engineering Students Perceive Women's (and Men's) Problems in Science, Math and Engineering", Sex Roles, 58: 251-265.
[29] Vrcelj Z. and Krishnan S. (2008), "Gender Differences in Student Attitudes Toward Engineering and Academic Careers", Australian Journal of Engineering Education, 14(2): 43-55.

g) "suggestions to ameliorate the under-representation of women in STEM: 1.Ensure students have equal access to the teacher and classroom resources. 2. Create examples and assignments that emphasize the ways that science can improve the quality of life of living things. 3. Use cooperative groups in class, or at least avoid dividing students by sex for class competitions or in seating arrangements. 4.Eliminate sexist language and imagery in printed materials. 5.Do not tolerate sexist language or behaviour in the classroom. 6.Increase depth and reduce breadth in introductory courses. 7. Openly acknowledge the political nature of scientific inquiry."[30]

h) "Develop forums to highlight successes of women scientists", "Formalize mechanisms for opportunities, awareness and development for women in science", "Increase the number of women in society leadership roles", "Find and implement new strategies for leadership development programs within societies", and "Provide training and facilitate understanding regarding the 'rules of the game' as they pertain to networking, promotion and tenure, etc."[31]

i) "Special efforts to expose female and minority students to elective math and science courses in their pre-college years is important to enhancing both the skill acquisition and the confidence necessary to making science a feasible choice for a college major", "Families clearly can be highly instrumental to the science and engineering related aspirations and commitment of their children. Special attention should be given to matters of early socialization", "We must develop also more and better interventions for the adolescent years, especially in support systems", and "Consideration should be given to structuring housing arrangements so that female and minority science and engineering majors can live in proximity to one another, thus permitting the reinforcement of science and engineering goals and proactively working against detractions".[32]

j) "Educate young girls in ways that build more independent modes of learning, choice-making, and assessment of their own abilities, so they may better survive in unremediated SME cultures", and "Make fundamental changes in traditional SME pedagogy (including those assumptions and practices which support it), so as to meet the needs of students (both men and women) who seek more interactive and nurturing teacher-learner relationships."[33]

k) "K-12 and undergraduate education can better educate women (and ideally all students) about the many ways in which scientific work aims at improving society and the human condition, particularly in an era of rapidly expanding computer and biological technologies", and "We must consider how science can be more accommodating for women who want to balance raising a family with a career in science."[34]

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[30] Blickenstaff J. (2005), "Women and Science Careers: Leaky Pipeline or Gender Filter?", Gender and Education, 17(4): 369-386.

[31] Burke, R.J. and M.C. Mattis, *Women and minorities in science, technology, engineering and mathematics: Upping the numbers* (Cheltenham: Edward Elgar Publishing Limited, 2007), 379.

[32] Leslie, LL., Gregory T. McClure, and Ronald L. Oaxaca. (1998), "Women and minorities in science and engineering: a life sequence analysis." Journal of Higher Education, 69(3) 239+

[33] Seymour, E. (1995), "The Loss of Women from Science, Mathematics, and Engineering Undergraduate Majors: An Explanatory Account." Science Education, 79(4) 437-473.

[34] Sax, L.J. (2001), "Undergraduate Science Majors: Gender Differences in Who Goes to Graduate School." The Review of Higher Education, 24(2), 153-172.

l) "Teachers who work with talented girls in maths and science must concern themselves with strategies that promote the development of girls' talent in all STEM areas", and "Science education should form a key part of the primary curriculum. But in recognising that students at this age are unable to cope with abstract ideas and tend to gain much from personal involvement activities, the 'hands-on' science education provided is readily accepted by students. Through this approach, it is easy to motivate and interest girls."[35]
m) "When SMET courses use gender-sensitive pedagogy that downplays the masculine culture of competition and encourages collaboration through group projects and negotiated learning, women tend to perform well and are reasonably well-satisfied."[36]
n) "To attract female students, Margolis and Fisher (2002) suggested that computer science not be embedded solely in science and mathematics, that its social relevance and practical applications be considered, that more concerted efforts be made to recruit women and minorities not simply on the basis of high test scores and grades, and that more intense faculty-student interaction be encouraged", "We also recommend that advising have a strong career-planning orientation, particularly for female undergraduates", and "Finally, the pilot study suggests that even in a situation where the numbers of women and men are equal, sexism is not totally absent. Hence, efforts have to be made to recognize and deal with the more subtle forms of gender inequality."[37]
o) "That the (remaining) barriers to women's progress in academia are systemic and rather than trying to change women to fit the sciences and engineering, these fields need to be changed in order to accommodate women", and "separating "mechanism" from "reductionism" can create space for a plurality of methods, including feminist and gender-sensitive approaches, and for science that is more inclusive of women and all those whose perspectives have been previously marginalized."[38]
p) "Science must also be "marketed" toward women", and "Talks, seminars, or workshops are single events; whereas changes in departmental practices and rules or the establishment of a commission for women in science, for instance, are more permanent."[39]
q) If we want more women scientists: "We must educate boys and girls for all their major adult roles-as parents, spouses, workers, and creatures of leisure. This means giving more stress in education, at home and at school, to the future family roles of boys and the future occupational roles of girls. Women will not stop viewing work as a stopgap until meaningful work is taken for granted in the lives of women as it is in the lives of men", "We must stop restricting and lowering the occupational goals of girls on the pretext of counselling them to be "realistic." If women have difficulty handling the triple roles of

[35] Little, A.J. and Leon de la Barra, B.A. (2009), "Attracting girls to science, engineering and technology: an Australian perspective." European Journal of Engineering Education, 34(5), 439-445.
[36] Zhao C.M., Carini R.M., and Kuh, G.D. (2005), "Searching for the Peach Blossom Shangri-La: Student Engagement of Men and Women SMET Majors." The Review of Higher Education, 28(4), 503-525.
[37] Harris B.J., Rhoads T.R., and Walden S.E. (2004), "Gender Equity in Industrial Engineering: A Pilot Study." Feminist Formations, 16(1), 186-193.
[38] Bystydzienski, J.M. (2004), "(Re)Gendering Science Fields: Transforming Academic Science and Engineering." Feminist Formations, 16(1), viii-xii.
[39] Sonnert, G. (1999), "Women in Science and Engineering: Advances, Challenges, and Solutions." Annals of the New York Academy of Sciences, 869, 34-57.

member of a profession, wife, and mother, their difficulties should be recognized as a social problem to be dealt with by social engineering rather than be left to each individual woman to solve as best she can. Conflicts and difficulties are not necessarily a social evil to be avoided; they can be a spur to creative social change", "We must apply our technological skill to a rationalization of home maintenance. The domestic responsibilities of employed women and their husbands would be considerably lightened if there were house-care service firms, for example, with teams of trained male and female workers making the rounds of client households, accomplishing in a few hours per home and with more thoroughness what the single domestic servant does poorly in two days of work at a barely living wage", and "We must encourage men to be more articulate about themselves as males and about women. Three out of five married women doctors and engineers have husbands in their own or related fields. The views of young and able women concerning marriage and careers could be changed far more effectively by the men who have found marriage to professional women a satisfying experience than by exhortations of professional women, or of manpower specialists and family-living instructors whose own wives are homemakers."[40]

r) "A better understanding of what engineers do will also help break the link between schoolgirls' underachievement in math and science and their absence from the engineering profession", "The image of an engineer as male is so deeply ingrained in the American psyche that simply seeing women who proudly announce that they are engineers can have a major impact. This visual message, that some engineers are women, is especially relevant for today's young people who have grown up with television and videos and are very visually oriented", and "Educating adults so that they are supportive of young women who are studying engineering is vital."[41]

s) "The need for female role models for women students in science and engineering has been widely noted as has the importance of out-of-class student-faculty interactions in promoting academic success and building self-esteem. Perhaps the most effective way to help women engineering students would therefore be to add more women to engineering faculties", "Strengthen organizations that can provide career guidance and emotional support to women students, such as student chapters of the Society of Women Engineers, and encourage participation in these organizations", "Use cooperative learning in engineering courses, structured to provide equal benefits to men and women", and "All faculty members should be made aware of the difficulties faced by women engineering students and of the resources on campus—support groups, mentorship programs, trained counsellors, etc.—available to help the women cope with and overcome these difficulties."[42]

t) It has been said that we need to consider not only women in science, but also women and science. Sustained efforts rather than short-term fixes are required with explicit goals,

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[40] Rossi, A.S. (1965), "Women in Science: Why So Few?" American Association for the Advancement of Science, 148(3674), 1196-1202.

[41] Isaacs, B. (2001), "Mystery of the Missing Women Engineers: A Solution." Journal of Professional Issues in Engineering Education and Practice, 127(2), 85-91.

[42] Felder MF, Felder GN, Mauney M, Hamrin CE Jr., and Dietz EJ (1995), "A Longitudinal Study of Engineering Student Performance and Retention.III. Gender Differences in Student Performance and Attitudes." Journal of Engineering Education, 84(2), 151-163.

implementation plans and quantitative and qualitative evaluations of processes as well as outcomes, bearing in mind that any initiatives are likely to falter along the way, given the complex processes involved in knowledge production."[43]

u) "To increase girls' confidence, performance, and interest in science, the major reform that advocates call for is increasing the emphasis on hands-on science instruction in schools", "In one study examining schools with favorable records of female enrolment in Advanced Placement courses in mathematics and science, Casserly (1980) outlined the components of teaching especially encouraging to girls, such as cooperative rather than competitive motivational techniques (putting students against each other), less public drill instruction, more hands-on learning, problems with practical implications and opportunities for creative solutions, and active, open-ended learning situations", and "Another suggestion is to increase the interest value (i.e., personal relevance) of science experiments. One study found that such interest enhancements are particularly effective for girls (Martinez, 1992)."[44]

v) Recommended to attract women to science: "For observations: 1. Expand the kinds of observations beyond those traditionally carried out in scientific research; 2. Increase the numbers of observations and remain longer in the observational stage of the scientific method; 3. Incorporate and validate personal experiences that women are likely to have had as part of the class discussion or the laboratory exercise; 4. Undertake fewer experiments that are likely to have applications of direct benefit to the military and propose more experiments to explore problems of social concern; 5. Consider problems that have not been considered worthy of scientific investigation because of the field with which the problem has been traditionally associated; 6. Formulate hypotheses that focus on gender as a crucial part of the question asked; For methods: 1. Use a combination of qualitative and quantitative methods in data gathering; 2. Include women as experimental subjects in experiment designs; 3. Use more interactive methods, thereby shortening the distance between observer and the object being studied; 4. Decrease laboratory exercises in introductory courses in which students must kill animals or render treatment that may be perceived as particularly harsh; For conclusions and theories drawn from data gathered: 1. Use precise, gender neutral language in describing data and presenting theories; 2. Be open to critiques of observations, conclusions, and theories drawn from the observations that would be different from those drawn by the traditional male scientist from the same observations; 3. Encourage uncovering of other biases such as those of race, class, sexual preference, and religious affiliation which may permeate theories and conclusions drawn from experimental observation; 4. Encourage development of theories and hypotheses that are relational, interdependent and multi-causal rather than hierarchical, reductionistic, and dualistic. For the practice of science: 1. Use less competitive models in practicing science; 2. Discuss the role of scientist as only one facet which must be smoothly integrated with other aspects of students' lives; 3. Put increased effort into strategies such as teaching and communicating with non-scientists to

[43] Bebbington, D. (2002), "Women in Science, Engineering and Technology: A Review of the Issues." Higher Education Quarterly, 56(4), 360-375.

[44] Burkham DT, Lee VE, and Smerdon BA (1997), "Gender and Science Learning Early in High School: Subject Matter and Laboratory Experiences." American Educational Research Journal, 34(2), 297-331.

breakdown barriers between science and the lay person; 4. Discuss the practical uses to which scientific discoveries are put to help students to see science in its social context."[45]

[45] Rosser, S.V. (1989), "Teaching Techniques to Attract Women to Science: Applications of Feminist Theories and Methodologies." Women's Studies Int. Forum, 12(3), 363-377.