

September 2007

DRAFT: Policy Brief

Gender Equity in Academic Programs at Washington's Public Four-Year Colleges and Universities

Summary

This policy brief explores gender equity in science and technology, engineering, mathematics, (STEM) and health sciences programs. It explores why relatively few female students earn degrees in STEM fields and few men earn degrees in health sciences fields. The report also identifies policy options that would help achieve a more equitable gender distribution in degree conferment rates.

Findings include the following:

- Male and female students are equally prepared to pursue postsecondary education in STEM and health science fields.
- High school students exhibit a high degree of vocational self-segregation by gender when asked to identify probable major fields; patterns that persist through their college experience.
- Women who take STEM courses as college freshmen are less likely to major in those fields than their male counterparts. Similarly, men who take courses in the pre-med/health sciences cluster are less likely to major in those subjects than are female students.
- Despite the recent growth of female doctoral graduates in STEM fields, the percentage of female faculty in these departments remains low.
- Women working in STEM fields earn a higher percentage of what men earn than women do in non-STEM fields, but wage parity has not yet been achieved in STEM fields or in health services.

Policy initiatives with the greatest potential for effectiveness are those that (1) raise student awareness of STEM and health sciences career opportunities, and (2) increase faculty diversity in STEM and health science departments.

Background

In December 2006, the Higher Education Coordinating Board (HECB) released a report on gender equity in higher education.¹ The report looked at gender equity in student services, athletics, and academic programs. At a subsequent HECB meeting, Board members took particular interest in the report's academic programs analysis and directed staff to conduct further analysis. This policy brief summarizes the results of that research.

Table 1

Program areas in which one or Washington public four-year institutions disproportionately awarded degrees to:

Female Students	Male Students
Family and consumer sciences/human sciences	Computer and information sciences
Health professions and related clinical sciences	Engineering technologies/technicians
Education	Engineering
Public administration and social service professions	Mathematics and statistics
Psychology	Business, management, and marketing
Visual and performing arts	Architecture and related services
Foreign languages, literatures, and linguistics	Physical sciences
Area, ethnic, cultural, and gender studies	Parks, recreation, leisure, and fitness studies
Communication, journalism, and related programs	History
	Security and protective services
	Philosophy and religious studies
	Social sciences

Note: Programs in italics are highly disproportionate (variance of 20 percentage points or more from institutional mean). Other programs are substantial disproportionate (10-20 percentage point variance).

Source: HECB, *Gender Equity in Higher Education*, <http://www.hecb.wa.gov/research/issues/gender.asp>.

The 2006 report found that among Washington's five public baccalaureate universities (University of Washington, Washington State University, Eastern Washington University, Central Washington University, and Western Washington University), 81 program areas confer 50 or more bachelor's degrees². Of those 81 major program areas, 45 (56 percent) are highly or substantially disproportionate in the awarding of degrees to male and female students, with 23 programs dominated by male students, and 22 dominated by female students. (Table 1 lists the program areas that exhibit disproportionate degree conferment rates.)

¹ Washington Higher Education Coordinating Board (2006), *Gender Equity in Higher Education*, Olympia, Washington. See <http://www.hecb.wa.gov/research/issues/gender.asp>.

² The Evergreen State College was not included in the analysis because the institution reports all degrees in the same major subject area, Liberal Arts/Interdisciplinary Studies.

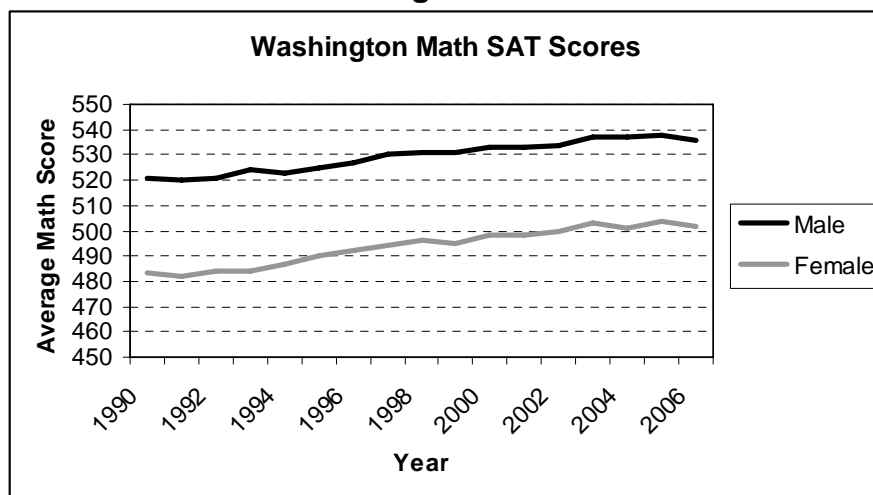
The HECB asked staff to examine why so many major programs exhibit disproportionate degree conferment rates, and also identify policy and program options for promoting greater gender equity. The Board was particularly concerned about academic fields that are in high demand in the state's economy, including science and technology, engineering, mathematics, and health sciences fields. A set of research questions was identified and are found in bold at the beginning of each section of this report.

Preparation

Are Washington's male and female students equally academically prepared to take science, technology, engineering and math (STEM) or health sciences courses when they enter college?

Washington State has only recently defined the skills, knowledge, and abilities that constitute college readiness in science and mathematics.³ Statewide assessment information on math and science college readiness, based on these new definitions, does not yet exist. In lieu of assessment results based on state college readiness standards, researchers often turn to standardized tests such as the science and math National Assessment of Educational Progress (NAEP), and college entrance exams - math SAT and science and math ACT scores. The college entrance exams are relevant because they zero in on the students that intend to go to college. In 2005-06, 54 percent of Washington high school graduates took the SAT and 15 percent took the ACT.

Figure 1



Source: College Board, *Washington State Profile Report*, http://www.collegeboard.com/prod_downloads/about/news_info/cbsenior/yr2006/washington-2006.pdf

³ For information about the math readiness standards, go to <http://www.transitionmathproject.org>. For the science readiness standards, go to <http://www.learningconnections.org/clc/hecb.htm>.

On all of these standardized tests, male students scored higher than female students. The test score gaps were small, but they were steady and persistent (see Figure 1). The test score gap exists at both the national and statewide levels. For 2005-06, the average male student score on the math SAT in Washington exceeded the average female score by 38 points (a 7.4 percent gap), the math ACT gap was 7.7 percent, the science ACT gap was 6.4 percent, and the math and science advanced placement gap was 7.3 percent.

Complicating the matter further is the apparent lack of a strong correlation between aptitude for math and science in high school expressed in standardized tests, and later student success in college courses and science and engineering careers. A study looking at mean college GPAs for engineering and physics majors at MIT found that gender differences in math SAT scores did not translate into differences in classroom performance.⁴ Another study found that when math SAT scores are matched, female students go on to earn higher grades in college mathematics classes.⁵ Finally, a study found that less than one-third of men working in STEM fields were found to have math SAT scores above 650 (800 is the maximum score on the test).⁶

Researchers continue to posit theories on why standardized tests appear to systematically underestimate female student achievement in science and math courses, and later college and career success in these fields (relative to that of male students). One theory is that the tests may be gender biased. Analysis of test items finds that many items show performance disparities by sex, making it possible to design a test that favors one gender or another by including items that favor that gender.⁷ Another theory suggests that female students may be at a disadvantage vis-à-vis their male counterparts when asked to come up with “clever and speedy” applications of mathematical skills to unfamiliar problems and circumstances, and that female students tend toward a more reflective approach to mathematical problem solving that takes more time (thereby increasing time pressures on a timed test). This theory would be consistent with female students doing better than male students in classroom math and science exams on familiar and practiced concepts, and not as well on standardized tests.

Analysis of a national sample of high school transcripts bears this out; and in fact, suggests that female students may have a slight edge over their male counterparts with regard to math and science. Female high school graduates have recently surpassed male graduates in completing rigorous curricula, earning more mathematics and science credits and higher math and science GPAs.⁸

⁴ Gallagher, A. (1998). “Gender and Antecedents of Performance in Mathematics Testing,” *Teacher College Record*, V. 100, No. 2, Winter 1998, pp. 297-314.

⁵ Spelke, E.S. (2005). “Sex Differences in Intrinsic Aptitude for Mathematics and Science? A Critical Review” *American Psychologist*, Vol. 60, No. 9, December 2005, pp. 950-958.

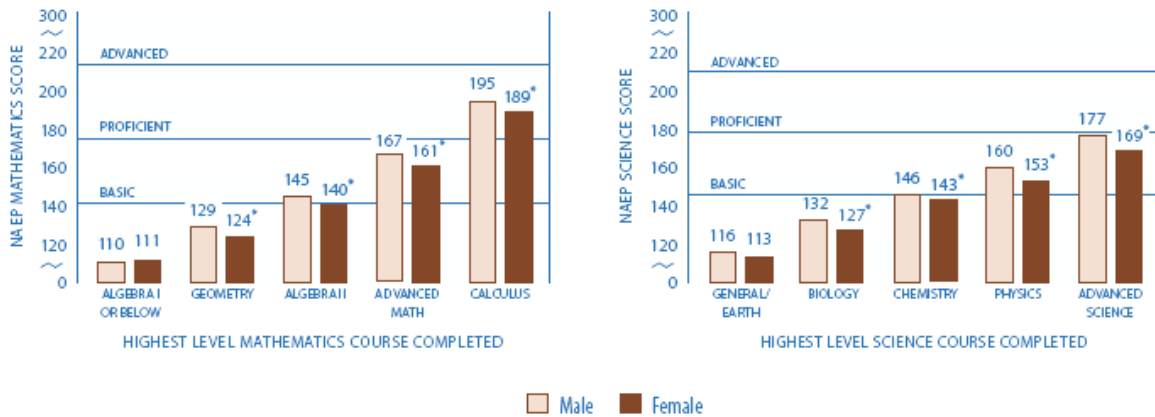
⁶ National Academy of Sciences (2006), *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*. Washington, D.C.: National Academy Press.

⁷ Spelke, E.S. (2005). *Supra*.

⁸ National Center for Education Statistics (2007). *The Nation's Report Card, America's High School Graduates: Results from the 2005 High School Transcript Study*. See <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007467>

So what happens when we look at standardized test scores and control for high school courses taken and GPA? As Figure 2 indicates, even when you control for the highest math and science course completed, male students outscore female students on the NAEP test. The same is true when you control for math and science GPA.

Figure 2
 NAEP Mathematics and Science Scores
 by Highest Course Completed and Gender



*Significantly different (p<.05) from males.

NOTE: Advanced mathematics includes courses, other than calculus, that are generally taken after algebra II (e.g., AP statistics and precalculus). Advanced science courses are courses that contain advanced content (like AP biology, IB chemistry, AP physics, etc.) or are considered second-year courses (chemistry II, advanced biology, etc.).

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, High School Transcript Study (HSTS), 2005.

Table 2

Mathematics Course-Taking Patterns
 Washington SAT-Takers
 2006

Years of Study	Test-Takers		Percent by Gender	
	Number	Percent	Male	Female
More than 4 years	3,408	12%	50%	50%
4 years	16,461	57%	46%	54%
3 years	7,545	26%	42%	58%
2 years	1,139	4%	44%	56%
1 year	105	0%	44%	56%
1/2 year or less	65	0%	48%	52%
No response	5,427			
Course Work				
Algebra	26,275	92%	45%	55%
Geometry	25,502	90%	45%	55%
Precalculus	17,457	61%	46%	54%
Calculus	16,400	58%	47%	53%
Other Math Courses	8,842	31%	50%	50%
Computer Math	6,731	24%	42%	58%
AP/Honors Courses	7,708	27%	47%	53%

Note: 54 percent of all test-takers were female.
 Source: The College Board, *State Profile Report: Washington, 2006*.

Table 3

Natural Sciences Course-Taking Patterns
 Washington SAT-Takers
 2006

Years of Study	Test-Takers		Percent by Gender	
	Number	Percent	Male	Female
More than 4 years	1,578	6%	46%	54%
4 years	11,294	40%	46%	54%
3 years	10,167	36%	43%	57%
2 years	4,530	16%	47%	53%
1 year	689	2%	51%	49%
1/2 year or less	239	1%	45%	55%
No response	5,653			
Course Work				
Biology	26,690	94%	44%	56%
Chemistry	22,893	80%	45%	55%
Physics	13,390	47%	51%	49%
Geology, Earth, or				
Space Science	10,951	38%	45%	55%
Other Sciences	12,635	44%	42%	58%
AP/Honors Courses	6,109	21%	45%	55%

Note: 54 percent of all test-takers were female.
 Source: The College Board, *State Profile Report: Washington, 2006*.

The 54 percent of Washington high school graduates that took the SAT exam in 2006 were asked about their course-taking behavior. This self-reported questionnaire data provides information on which math and science courses students planning to attend college have taken and plan to take in high school. The results are summarized in Tables 2 and 3.

These tables indicate that female students are taking upper-level science and math courses (with the exception of physics) at or near their representation in the test-taking population (54 percent of Washington SAT-takers are female), including AP/honors courses. Average grade point averages for mathematics self-reported by male and female test-takers are equal (3.2), and are slightly higher for female students for natural sciences (3.4 for female test-takers and 3.3 for male test-takers).⁹

The two main measures of math and science college readiness yield contradictory information on gender equity. Females in Washington state and nationally, appear to score consistently and slightly lower than their male counterparts do on standardized assessments of math and science aptitude. But when math and science high school course-taking behavior and grades are analyzed, female students appear to have a slight edge over their male counterparts. Because common practice in college admissions is to consider both test scores and high school transcripts, the two may balance each other out. This yields the conclusion that male and female high school graduates in Washington are roughly equally prepared to complete college-level math and science courses.

Interest

Are male and female lower-division students equally likely to take STEM and health sciences courses? Why do students who take introductory courses in these fields decide whether or not to major in them?

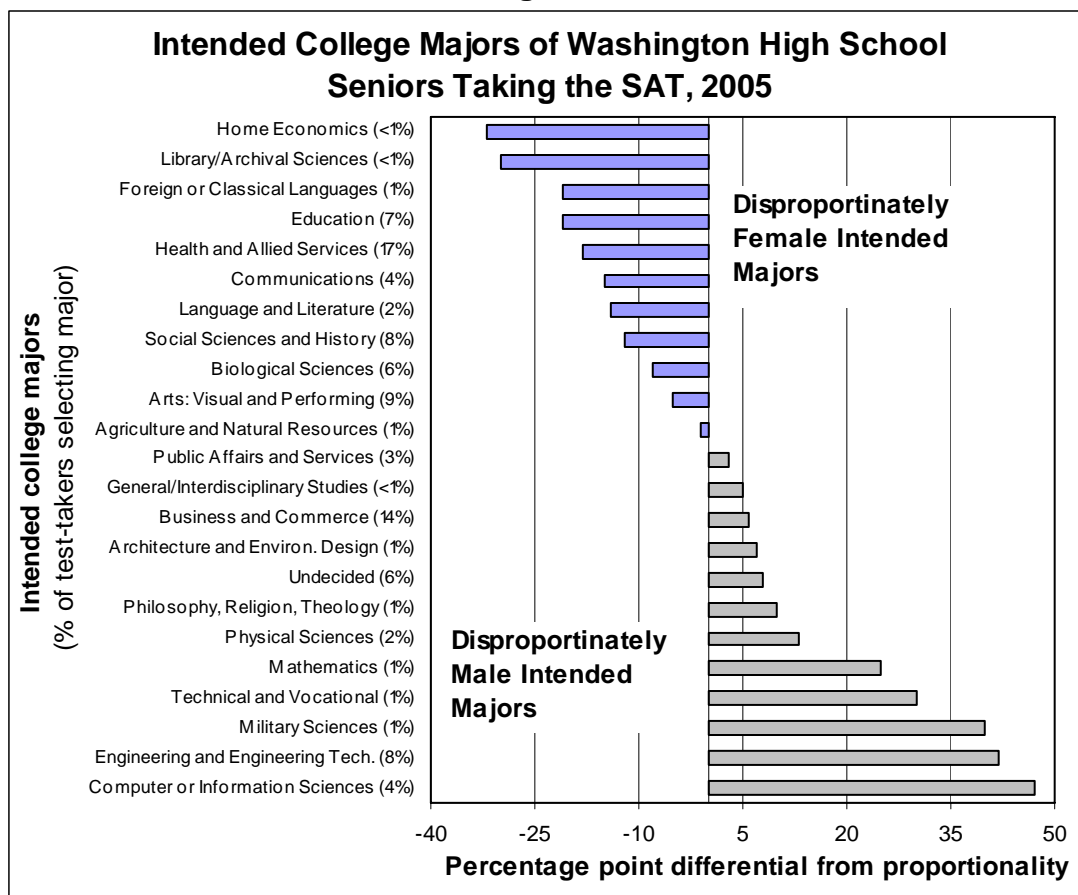
Despite the apparent rough parity in the academic preparation of male and female students for college-level work in the STEM and health sciences fields, the choices students make regarding college and careers seem to diverge before getting to college. National data from 2004 indicated that about 26 percent of female college freshmen intended to major in science and engineering fields, compared to 41 percent of freshman males.¹⁰ Male freshmen are predisposed to major in every field of science and engineering except the biological and social sciences.

A look at Washington SAT-takers in 2005 shows that, even before getting to college, college-bound high school students are starting to make academic and career choices in a gender-skewed manner. Most college major fields indicate interest from either predominately male or predominantly female students. As Figure 3 indicates, only about one-third of intended major fields show rough proportional equity (less than 10 percentage point deviation) by gender.

⁹ The College Board (2006), *State Profile Report: Washington 2006*. See http://www.collegeboard.com/prod_downloads/about/news_info/cbsenior/yr2006/washington-2006.pdf.

¹⁰ Based on data from the Higher Education Research Institute at UCLA, *Survey of American Freshmen*, as presented in National Science Foundation (2004), *Women, Minorities, and Persons with Disabilities in Science and Engineering*, *op. cit.*

Figure 3



Source: The College Board, *State Profile Report: Washington 2005*.

Figure 3 shows that by the senior year of high school when most test-takers sit for the SAT, intended college majors are highly skewed by gender for many fields of study. The percentages following each major are the percentage of all test-takers who selected the intended major on the questionnaire. The length of the bars indicates the percentage point deviation from proportionality: 44 percent of all test takers indicated an intended major were male, and 56 percent were female, so the bars represent the percentage point deviation from those benchmarks.

Table 4 shows the distribution for the fields of study currently in high demand by Washington employers. The STEM fields -- computer science, engineering, mathematics, physical and biological sciences -- are grouped together.

Table 4
Intention of Washington SAT-Takers to Major
in High Demand Fields, 2005

Intended Field of Study	Test-Takers		Percent	
	Number	Percent	Male	Female
STEM Fields	5,168	21%	70%	30%
Health and Allied Services	4,220	17%	26%	74%
Education	1,806	7%	23%	77%

Source: The College Board, *State Profile Report: Washington 2005*.

Table 4 shows that nearly half of all high school students are interested in majoring in three high-demand fields of study, but their interest is highly skewed by gender. Convincing more female students to pursue the STEM fields and more male students to pursue health services and education may be an effective strategy for meeting employer demand for qualified workers in these fields.

Persistence

Are male and female students in Washington who take introductory courses in STEM and health sciences equally likely to persist and take additional courses and go on to get a degree in these fields? Have persistence rates changed over time?

National studies of student persistence in STEM fields by gender present a mixed picture that varies from study to study and for different fields within STEM. Engineering programs show higher rates of persistence for male students than for female students. This is particularly true for high-achieving students. One study found that only 29 percent of top undergraduate women remained in engineering programs, compared to 82 percent of top undergraduate men.¹¹

The variables that affect persistence affect both men and women, but may affect women disproportionately. These variables include the presence of appropriate role models, student knowledge about engineering, and the student's willingness/ability to work long and stressful hours while managing other competing demands for his or her time. There is also a demographic factor that inhibits persistence of female students in all fields (not just STEM fields). Women comprise 60 percent of all students in the lowest income quartile, 62 percent of all students 40 and older, 62 percent of married or separated students with children or dependents, and 69 percent of single-parent students.¹²

Finally, the structure of the science and engineering curriculum itself may inhibit students from testing the waters in a field and from persisting in that field. On many campuses, students are not presented with a clear picture of the field of engineering and its applications until far into the

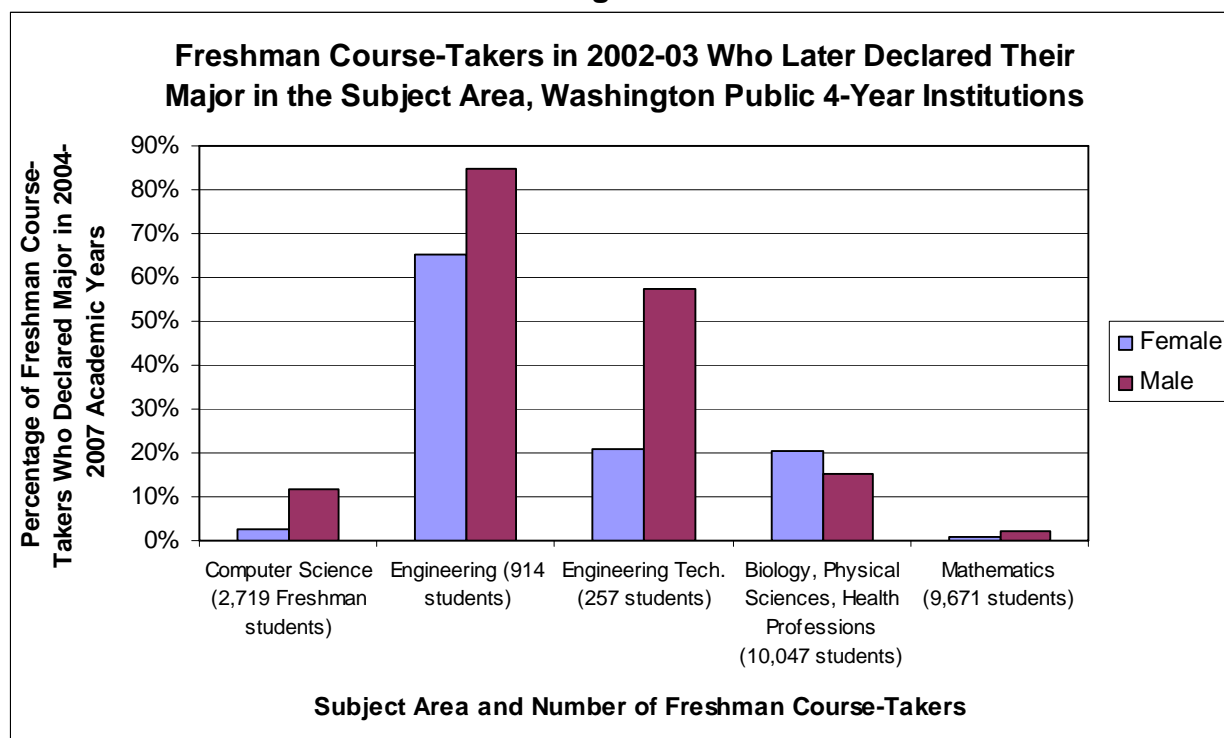
¹¹ National Research Council of the National Academies (2006). *To Recruit and Advance: Women Students and Faculty in Science and Engineering*, pages 46-50.

¹² *ibid*, page 51.

curriculum, often the second or third year of study. Women and under-represented minorities are less likely to be exposed to engineering as a profession prior to their first foray into the field, and may find the curriculum uninviting.¹³

To look at persistence rates by gender for students at Washington public 4-year institutions, HECB staff conducted an analysis using the state's Public Centralized Higher Education Enrollment System (PCHEES) database. First, a cohort of new freshman students who were taking STEM and health sciences courses in 2002-03 was identified. The system was queried to determine whether these students subsequently declared a major in the same fields in which they had taken courses as freshmen. The results are broken out by gender and presented in Figure 4. (Note that The Evergreen State College was not included in the analysis because all students major in the same Liberal Arts and Sciences academic field of study.)

Figure 4



Source: HECB analysis using PCHEES state data reporting system.

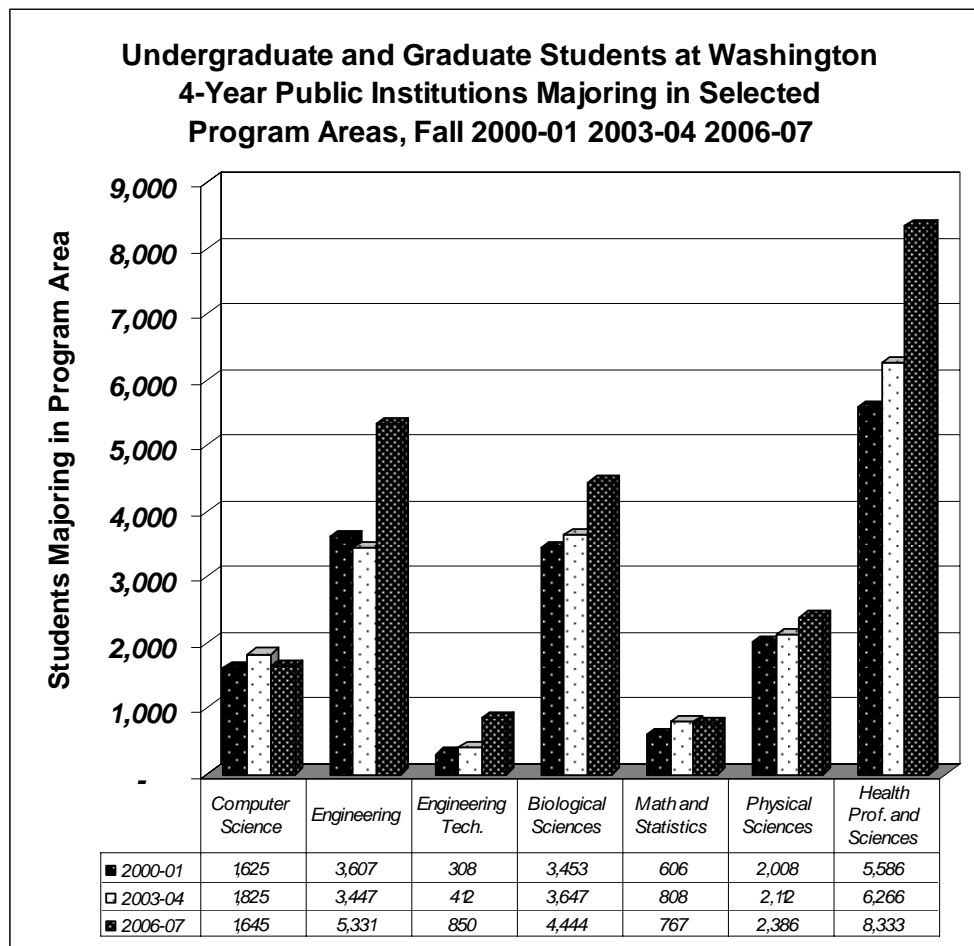
Many students take math and computer science courses as freshmen to support their studies in many other fields or to fulfill a distribution requirement, but they do not intend to major in math or computer science. This explains the low percentages of students who later choose to major in these subject areas. Biology, physical sciences, and health professions were grouped together because nurses, pre-med students, and other health professionals typically take biology and chemistry as freshmen. This is the only area studied where female students more often than male students tend to major in the field they first started studying as freshmen. Overall, more female than male students are majoring in the biological sciences and the health professions (including nursing).

¹³ National Research Council of the National Academies (2006). *Supra*, page 53.

Male students who took computer science, engineering, engineering technology, and mathematics courses as freshmen were more likely than their female counterparts to later select those fields as majors. The chart indicates that most students (male and female) tend not to take engineering courses, even as freshmen, unless they intend to major in the subject. Based on the chart, gender inequality in student persistence is highest for computer science and engineering technology.

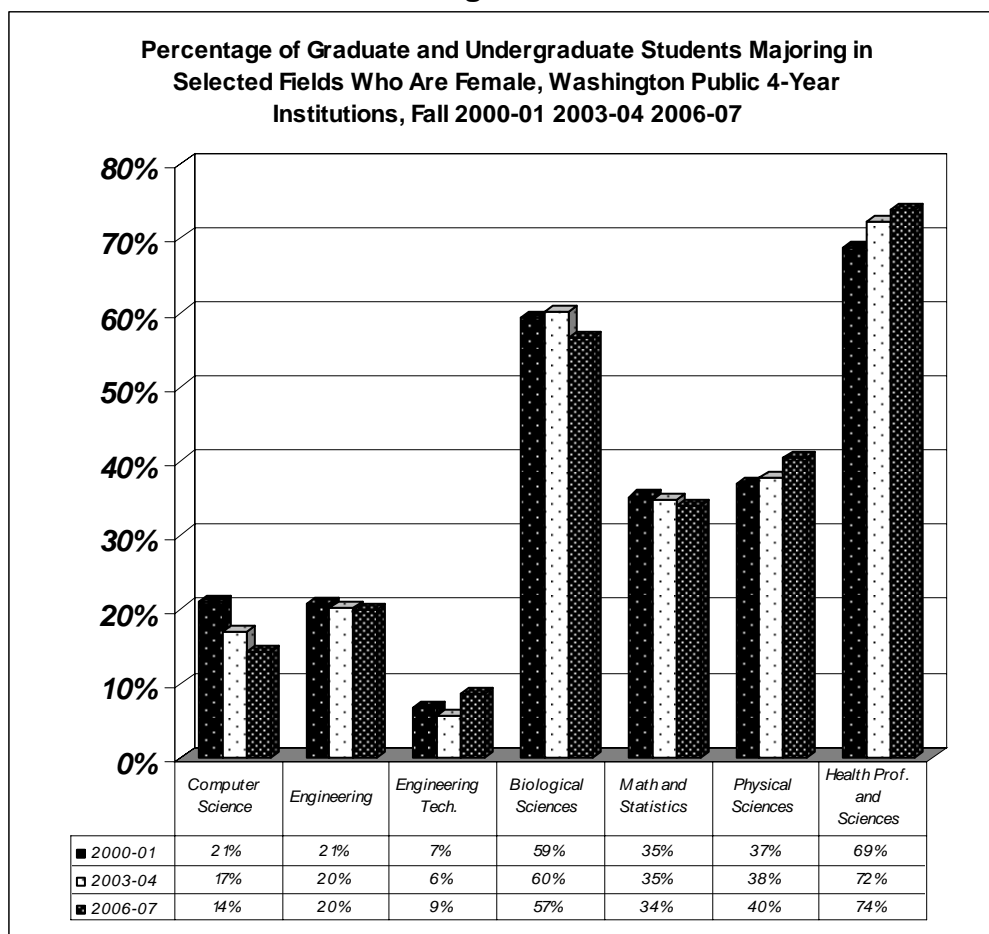
Over the last few years, the Washington State Legislature has funded the expansion of programs in the STEM and health sciences fields under its high-demand and math and science enrollment programs. HECB staff recently conducted a second analysis that looked at whether the increase in capacity has led to greater gender equalization of students majoring in the STEM and health sciences fields. Figure 5a shows the growth in the number of students majoring in these fields over the last few years, as a result of expanded capacity. Figure 5b shows that this expanded capacity has not led, in several instances, to greater proportionality by gender; and in some cases, the disparities have actually increased slightly. With the exception of engineering technology, biological sciences, and physical sciences, expanded capacity does not appear to have been accompanied by new strategies to recruit students that have not traditionally shown interest in these fields, at least with regard to gender.

Figure 5a



Source: HECB analysis using PCHEES state data reporting system.

Figure 5b



Source: HECB analysis using PCHEES state data reporting system.

Role Models

Do STEM and health sciences students persist at higher rates when they take courses taught by faculty of the same gender? What is the percentage in Washington of female faculty teaching in STEM fields, and male faculty teaching in the health sciences? How have these percentages changed recently? What are the faculty hiring pipeline trends and capacity issues (doctorate degree conferment rates, progression toward full professorship) in these fields?

To understand the importance of role models in promoting retention of female students, one needs to probe further into why female students do not pursue and persist in the STEM fields at rates similar to male students. Studies indicate that high school preparation, ability, and effort are not key determinates of persistence in STEM fields. Rather, the educational climate of science and engineering departments seems to matter most.¹⁴

¹⁴ National Academy of Sciences (2006). *Supra*, p. 3-13.

The climate issues manifest themselves early on in the undergraduate student's experience. We know this because once students have declared themselves science and engineering majors, they are equally likely to complete the major (about 60 percent for both male and female students). What inhibits many students from selecting a field of study is role incongruity--a perceived difference between the stereotypical characteristics of their gender (and by extension, of themselves) and the attributes thought to be required for success in the field.¹⁵

There are also differences between male and female students in what attracts them to science and engineering. Women are almost twice as likely as men to have chosen science or engineering through the influence of a role model. Men are twice as likely as women to cite their skills in math and science as a primary reason for selecting a science or engineering major.¹⁶

Studies of why students leave science and engineering once they have selected it as their major field of study, also reveal gender differences. Female students cite getting a better education in another major, poor teaching, and poor career options. Male students cite course overload, loss of confidence, financial problems, and issues with competition.¹⁷ A 1997 University of Washington study cited the importance of advising and a supportive community in the retention of female science, engineering, and mathematics majors.¹⁸

Given that the evidence shows that female students are turned off to STEM fields by a perceived gender role incongruity, attracted to the field by the influence of a role model, and fail to persist in the field when they perceive poor teaching, poor career options, and/or inadequate advising and support, it would follow that providing STEM students with more and better role models would improve the educational climate and increase persistence rates. Providing better role models for female students would focus precisely on the factors that inhibit female student selection of, and persistence in, STEM fields.

There is scientific evidence indicating that the academic environment, including the presence of a female instructor, can mediate students' automatic gender stereotypic beliefs. A 2004 University of Massachusetts study by Dasgupta and Asgari showed that, not surprisingly, women in male-dominated science and math classes at a coed college exhibited increased stereotypic beliefs than science and math students who attended a women's college. Importantly, this effect was mediated when the professor at the coed institution was female.¹⁹ This is important because the study results show that student pre-conceptions about gender-appropriate careers and leadership roles can be mediated in a coeducational environment by exposure to women in leadership positions. Presumably, the same is true for men in reverse.

¹⁵ *ibid.*, p. 3-14.

¹⁶ *ibid.*, p. 3-14.

¹⁷ *ibid.*, p. 3-14.

¹⁸ SG Brainard and L Carlin (1997). A Longitudinal Study of Undergraduate Women in Engineering and Science. <http://fie.engrng.pitt.edu/fie97/papers/1252.pdf>.

¹⁹ N. Dasgupta and S. Asgari, "Seeing Is Believing: Exposure to Counterstereotypic Women Leaders and Its Effect on the Malleability of Automatic Gender Stereotyping." *Journal of Experimental Social Psychology*, Vol. 40, Issue 5, pp. 642-658.

The percentage of female faculty in STEM fields is low, ranging from 10 to 30 percent nationally across the science and engineering disciplines. The number is lowest in engineering, where nationwide, female faculty make up just 10 percent of all tenured and tenure track faculty.

At the University of Washington (UW), the state's largest institution, the female faculty ratios are similar to the national averages, although they are slightly better in engineering. The figures are presented in Table 5.

Table 5

University of Washington

Tenured and Tenure-Track Faculty in Selected Colleges and Departments,

College/Department	Total	% Female	College/Department	Total	% Female
<i>College of Engineering</i>	208	16%	<i>College of Arts and Sciences</i>	793	34%
Industrial Engineering	9	44%	Biology	36	31%
Civil and Environmental Eng.	33	21%	Astronomy	11	27%
Material Science and Eng.	10	20%	Statistics	20	25%
Bioengineering	10	20%	Atmospheric Sciences	16	19%
Electrical Engineering	38	16%	Mathematics	50	14%
Chemical Engineering	13	15%	Applied mathematics	9	11%
Computer Science and Eng.	43	9%	Earth and Space Science	22	9%
Mechanical Engineering	25	8%	Physics	44	9%
Aeronautics and Astronautics	18	6%	Chemistry	40	8%
<i>School of Nursing</i>	75	92%			
<i>School of Public Health</i>	119	36%			
<i>School of Dentistry</i>	57	32%	Total UW-Seattle	3,051	32%
<i>School of Medicine</i>	1,287	28%	Total UW-Bothell	64	44%
<i>School of Pharmacy</i>	35	26%	Total UW-Tacoma	107	51%

Source: UW Affirmative Action Reports, http://www.washington.edu/admin/eoo/AA_Reports.html

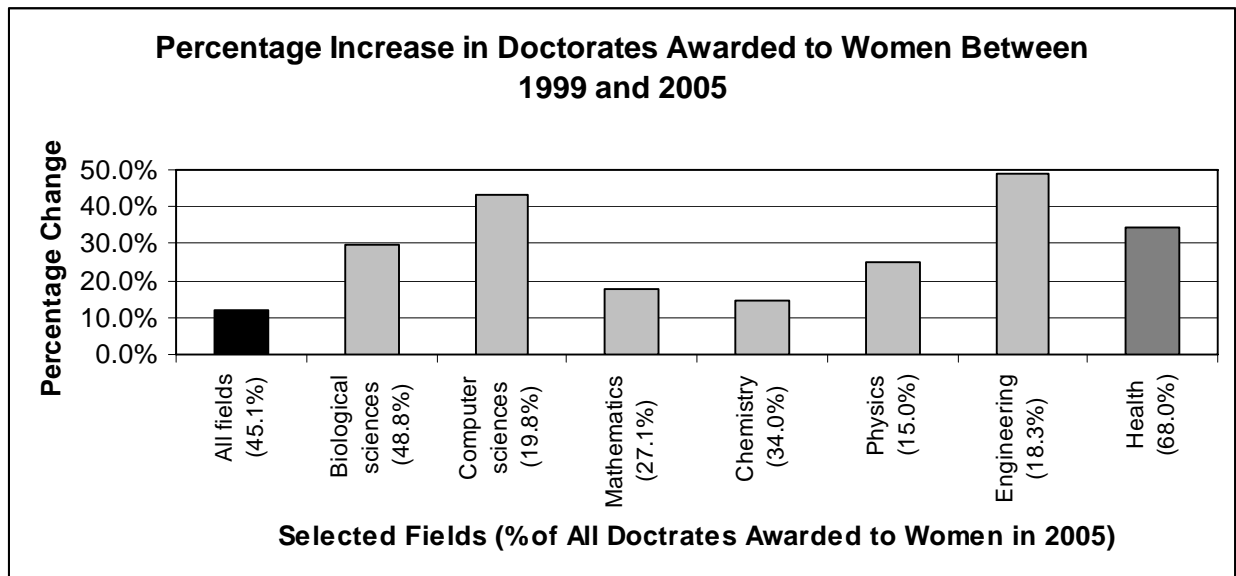
The percentage of women instructional faculty (in all subject areas and including non-tenure track faculty) is 41 percent across the six public institutions, ranging from 39 percent at the University of Washington to 49 percent at The Evergreen State College.²⁰

Recruiting more women into faculty positions is inhibited by low percentages of women reaching the doctorate level in STEM fields (and men in health sciences fields). However, in all areas except health sciences, there have been dramatic improvements in the number of doctorates awarded to women in the last few years, as indicated in Figure 6. The percentage increase in doctorates awarded to women between 1996 and 2005 in the STEM fields indicated exceeded the overall percentage increase in doctorates awarded to women in all fields. In health sciences, over-representation of women doctorates increased during the period, making it more difficult to recruit men to some professorship positions, like nursing.

²⁰ Information is based on HECB analysis based on 2006-07 Common Data Set information provided by the institutions.

Nevertheless, it would seem appropriate for institutions to set a benchmark target for recruitment of new faculty that at least matched (if not exceeded) the gender distribution of doctorates awarded in the field. For example, a statistical disparity such as the one between the UW chemistry department (8 percent women tenure/tenure track faculty) and a 34 percent national doctoral award rate to women may signal a need for review and potentially modification of hiring procedures and practices.

Figure 6



Source: NSF Division of Science Resources Statistics, Survey of Earned Doctorates.

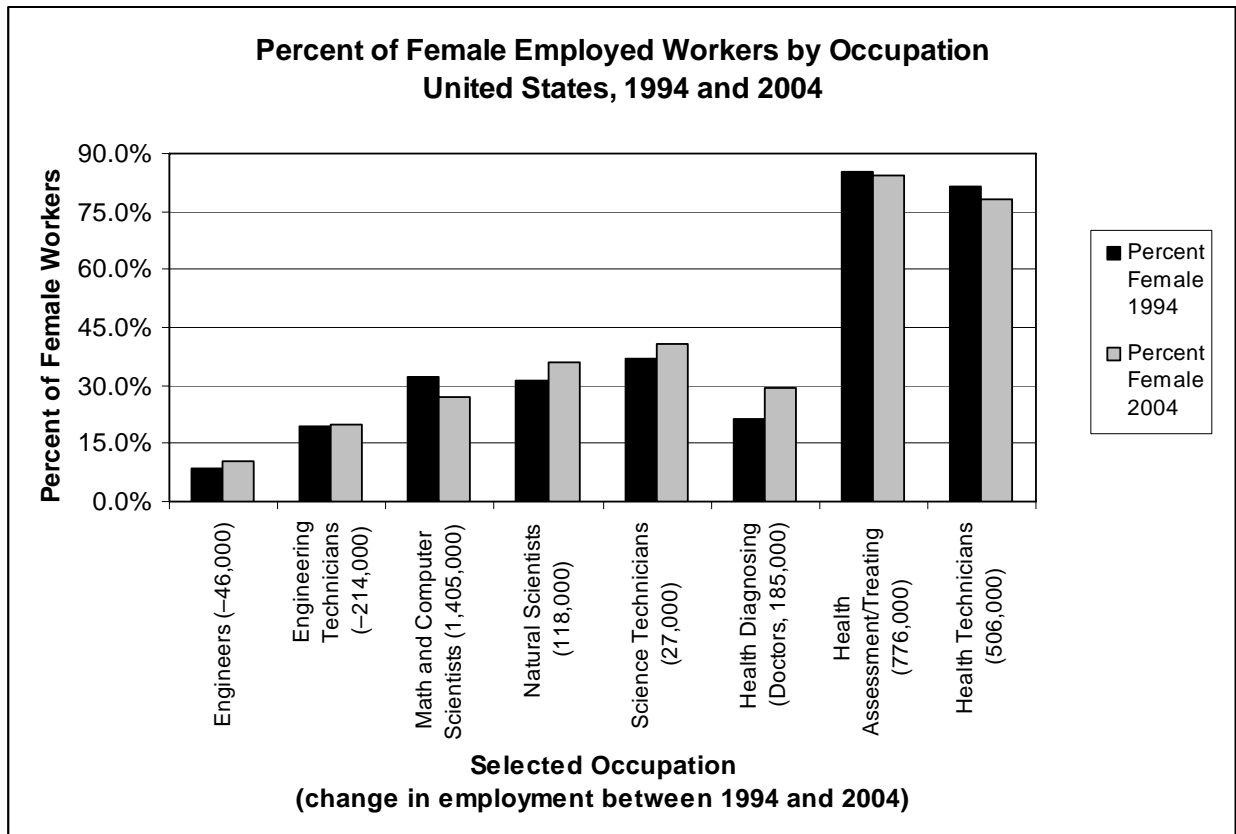
Outcomes

Are male and female graduates from Washington's STEM and Health Sciences programs equally likely to work in their field following graduation? Receive similar earnings? Continue their studies to achieve an advanced degree in their field?

Figure 7 shows national statistics indicating that the percentage of female professionals and managers working in the STEM fields and health diagnosing occupations is lower than that of men, as well as the overall percentage of female managers and professionals in all fields. The opposite is true in some of the health sciences professions where female nurses, therapists, and health technicians outnumber men.

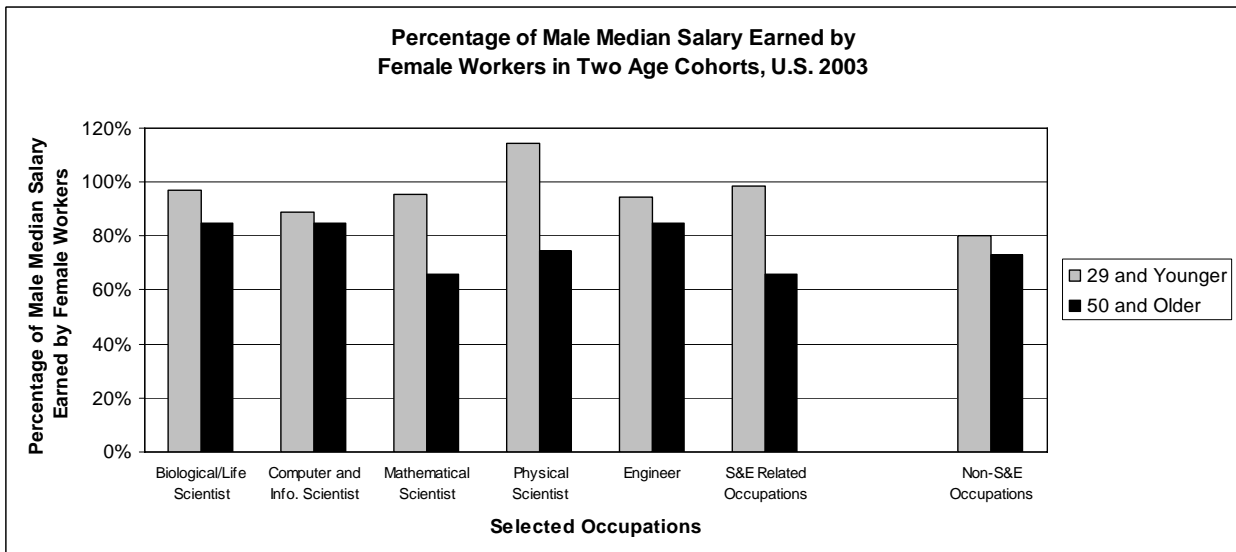
The figure also shows national-level changes in employed workers for selected occupational categories between 1994 and 2004, as well as changes in the percentage of female workers in each category over the period. The graph shows growth in all fields except engineering and engineering technicians over the 10-year period. Gains were made toward greater gender equity in each occupational category except for math and computer scientists, the category that experienced the largest total gain in employment, among those indicated. The largest percentage gain was for female workers in the health diagnosing occupations.

Figure 7



Source: NSF Division of Resources Statistics, from BLS Current Population Survey data.

Figure 8



Source: NSF Division of Resources Statistics, Scientists and Engineers Statistical Data System.

Figure 8 compares median female and male salaries for selected occupations. The grey bars indicate workers under age 29 and the black bars are for workers aged 50 and older. In each instance, younger female workers are showing greater wage parity with their male counterparts than older workers. This indicates either progress in wage parity for younger (recently hired) female workers or fewer opportunities for women to advance to higher paying jobs (the “glass ceiling”). It is possible that both explanations are happening simultaneously. Also of note is that wage parity with male counterparts in the 29-and-under age bracket is higher for all of the science and engineering occupations than for non-S&E occupations. This indicates that S&E jobs show greater gender pay equity than non-S&E jobs, at least for younger workers.

The wage parity picture in the health sciences is similar, even in occupations such as nursing and diagnostic support technicians that are dominated by female workers. According to the latest BLS Current Population Survey data, female registered nurses earn 90 cents for every dollar male nurses earn (90 percent of all registered nurses are female), and for physicians and surgeons (42 percent of all doctors are female) it is 72 cents on the dollar.²¹

HECB staff reviewed 2006 alumni survey data from the University of Washington and found that engineering, public health, and nursing baccalaureate students all earned more during their first year after college than other UW graduates, and those increased earnings were retained by engineering graduates in 5- and 10-year follow-up surveys. Contrary to the national data, women engineering respondents reported higher earnings than male respondents. Natural science majors had earnings levels and gender disparities that tended to track more closely to the overall university average.

Policy Options

What successful policies and programs have other states implemented to improve gender proportionality of students and faculty? What strategies have been proven effective at the institutional level that can be replicated statewide?

From the discussion above, we can draw the following conclusions to help inform policy options for increasing gender equity in academic programs:

- Male and female students are equally prepared to pursue post-secondary education in STEM and health science fields, even though there are relatively small and persistent differences by gender in test scores and course-taking behavior.
- However, even before getting to college, high school students exhibit a high degree of vocational self-segregation by gender when asked to identify probable major fields; patterns that persist through their college experience.

²¹ Bureau of Labor Statistics, *Current Population Survey*, <http://stats.bls.gov/cps/cpsaat39.pdf>.

- Women who take STEM courses as freshmen are less likely to major in those fields than their male counterparts. Similarly, men who take courses in the pre-med/health sciences cluster are less likely to major in those subjects than are female students. Persistence rates vary by gender.
- Despite the recent growth of female doctoral graduates in STEM fields, the percentage of female faculty in these departments remains low.
- Women working in STEM fields earn a higher percentage of what men earn than they do in non-STEM fields, but wage parity has not yet been achieved in STEM fields or in health services. Wage disparity by gender seems to be highest for older workers, possibly due to the “glass ceiling” effect. The existence of this effect in our state is supported by UW wage survey data that shows wage disparities by gender for program graduates that often increase between the first, fifth, and tenth year after graduation.
- These research results suggest that appropriate policy and program areas of focus for new initiatives in Washington State would be:
 - increasing awareness of high school students (targeting under-represented gender students) to career opportunities in the STEM and health sciences fields, and providing these students with opportunities to interact with gender-minority role models working in these fields;
 - improving the welcoming experience of gender-minority students who express interest in the STEM and health sciences fields by enrolling in those courses as freshmen, in an effort to raise persistence rates and the number of gender-minority students that major in these fields;
 - Provide support and assistance to STEM and health sciences departments in their efforts to hire gender-minority faculty and faculty of color, and secure institution-wide commitment to achieving aggressive hiring targets.

Most of the program and policy initiatives designed to encourage greater gender equity in the STEM or health sciences fields has been at the institutional level or by partnerships between community organizations and K-12 schools and school districts. There are few examples of statewide policies or program initiatives undertaken by state higher education boards, executive officers, or at the state university system level.

Career Awareness

There is a high level of activity in Washington State in programs that encourage young girls in middle and high school to consider careers in STEM fields. In fact, Table 6 lists 27 community-based programs in Washington found in the National Girls Collaborative Project database. It is important to note that this is not an exhaustive list and that the programs vary greatly in design and intensity; some are one-day workshops, others are summer programs (typically one-to-three weeks), and others are year-round and intensive.

The near-absence of Eastern Washington programs from the database (only one is listed in Walla Walla) suggests that these opportunities may not be widespread throughout the state. Most of these programs involve partnerships with middle and high schools, and several involve

community and technical colleges and four-year institutions. However, program administrators are quick to note the difficulty of getting these experiential learning initiatives mainstreamed into the middle and high school curriculum, as well as the problem of achieving sufficient program scale to achieve a broad impact.

Table 6

Washington Programs Raising Girls' Awareness of STEM Careers

Program	Organization	City
Salish Sea Expeditions - Sea Investigators	Salish Sea Expeditions	Bainbridge Island
WWU Engineering Technology	Engineering Technology	Bellingham
Northeast Vocational Area Cooperative (NEVAC)	NorthEast Vocational Area Cooperative	Bothell
TechREACH	Puget Sound Center for Teaching, Learning and Technology	Bothell
Junior Recognition Scholars	Stanwood-Camano Branch AAUW	Camano Island
Girls Go Tech	Girl Scouts -- Pacific Peaks Council	DuPont
Scholar Recognition Program-Edmonds AAUW	American Association of University Women	Edmonds
Lakewood Computer Clubhouse	Lakewood Computer Clubhouse	Lakewood
MESA: Yakima/Tri-Cities	Yakima Valley Tri-Cities MESA	Richland
BioQuest	BioQuest	Seattle
Discovery Corps	Pacific Science Center	Seattle
Girl Scouts - Totem Council	Girl Scouts - Totem Council	Seattle
Inspiring Youth Through Technological Creativity	Red Llama	Seattle
MESA - Seattle	Seattle MESA	Seattle
Passages Northwest	Passages Northwest	Seattle
Reel Grrls	Reel Grrls	Seattle
Seattle Expanding Your Horizons	SMARTgirls	Seattle
Seattle Girls' School	Seattle Girls' School	Seattle
Society of Women Engineers-Pacific NW Section	Society of Women Engineers	Seattle
TechNet Program	Associated Recreation Council	Seattle
University of Washington Women's Initiative (UWWI)	University of Washington Women's Initiative	Seattle
Washington Aerospace Scholars	Washington Aerospace Scholars/The Museum of Flight	Seattle
Women Fly!	The Museum of Flight	Seattle
Girls on Ice	Girls on Ice (North Cascades Institute)	Sedro-Woolley
WSU Spokane CityLab	WSU Spokane CityLab	Spokane
AAUW-WA High School Scholars	Puyallup Valley Branch American Association of University Women	Tacoma
Great Explorations: A Math and Science Adventure	Great Explorations in Education	Walla Walla

Source: Northwest Girls Collaborative Project database, <http://www.pugetsoundcenter.org/ngcp/directory/index.cfm>

A state policy initiative to provide support for career awareness programs and to integrate them into school districts' academic programs could be modeled after the Massachusetts STEM Pipeline Fund. The Commonwealth has put \$6.5 million in general fund resources into the program since 2003, providing grants of up to \$350,000 for each project proposed by seven regional PreK-16 Networks. The grants are used to support teacher professional development and teacher mentoring, curriculum development, science fairs, career fairs, science academies, summer science camps, and many other important activities designed to increase interest in STEM fields.

Improving Student Persistence

The data presented in Figure 4 show that female students in Washington are less likely to major in computer science, engineering, or mathematics than their male counterparts, even after they take a course in these subjects as freshmen. The same is true, to a lesser degree, for male students taking courses in the pre-med/health sciences cluster. Although the latter is a more recent phenomenon, due in part to extraordinary efforts by the medical education profession to make careers in medicine, especially doctors, a more attractive and viable choice for female students.²² Many institutions are working to extend some of the procedural, program and cultural changes that have occurred in medical education to the STEM fields to make them equally welcoming and supportive for female students.

One example is Carnegie Mellon University's Women in Computer Science Program, which succeeded in raising female enrollment from 7 percent in 1995 to 40 percent in 2000, but despite continued efforts has fallen back down to about 28 percent (still much higher than the Research I average of 15 percent). Activities included professional development training for high school AP computer science teachers in C++ and gender equity issues, modification of admissions criteria to de-emphasize prior programming experience, and development of a supportive community that included a new Women@CS Advisory Council.

The National Research Council identifies the following strategies for retaining female students in science and engineering programs: signal the importance of women, build K-12 bridging programs at the undergraduate level, improve advising, establish mentoring programs, change the pedagogical approach, increase engagement with students, and increase professional socialization.²³ It is easy to see from this list that student retention strategies need to be built primarily at the institutional level, based on the institution's analysis of when and where they are losing students and what support strategies are most needed and appropriate. From a statewide policy perspective, merely asking institutions to develop a student retention plan to promote gender equity may be a good place to start.

²² According to the Association of American Medical Colleges, the percentage of female medical school graduates has risen from 36 percent to 49 percent in the last 15 years. In 2005, 34 percent of full-time faculty at the University Of Washington School Of Medicine were women, exceeding the national average by 2 percentage points. However, there remain gender gaps at the UW and nationally with regard to rates of female tenured faculty and full professorships. See <http://www.aamc.org/members/wim/statistics/stats06/start.htm>.

²³ National Research Council of the National Academies (2006), *supra.*, p. 113.

Increasing Faculty Diversity

Students need role models to help them envision their career opportunities. Nothing can be more encouraging than having someone say to a student that they were once where they are now, and that they found a path that has led them to a fulfilling and rewarding career. This is why it is so important to have women faculty in the STEM fields and men teaching in the health science fields, especially nursing. The data presented above show that institutions across the country, including in Washington State, continue to struggle to attract, retain, and promote women faculty in the STEM fields and men in some health fields, despite recent improvements in the doctoral hiring pool.

There is a long list of successful programs and initiatives that departments and institutions have established to promote a more welcoming and supportive environment for faculty of all racial, ethnic, and gender groups. Activities include bringing in speakers on the topic, creating special recognition and awards for work in this area, developing diversity committees, assessing institutional patterns and practices, creating support networks and societies, providing workshops for search committee chairs and department chairs on diversity, revising hiring procedures and credential assessment rubrics, and providing support for dependent care. Most of the work has been done at the institutional or even the department level, where solutions can be customized within a given institutional context.

Recognizing that institutional culture can only be changed at the institutional level, the National Science Foundation (NSF) created the ADVANCE program in 2001. The program provides grants to institutions to assess themselves and implement a plan to increase participation and advancement of women scientists and engineers. Funding is available for partnerships engaged in adaptation, implementation, and dissemination of best practices. The program also provides opportunities for research fellowships for women scientists.

The University of Washington is the only institution in the state to receive support for institution-wide activities through the program. Since 2001, the university has received nearly \$5 million to support a range of activities both on and off campus through the Center for Institutional Change (CIC) in the College of Engineering (see <http://www.engr.washington.edu/advance/>). The CIC organizes a range of activities involving 21 departments in the Colleges of Engineering and Arts and Sciences, including the monitoring of women faculty hiring and advancement in science and engineering, awards and recognition to women scientists, a transitional support program to promote faculty retention, a visiting scholars program, leadership workshops, mentoring programs, and cultural change/policy transformation advocacy within the institution. In addition, the CIC has received NSF support for national dissemination of best practices, and offered a well-attended national leadership workshop for department chairs and deans from across the country in July 2007.

One policy option available to Washington State is to create centers like the UW CIC at each public four-year institution. Essentially, Washington could create its own state version of the NSF ADVANCE program. The UW could provide technical assistance to the other five public institutions on self-assessment, strategy selection and implementation to promote cultural change. Private and neighboring state institutions could “buy in” to the network if they were interested in receiving technical assistance.

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RESOLUTION NO. 07-16

WHEREAS, The Higher Education Coordinating Board recognizes the critical need to expand degrees in science, technology, engineering and math (STEM) and health sciences fields to support economic growth in Washington State and the nation, and provide high paying jobs to Washington citizens; and

WHEREAS, Expanding enrollments in STEM and health sciences programs is essential to ensure that more degrees are awarded and high-demand jobs are filled; and

WHEREAS, The Board understands the importance of expanding the pipeline of students seeking STEM and health sciences careers, and that it is particularly important to focus on minority-gender and other under-represented students who have, in the past, shown limited interest and success in achieving degrees in these fields; and

WHEREAS, The Board has developed an Issue Brief on gender equity in STEM and health sciences academic programs that analyzes factors contributing to disproportionate degree conferment rates by gender, and policy options for achieving greater proportionality;

THEREFORE, BE IT RESOLVED, That the Higher Education Coordinating Board approves the Gender Equity Issue Brief for publication and distribution, and that it endorses the development of a STEM Pipeline Initiative to enhance K-12 instruction in STEM fields and student awareness of STEM careers. The Board also approves establishment of a state program of support and technical assistance for Washington's public four-year institutions in their efforts to increase faculty diversity in STEM and health sciences departments—modeled after the National Science Foundation's ADVANCE program—with the goal of providing appropriate role models for under-represented students; and

BE IT FURTHER RESOLVED, That the recommendations contained herein should be incorporated into the 2008 strategic master plan and integrated with recommendations and strategies to enhance diversity in higher education; and

BE IT FURTHER RESOLVED, that staff are instructed to work with higher education institutions, the Legislature, the Governor's office, and education partners to fund and implement these programs.

Adopted:

September 27, 2007

Attest:

Bill Grinstein, Chair

Betti Sheldon, Secretary