Michigan Women
and
The High-Tech Knowledge Economy

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Executive Summary

The United States faces increasing economic competition in the new global economy. Nowhere in the country are those changes felt more keenly than in Michigan, whose citizens are experiencing an unprecedented period of job loss and economic upheaval, with the end nowhere in sight. As manufacturing industries decline and manufacturing jobs disappear, it is becoming increasingly clear that, for the state and the nation to thrive, we in Michigan must cultivate the knowledge-driven, entrepreneurial sectors of our economy, particularly so-called "high technology." To do so, we will have to greatly increase the number of residents holding college degrees, particularly in the sciences, computer technology, engineering and mathematics (STEM) fields, in which women's participation rates are generally low. Impending Baby Boomer retirements, with the potential loss of half our scientists and engineers, make this need even more critical.

In her 2007 State of the State address, Gov. Jennifer Granholm said: "Economists and experts across the country agree that education is the single most effective strategy for stoking a state's economic growth. That means we all must create a
culture of learning that is unprecedented in Michigan's history."[1] According to Michigan State University, "Michigan produces its own labor force." Because migration to Michigan from other states is slight, we create our own workforce to a greater extent than only two other states.[2] Therefore, the education delivered by Michigan's institutions of higher education determines our economic destiny. In 2006, Michigan ranked 29th in the nation for the proportion of its female population 25 and older with four or more years of college (25%),[3] while in 2004, the state ranked 32nd in the nation overall for the percentage (25%) of adults 25 and over with a bachelor's degree.[4]

Stark statistics from Girls, Inc. demonstrate the extent to which women's talents and skills in the STEM fields are untapped:

Of all doctoral degrees earned by U.S. women in 2000, "5% were in engineering, 1% in math, [and] 1% in computer science."[5]

Because we do not train enough U.S.-born scientists and engineers to meet our needs—in large measure because of women's low rates of participation—a high percentage of degrees in STEM fields are awarded to foreign-born students: 34% in the natural sciences and 56% in engineering, for example.[6] According to the

National Science Foundation, "Among all doctorate holders resident in the United States in 2003, a majority in computer science (57%), electrical engineering (57%), civil engineering (54%), and mechanical engineering (52%) were foreign born."[7]

Women's participation in STEM fields is important for more than attracting and generating jobs. It also has a direct impact on innovation. Describing the negative effects of women's relative scarcity among information technology product designers, William Wulf, past president of the National Academy of Engineering, says: "Since the products and processes we create are limited by the life experiences of the workforce, the best solution—the elegant solution—may never be considered because of that lack." He continues: "At a fundamental level, men, women, ethnic minorities, and people with handicaps experience the world differently.

Those experiences are the 'gene pool' from which creativity springs."[8]

Women represent the greatest potential for increasing the state and country's scientifically- and technologically-trained workforce. A sizeable body of literature documents barriers girls and women face in the STEM fields as well as practices that have been successful in overcoming those obstacles.

Still, there has been virtually no public discussion of the role gender might play in the success or failure of Michigan's emerging economic development strategies.

In that context, this paper examines how well women and girls in the United States and in Michigan are preparing for and moving into STEM-related "high-tech" fields. It closes with recommendations for breaking down barriers and boosting women's participation in these vital sectors of the state and national economy.

The Challenge to American Competitiveness

In a November 2, 2006 talk at the Federal Reserve Bank of Chicago, former University of Michigan President James Duderstadt proposed that we are entering "an *age of knowledge*, in which the key strategic resource necessary for prosperity has become knowledge itself—educated people, their ideas and innovation, and their entrepreneurial spirit."[9] He continued, "Nations are investing heavily and restructuring their economies to create high-skill, high-pay jobs in knowledge-intensive areas . . . The lessons are clear: regions must create and sustain a highly educated and innovative workforce and the capacity to generate and apply new knowledge, supported through policies and investments in developing human capital, technological innovation, and entrepreneurial skill."[10] Speaking to Congress on March 7, 2007, Microsoft chairman Bill Gates said, "The U. S. cannot maintain its economic leadership unless our workforce consists of people who have the knowledge and skills needed to drive innovation." He continued, "We simply cannot sustain an economy based on innovation unless our citizens are educated in math, science and engineering."[11]

Gates' statements echo a call to action issued in 2005 by a group of 15 business leaders representing the Business-Higher Education Forum, Business Roundtable, Council on Competitiveness, U.S. Chamber of Commerce, Minority Business Round Table, National Association of Manufacturers, National Defense Industrial Association, and the information technology sector. In an open letter "to leaders who care about America's future," they called on the nation to "double the number of science, technology, engineering and mathematics graduates with bachelor's degrees by 2015."[12] These leaders expressed concern about America's declining competitiveness, citing sources indicating that

- By 2010, more than 90% of all scientists and engineers may be living in Asia.[13]
- U. S. engineering degrees have declined by 20% since 1985.[14]
- U. S. students compare poorly to children in many other countries on measures of mathematics and science achievement.[15]

In addition, they point out,

"More than 50 percent of the current science and engineering workforce is approaching retirement. It must be replaced by a larger pool of new talent from a more diverse population."[16]

These business leaders believe that "to sustain American competitiveness in science and engineering, we need a focused, long-term,

comprehensive initiative by the public and private sectors to . . . motivate U.S. students and adults . . . to study and enter science, technology, engineering and mathematics careers, with a special effort geared to those in currently underrepresented groups."[17] Without such an effort, they foresee "a slow withering, a gradual decline, a widening gap between a complacent America and countries with the drive, commitment and vision to take our place."[18] Engaging and mobilizing women is critical to avoiding that scenario.

The Michigan Economy

Although the entire nation faces increasing competition from abroad, Michigan represents the most extreme case. A January 2007 report prepared for the National Governors Association and the National Conference of State Legislators ranked the Michigan economy at the bottom among all the states, based on declines in personal income, employment and population.[19] At 7.1% in January 2008, the state's unemployment rate was the highest in the nation. *The Michigan Economic Outlook for 2007-2008*, the annual economic forecast by University of Michigan economists Joan Crary, Saul Hymans, and George Fulton, calls for continuing job losses through 2008. "This pattern would extend our duration of job loss to eight years, the longest in Michigan since the Great Depression."[20]

According to a February 2008 report prepared by Michigan Future, Inc., Michigan per capita income in 2006 was "8% below the national average. The worst performance in our history compared to the rest of the United States, even worse than the previous low in 1933."[21] The same report indicates that "in 2006 Michigan ranked 26th in per capita income, an unprecedented drop of 10 places in a relatively short six year period,"[22] as the result of a 12% drop in inflation-adjusted state median income between 1999 and 2007.[23] Chief Comerica economist Dana Johnson describes Michigan's situation as a "one-state recession."[24]

Clearly, the Michigan economy is undergoing a profound and painful transformation. According to a June 2007 forecast, "a domestic auto industry that employed 342,000 Michigan workers in 2000, is expected to employ just 165,000 by the end of 2008."[25] A new study by Bartik *et al* for the W. E. Upjohn Institute for Employment Research indicates, "Each job lost in the Michigan motor vehicle industry causes a loss of more than four other jobs in other industries in the short run, and more than five other jobs in other industries in the long run."[26]

In addition to its reliance on automobile production, Michigan is more concentrated in manufacturing generally than many other states. In 2003 almost 17 % of Michigan jobs were

concentrated in manufacturing, compared with a national average of 11%.[27] A recent spate of additional layoffs in automobile manufacturing, pharmaceuticals and other sectors has only deepened the state's economic troubles. The *Washington Post* reported on April 1, 2007 that the state had lost 305,000 jobs, approximately 40% of them "from automakers and their suppliers," since 2001.[28]

Many Michigan leaders have recognized that turning the state economy around will require investment and growth in "knowledge economy" employers and jobs. For example, a group of Michigan business, government and non-profit leaders known as Michigan Future, Inc.,[29] the authors of *A New Agenda for a New Michigan*, released in June 2006, declare, "The only reliable path to a high-prosperity Michigan is to be concentrated in knowledge-based enterprises."[30] They report that manufacturing in Michigan is declining no more rapidly than it is in the rest of the nation (down around 19% since 1990 as of June 2006), but that middle- and high-wage knowledge-based jobs have grown only 17% in Michigan during that period, while growing 32% nationally—almost twice as fast.[31]

High Tech in Michigan

University of Michigan economists George Fulton and Donald Grimes define the knowledge economy broadly, to include "information services, finance and insurance, professional and technical services, and company management."[32] While they acknowledge that the knowledge-based economy is "much broader than the high-profile high-technology sector," that sector is of such central importance that Fulton and Grimes, along with Abel Feinstein, have undertaken pioneering work to define the high-tech sector in Michigan as well as the nation and to assess the role it plays in economic growth.[33] Their definition divides the sector into three components: "industrial high tech (research, development, and engineering functions in the industrial manufacturing economy); information technology (electronic engineers and technicians, systems analysts and programmers); and biotechnology (life and medical scientists and technicians)."[34] They find that "a region cannot go wrong with a skilled high-tech workforce. . . .

The advantages to the economy— higher wages, faster wage growth, and greater productivity—are a major justification for pursuing high tech."[35]

Later they continue, "Since improvements in an area's standard of living are derived largely from increases in productivity, the productivity premium that high tech delivers becomes a critical focus for regional economic development."[36] According to a report issued by the National Academies of Sciences and

Engineering and the Institute of Medicine, known collectively as the National Academies, "Even before the information technology revolution . . . as much as 85% of measured growth in US income per capita was due to technological change."[37]

The 2007 State New Economy Index produced by the Information Technology and Innovation Foundation ranks Michigan:

19th overall

22nd for percentage of IT professionals in the workforce

28th for level of workforce education

6th for educational attainment of recent migrants from abroad

37th for job churning (growth or expansion of new businesses and destruction or decline of old, inefficient ones)

30th for presence of the fastest growing firms

40th for entrepreneurial activity

32nd for technology in schools

20th for high-tech jobs

25th for proportion of scientists and engineers in the workforce

4th for industry investment in R&D[38]

Michigan has strengths from which to grow its high-tech sector. Feinstein, Fulton and Grimes observe that "Michigan is quietly becoming the world center for automotive engineering, research, and design,"[39] with foreign as well as domestic manufacturers locating their research and development operations in the state. The Michigan Economic Development Corporation touts Michigan as the "#1 state for automotive research and development . . . employing over 60,000 professionals." In addition, according to the MEDC, the state ranks second in the nation for overall research and development expenditures and houses the University of Michigan, which also ranks second nationally for research and development funding.[40]

Major new initiatives like Automation Alley, the Life Sciences Corridor, the 21st Century Jobs Fund, the Prima Civitas Foundation in mid-Michigan, Southwest Michigan First, TechTown in Detroit, Ann Arbor Spark and many others large and small across the state are working to support research, technology transfer and creation of high-tech businesses while also attracting already-established firms to Michigan.

"Michigan is not in a state of total economic meltdown or implosion. Rather, Michigan appears to be in the midst of a wrenching economic transformation." [41]

Higher Education in Michigan

Predicting increasing labor shortages, particularly of highly educated workers, after 2010 because of

Baby Boomer retirements, Feinstein, Fulton and Grimes state,

"Michigan must become more successful in educating, training, attracting, and retaining highly skilled workers in order to flourish in the high-stakes technology game."[42]

Like Gov. Granholm's call for a new "culture of learning," this expression of concern is linked to Michigan's generally poor record of educational achievement. Because of the ready availability, until relatively recently, of high-wage manufacturing jobs that did not require advanced education, Michigan has lagged behind much of the nation in the percentage of citizens who have attained a bachelor's degree or more. In 2004, Michigan ranked 32nd in the nation overall for the percentage (25%) of adults 25 and over with a bachelor's degree.[43] A 2006 study ranked Michigan 29th for the percentage of all women (25%) with a bachelor's degree or more.[44] On a brighter note, the state ranked 9th in 2004 for the percentage of young adults (ages 18 to 24) enrolled in college or graduate school.[45] Between 2002 and 2007, Michigan spending on higher education declined by 15%, making the state's investment in higher education the lowest in the nation.[46]

Why, exactly, are forward-looking business, educational and political leaders so concerned about Michigan's low levels of educational attainment? Experts agree that the availability of a highly talented, creative and educated workforce is the primary determinant of where knowledge economy businesses choose to locate. According to Richard Florida, author of *The Rise of the Creative Class*, "Human capital or talent drives economic development."[47] He elaborates: "Places that bring together diverse talent accelerate the local rate of economic development. When large numbers of entrepreneurs, financiers, engineers, designers, and other smart, creative people are constantly bumping into one another inside and outside of work, business ideas are more quickly formed, sharpened, executed, and--if successful--expanded."[48] Michigan Future, Inc. states the proposition even more baldly:

"The places with the greatest concentrations of talent win."[49]

A March 2006 survey of 1,200 "new economy" business executives in five states conducted for Western Michigan University found that they believed an educated workforce to be much more critical to business creation than favorable tax policy.[50] In fact, "tax cuts haven't resulted in any net job increases in Michigan for the past seven years," according to a 2008 statement by Lou

Glazer of Michigan Future, Inc.[51] Tellingly, a recent survey by the Accident Fund found that small to mid-size Michigan businesses would like to hire more workers but are having trouble finding enough with adequate math, science and communication skills. The Fund estimates that over 30,000 jobs in this sector alone could go unfilled.[52]

The STEM Disciplines: The National Picture

The Society of Women Engineers reports that "in the last 50 years, more than half of America's sustained economic growth was created by the five percent of the workforce who create, manage, and maintain the processes and products of innovation: engineers, scientists, and advanced-degree technologists." Furthermore, they continue, "Jobs requiring technical training are beginning to grow at five times the rate of other occupations." Despite the centrality of engineers and scientists to the economy, the Society believes that "engineering and technology are losing the battle for the hearts and minds of tomorrow's U.S. workforce," with only 15% of high school students "prepared to pursue scientific/technical degrees in college."[53] Skill in mathematics is an essential pre-requisite for entry into undergraduate programs in STEM fields. Yet a 2006 report by the Women in Engineering Programs and Advocates Network

(WEPAN) indicates that "the capability of U.S. 15-year-olds to compete internationally in mathematics is declining. In 2000, U.S. 15-year-olds ranked 18th in mathematics literacy, while in 2003, they ranked 24th among students from 32 countries."[54]

WEPAN data show that China awards 351,537 engineering degrees annually; Japan, 98,431; South Korea, 64,942; and the U.S., 60,639.[55] In addition, WEPAN reports: "In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, the figure is 47%, in China, 50%, and in Singapore, 67%. In the United States, the corresponding figure is 15%."[56] The National Science Foundation reports:

"The U.S. ranks just 29th of 109 countries in the percentage of 24-year-olds with a math or science degree,"[57]

behind Finland, Hungary, France, Taiwan, South Korea, United Kingdom, Sweden, Australia, Ireland, Russia, Spain, Japan, New Zealand, Netherlands, Canada, Lithuania, Switzerland, Germany, Latvia, Slovakia, Georgia, Italy and Israel.[58] The low number of degrees awarded to U.S.-born students is reflected in large percentages of foreign-born Ph.D.s among professionals working in the U.S. The National

Percentage of Degrees in STEM Fields Awarded to U.S. Women, 2004

	Bachelors	Masters	Doctorates
Computer sciences[59]	26%	31.2%	20.5%
Physical sciences[60]	42.1%	37.5%	25.9%
Engineering[61]	20.5%	21.1%	17.6%

Source: National Science Foundation, Division of Science Resources Statistics

See Appendix A for the percentage of degrees in selected STEM sub-disciplines awarded to U.S. women in 2004.

Science Foundation indicates: "Among all doctorate holders resident in the United States in 2003, a majority in computer science (57%), electrical engineering (57%), civil engineering (54%), and mechanical engineering (52%) were foreign born."[62]

Women's Educational Attainment in the STEM Fields in the United States

Stark statistics from Girls, Inc. demonstrate the extent to which women's talents and skills in the STEM fields are untapped:

"Of all doctoral degrees earned by [U.S.] women in 2000, "5% were in engineering, 1% in math, [and] 1% in computer science."

Within many STEM fields, women's representation remains low. While engineering bachelor's degrees granted to women held steady at 20-21% from 2000-2004, they have been dropping since, falling to 18.6% in 2007.[63] At the graduate level, women's degree achievement has been generally rising, with women receiving 22.2% of engineering master's degrees and 19.6% of Ph.D.'s in 2007.[64]

Computer science represents a uniquely dire case. Women are losing ground dramatically, dropping from 37.2% of bachelor's degree recipients in 1984 to 26% in 2004[65] and 21% in 2006 (but only 17% at major research universities).[66] The *New York Times* reports: "At universities that . . . offer graduate degrees in computer science, only 17% of . . . bachelor's degrees in the 2003-2004 academic year went to women."[67] The National Center for Women & Information Technology reports:

There was a "70 percent decline in the number of incoming undergraduate women choosing to major in Computer Science between 2000 and 2005."[68]

Women are making slow gains in some of the STEM disciplines but often doing so in the

context of major declines in the total number of degrees awarded, which has troubling implications for national competitiveness. The physical sciences, computer science, mathematics and engineering are all experiencing stagnant or declining undergraduate degree production and graduate degree production that is steady or shrinking more often than growing.[69] Women's participation rates should be viewed critically, because they reflect both increasing numbers of women and, in many fields, declining numbers of men. In the face of significant male disinvestment in some STEM fields, particularly at the undergraduate level, women's increasing participation is an important countervailing trend. Considering the growing need for highly trained workers to drive research and business innovation, it is clear that **Women are a greatly needed and underused national resource.**

How Well Are Michigan Women Preparing for the High-Tech Economy?

Women's degree achievement in STEM fields in Michigan is generally comparable to national levels, with the same troubling indications of low rates and little progress in computer science and engineering and declining total degree production in the physical sciences at all levels.

Percentage of Degrees Awarded to Women at Michigan 4-Year Public Universities

	Bachelors			Masters			Doctorates		
	1995	2000	2005	1995	2000	2005	1995	2000	2005
Computer & Information Sciences									
% Women	24.4%	22.8%	14.5%	26.9%	34.5%	38.9%	21.1%	0.0%	8.7%
Degrees to women	151	148	143	87	129	172	4	0	2
Total degrees	618	650	989	323	374	442	19	13	23
Engineering									
% Women	20.0%	24.0%	22.5%	19.2%	20.5%	20.7%	11.7%	16.5%	13.6%
Degrees to women	610	769	673	283	344	365	32	44	44
Total degrees	3,051	3,208	2,993	1,475	1,674	1,767	274	267	323
Physical Sciences									
% Women	31.9%	37.8%	40.0%	32.3%	43.8%	41.3%	22.9%	28.7%	32.4%
Degrees to women	167	170	177	73	60	81	36	43	46
Total degrees	524	450	443	226	137	196	157	150	142

Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System Peer Analysis System

See Appendix B for the percentage of Michigan degrees in STEM fields awarded to women, by race/ethnicity, in 1995, 2000 and 2005.

Strikingly, however, the proportion of undergraduate computer and information sciences degrees awarded to women by Michigan four-year public institutions dropped by nearly one-third between 2000 and 2005, falling far behind the dismally low national rates in computer science. For example, between 2002 and 2006, women's undergraduate enrollment in computer science at Eastern Michigan University dropped by 70%, from 70 students to 21. During the same period, the number of women concentrating in computer science at the University of Michigan dropped by 30%, from 30 students to 21.[70] Michigan public universities in 2005 awarded only 23 Ph.D.s in computer and information sciences—and only 2 of those went to women. Nonresident aliens—that is, international students—represent high percentages of women earning graduate degrees in Michigan. In 2005, of degrees awarded to women, such students earned 44.2% of master's degrees and 50% of doctorates in computer and information sciences, 34% of master's degrees and 47.7% of doctorates in engineering, and 29.6% of master's degrees

and 32.6% of doctorates in physical sciences. (See appendix B).

Women's Employment and Wages

United States

Occupational Distribution
Women's employment as scientists and engineers reflects the rate, over time, at which they have earned degrees in those fields. While women remain a small fraction of practicing engineers, they have thrived in other fields. In 2005 women were 5.8% of mechanical engineers, 7.1% of electrical engineers, 13.2% of civil engineers, 13.3% of aerospace engineers, 14.3% of chemical engineers, 14.9% of industrial engineers and 20.9% of computer software engineers, as opposed to 30.2% of lawyers, 32.3% of physicians and surgeons and 48.7% of biologists.[72]

According to the Michigan Council of Women in Technology Foundation, "women made up 32

Percentage of U.S. Scientists and Engineers Who Are Women by Highest Level of Education, 2003				
	All levels	Bachelors	Masters	Doctorates
Computer & information scientists	27.6%	28.4%	27.0%	15.4%
Physical scientists	35.4%	43.4%	32.6%	14.7%
Engineers	11.1%	10.6%	12.3%	9.2%

Source: National Science Foundation.[71]

percent of the tech work force in 2004, a drop from 41 percent at its peak in 1996."[73] By contrast, women now occupy 56% of all professional positions.[74]

The National Science Foundation indicates that "46% of women . . . employed as scientists and engineers received their degrees within the past 10 years," with many "female doctorate degree holders in their late 30s." Men are, as a group, significantly older. "One clear consequence of this age distribution is that a much larger proportion of male scientists and engineers at all degree levels, but particularly at the doctorate level, will reach traditional retirement age during the next decade. This . . . will have a significant effect upon sex ratios, and also perhaps on the numbers of female scientists in positions of authority,"[75] possibly opening opportunities for women—if sufficient numbers of women are available to take them.

Wage Equity

American women working full-time, year-round face a significant wage gap compared with comparably employed men. Although the gap has been very slowly narrowing, it remains substantial. A comparison of the wages of women and men working full-time, year-round in 2005 shows that women, as a group, earned 77% of men's wages.[76] During 2003-2005, college-educated women did somewhat less well.

Women holding a bachelor's degree or more and working full-time earned only 74% of the wages of similarly educated and employed men.[77] However, an April 2007 report by the American Association of University Women reveals that women working in STEM fields fare better. Looking at the 2003 salaries of 1993 college graduates, they found that women in engineering and architecture earn 93% as much as men; in computer science, 94%; and in the larger category of research, science and technology, 89%,[78] demonstrating that high-tech employment pays off for women.

Because jobs in STEM fields are, in general, well‑paying and more equitably paid than many other fields, increasing women's participation in them is one way to reduce the gender wage gap.

Michigan

Occupational Distribution

Not surprisingly, the Michigan Department of Labor and Economic Growth notes that "In 2005, women were less likely than men to be employed in some of the highest paying fields, such as engineering, and computer and mathematical occupations."[79] In 2004, women in Michigan represented 28.6% of those working in computer

and mathematical sciences and 12.1% of those working in architecture and engineering.[80]

Wage Equity

The Institute for Women's Policy Research looked at the wages of all full-time, year-round workers employed in Michigan in 2005 and found that women's wages were only 70% of men's, causing Michigan to be ranked 46th among the states in wage equity.[81] Data provided by the American Association of University Women compare the 2003-2005 wages of Michigan men and women working full-time, year-round who have earned at least a four-year college degree and find that women's wages are 72% of men's, causing Michigan to be ranked 35th for wage equity among this population.[82] However, in 2004, Michigan women working full-time in computer and mathematical sciences earned 83% of men's wages, and women working in architecture and engineering earned 82.4%-- certainly better than the state average but approximately 11% behind the national wage ratios in those fields.[83]

Barriers to Women's Participation in STEM Fields

According to the National Academies, "About one-third of US students intending to major in engineering switch majors before graduating."[84] Furthermore, "Undergraduate programs in these [science and engineering] disciplines report the lowest retention rates among all academic disciplines . . . Undergraduates who opt out of these programs by switching majors are often among the most highly qualified college entrants, and they are disproportionately women and students of color . . . Potential science or engineering majors become discouraged well before they can join the workforce."[85]

The impediments facing women in science and mathematics as both students and faculty members are of sufficient concern that the U.S. Department of Education announced in March 2006 that its Office of Civil Rights would launch a series of in-depth Title IX compliance reviews to look for evidence of discrimination.[86] (Title IX of the Educational Amendments of 1972 is the federal law banning discrimination in all facets of education.)

Much has been written to explain the barriers women and girls experience in the STEM fields. The issues identified include lack of self-confidence, self-concept and cultural fit, interests and values, stereotyping, teaching methods, discrimination and other institutional barriers, and difficulty combining work and family.

Self-Confidence

William Wulf, past president of the National Academy of Engineering and Vice Chair of the

National Research Council, addresses the declining percentage of women studying computer science. He says, "The most troubling and bizarre issue . . . is women's lack of confidence in their abilities. The objective measures are that women do just as well as men. There is no difference in grade point average and no discernible difference in performance. Yet . . . women consistently believed they were not doing as well."[87]

According to Jane Margolis, who conducted a four-year study, from 1995 to 1999, of men and women studying computer science at Carnegie Mellon University, "By the time they finish college, we find that most women studying computer science have had to face a technical culture whose values often do not match their own, and have encountered a variety of discouraging experiences with teachers, peers, and curriculum. Many wind up doubting their basic intelligence and their fitness to pursue computing."[88]

Interests and Values

William Wulf observes that "men seem to be interested in computers *per se*. They are fascinated by the device, programming and by the mathematics involved. Women seem to be much more interested in the application of computers to things."[89]

A 2003 study by University of Michigan psychologist Jacquelynne Eccles and researcher Mina Vida found that the way to increase girls' interest in mathematics, engineering and the physical sciences is to demonstrate that they involve working with people, and that they provide opportunities to help people, both important values for many girls. The study also found that, although girls tend to underestimate their math ability, which is just as strong as boys', math self-confidence influences girls' career choices less than their beliefs about whether math and mathematically-based sciences have social utility.[90]

Stereotyping

An April 2007 *New York Times* article on women in computer science quotes University of Oregon computer scientist Jan Cuny: "The nerd factor is huge."[91] The same article describes a 2005 report by the National Center for Women and Information Technology reporting:

"When high school girls think of computer scientists they think of geeks, pocket protectors, isolated cubicles and a lifetime of staring into a screen writing computer code . . . They don't think of it as revolutionizing the way we are going to do medicine or create synthetic

molecules or study our impact on the climate of the earth."[92]

Cultural Fit

Lenore Blum, Carol Frieze *et al* write that "the reasons for women entering—or not entering—the field of computer science have *little* to do with *gender* and a *lot* to do with *environment* and *culture* as well as the *perception* of the field."[93] They find that gender " 'differences' tend to dissolve and gender similarities emerge when the environment becomes 'more [gender] balanced.'"[94] Furthermore, they argue that in studies showing significant gender differences, "the experiences and perspectives of the women . . . were in part shaped by their minority, and sometimes token, status rather than by gender."[95] Finally, they point out:

In many parts of the world, including India, Brazil, Argentina, North Africa and the Middle East, women have high rates of participation in computer science.[96]

Elizabeth Larsen and Margaret Stubbs find that "compared to males, females have less experience 'fooling around' with computers and with programming; at the beginning of undergraduate study, females are not likely to self-identify as programming geeks/intense hackers and will experience a lack of fit to the extent that hacker

culture with its 'boy hacker icon' defines the climate of the computer science program."[97]

William Wulf observes that in computer science, there "is this notion that the undergraduates have that you must do all of your work between midnight and 5 a.m., and live on Twinkies and Coke. That doesn't seem to be particularly attractive to women."[98]

The Computer Science Advanced Placement Test

Some experts identify the Computer Science Advanced Placement exam and the courses that prepare students to take it, as significant roadblocks for women who might be interested in pursuing computer science degrees in college. Test takers are only 15% female, the lowest percentage for any of the Advanced Placement tests.[99] According to Blum and Frieze, the test promotes the misconception "that computer science equals programming . . . Unlike AP tests in other fields . . . the AP computer science test is almost devoid of intellectual content." Instead, "the tests focus on the idiosyncrasies of the programming language *du jour*." They recommend: "AP computer science should be replaced by a course exposing the breadth and depth of computer science" that would foster understanding of logic, "intelligence and problem-solving," helping to cultivate "women

and men with a broader and diverse vision and deeper perspective."[100]

Bias and Discrimination

Explaining young women's somewhat negative attitudes toward science and engineering, the National Research Council notes: "Prospective female students . . . may hear stories about harassment, 'glass ceilings,' lower salaries, and the marginalization of women in college."[101] In addition, the Council points to isolation of female students as a barrier to retention.[102]

Teaching Methods

The National Academies find: "Introductory science courses can function as 'gatekeepers' that intentionally foster competition and encourage the best students to continue, but in so doing they also can discourage highly qualified students who could succeed if they were given enough support in the early days of their undergraduate experience."[103]

The Academies also indicate that "an increasing majority of those with doctorates in science or engineering now work outside of academia. Doctoral training, however, still typically assumes all students will work in universities and often does not prepare graduates for other careers . . . Addressing the issues of effective lifelong training, time-to-degree, attractive career options, and appropriate type and amount of

financial support are all critical to recruiting and retaining students at all levels."[104]

Difficulty Combining Work and Family

For graduate students considering careers in STEM fields, female faculty members may provide a cautionary example. According to the National Research Council, "Some younger women observe the long hours, stress, and lack of family time experienced by women academics and decide that 'doing it all' is not for them."[105]

"[Kimberlee] Shauman and [Yu] Xie found that the time it takes to get a Ph.D. and the desire to have a family are major reasons women [in science] are less likely to make the transition from undergraduate to graduate school . . . 'We, as a society, are wasting a huge amount of potential because of the way the science career is structured,' says Shauman."[106]

Referring to the biosciences, the president of the National Academy of Sciences noted in 2003 that "almost no one finds it possible to start an independent scientific career under the age of 35,"[107] creating "conflicts with marriage and family life," according to Alfred P. Sloan Foundation Vice President Michael Teitelbaum.[108]

Describing the difficult choices that face minority women considering careers in science, Richard

Tapia says, "Traditional culture dictates a dream with expectation of dating, marrying, raising children near their grandparents and family, and then grandchildren. Science culture sells an opportunity for them to either have no husband or a late marriage, no children or few and late, live away from the extended family, much stress, little relaxation. It's a very hard sell that women have to deal with."[109]

Perceived Lack of Jobs

One reason for declining enrollments in computer science, especially of women, appears to be "the misconception that the job market is poor." However, Martha Pollack, associate chair for computer science and engineering at the University of Michigan, reports, "The job market is unbelievably strong."[110] According to Jan Cuny, a computer scientist at the University of Oregon:

There are more people involved in computer science now than at the height of the dot.com boom."[111]

Michigan Context

Numerous state and federal initiatives have encouraged girls to become and remain interested in STEM fields. Following passage of Proposal 2 banning affirmative action in public education in Michigan, it is possible that some state- and

university-supported programs may face legal challenges, even if they are funded by corporations, foundations or private donors. Federally-funded programs, on the other hand, may legally continue to require that race or gender be taken into account. Examples of potentially affected programs in Michigan include:

- University outreach to K-12 girls and underrepresented minorities, as well as their parents, that is designed to promote college attendance and interest in STEM fields
- Science and technology summer camps or fairs designed to provide underrepresented students with hands-on experience
- Sally Ride Science Festival
- University-based women in science, engineering or computing programs for middle school, high school and college women
- University residence hall-based residential programs for women studying science and engineering.

Public institutions in Michigan are no longer able to designate new scholarships or fellowships (created after December 21, 2006) to support women in science or engineering, unless the funds originate with a federal program.

Improving Educational Attainment in Michigan

Michigan has recently taken actions that will help to promote adequate high school preparation and a "college-going culture" in the state:

- The Michigan Merit Curriculum, adopted in 2006, requires every high school student to complete four credits in mathematics and three in science,[112] among others, resulting in some of the strongest curricular requirements in the country.

- Michigan has aligned "high school assessments/exit exams and college entrance exams."[113]

- The Michigan Promise Scholarship adopted in 2006 "provides every child a $4,000 scholarship to attend college, community college or a technical training program."[114]

National Efforts to Increase the Number of Graduates in STEM Fields

At each step in the educational pipeline, students need to be presented realistic information about science and engineering careers that includes stories about the accomplishments of female and minority scientists and engineers. For example, the Sloan Foundation Career Cornerstone website (www.careercornerstone.org) provides comprehensive information and resources to students, parents, teachers, counselors, and graduates on careers in science, technology, engineering, mathematics, computing and medicine and prominently features female professionals.[115] It should be widely used in middle and high schools.

The National Academies' 2007 report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, makes a number of recommendations for federal action to increase the supply of professionals employed in STEM fields:

- Increase the number and percentage of K-12 science and math teachers who have degrees in the fields they teach, and provide a variety of lifelong opportunities to upgrade their skills.

- Enlarge the pipeline by increasing the number of students who take advanced math and science courses.

- Increase funding for basic research in the physical sciences, engineering, mathematics, and information sciences.

- Increase funding for researchers at early stages in their careers.

- Increase scholarship support for U.S. citizens in STEM fields.

- Make it easier to recruit students from abroad and to retain them as skilled workers.[116]

In response to the limitations of the Ph.D. and post-doctoral work as a one-size-fits-all model for scientific training, the Sloan Foundation launched an initiative to sponsor Professional Science Master's degrees as an alternative that could keep more students in the pipeline while preparing them to work in industry.[117] Although not created specifically to increase women's participation, such programs may be attractive to women unwilling to delay childbearing until their mid- to late-thirties, after they have secured a laboratory or achieved tenure, as well as to women and men interested in a career outside the academy. Currently, 50 institutions, including Eastern Michigan, Grand Valley, and Michigan State Universities, and the University of Michigan, offer a total of 100 Professional Science Master's degree programs, and the Sloan Foundation is committed to funding expansion.

Other recommendations include:

- Creating math and science magnet high schools. According to the Information Technology and Innovation Foundation, such schools translate "into much higher rates of college attendance and graduation in scientific fields. Moreover, there is evidence that they are able to engage women and minorities in STEM fields more effectively than traditional high schools."[118]

- Creating opportunities for life-long learning, so workers can change careers or update their skills in response to economic and technological change. Returning students tend to be very focused, persistent and high-achieving; making academic programs more accommodating to adult learners could counter the high drop-out rate among younger students in STEM fields.

- Providing varied formats for learning, including certification programs and online learning, to meet both the demands of the workplace and the needs of adult learners with jobs and family responsibilities.

Keeping Women in the Pipeline

To Recruit and Advance: Women Students and Faculty in U.S. Science and Engineering, a study by the Committee on Women in Science and Engineering of the National Research Council, analyzes impediments to recruiting and retaining female undergraduates, graduate students and faculty members and contains a comprehensive set of recommendations that is too extensive to be fully reflected here. It is available through the National Academies Press.[119] The following examples and recommendations derive from a variety of sources.

Teaching introductory courses in the sciences and mathematics from the premise that all students can and should succeed increases the success of all students, but particularly women and underrepresented minorities. Methods might include "phased entry, sometimes with peer-taught workshops,"[120] self-paced, collaborative and hands-on learning opportunities. Writing for the National Center for Women & Information Technology, Lecia J. Barker and J. McGrath Cohoon report on a number of "promising practices," with successful case examples of each:

- Research experiences for undergraduates[121]
- Collaborative learning environments and pair programming[122]
- Revamped introductory courses[123]
- Inclusive pedagogy, resulting in improved classroom climate[124]
- Electronic mentoring[125]
- Encouraging persistence[126]
- Targeted recruitment[127]
- Intentional role modeling.[128]

For instance, the University of Virginia "instituted multiple entry paths that tracked experienced and inexperienced students into different sections and incorporated structured laboratories into the 'lecture' portion of the inexperienced section." In the section for inexperienced students, which enrolled much higher percentages of African American and

women students than traditional courses, "the instructor repeatedly and explicitly encouraged students to choose a computer science major, and used examples and assignments that appeal to diverse student groups." Having established through surveys that "women and minority students are particularly interested in applications with obvious benefits to society," teaching in this section "emphasizes examples and assignments related to language translation, psychological testing, health, medical diagnosis, and games." In addition, "the instructor brings women professionals to discuss their careers . . . Classroom discussion is routine and offers opportunities for students to learn each others' interests and activities." As a result, students achieved the same grades as those in the traditional section, "but with more students, more women, and more minority students choosing a CS major."[129]

At the University of California-Santa Cruz, students have been both encouraged and assigned to learn computer programming in pairs for a number of years. Originally developed for introductory courses, the strategy has been so successful that it has been extended to advanced courses. Evaluation research shows that paired programming has the following effects:

- "Increases the percentage of introductory students (especially women) who declare a computer science major;

- Increases the number of students who remain in the computer science major one year later . . . ;
- Reduces the so-called 'confidence gap' between female and male students, while increasing the programming confidence of all students;
- Leads to higher-quality student programs."[130]

Writing about efforts at Carnegie Melon University since 1995 to transform the Computer Science Department in order to make it more attractive and responsive to women, Lenore Blum and Carol Frieze describe a number of "essential" actions:

- "Outreach in the form of summer workshops for high-school computer-science teachers" to both teach material for the then-new Computer Science Advanced Placement test and to address the gender gap in the field
- Changes in admissions criteria "to downplay prior programming experience and place high value on indicators of future visionaries and leaders in computer science"
- Providing "various entry routes into the entry-level programming sequence"
- "Creating a professional organization and community for students." [131]

Following implementation of all these changes, women's enrollment increased from 7% in 1995 to 42% in 2000.[132] When Blum and Frieze interviewed the Carnegie Mellon class of 2002, they

> "found many students who did not fit traditional CS gender stereotypes, men and women whose perspectives were often more alike than different, students who were well rounded . . . whose views of their field had broadened quite dramatically from seeing CS as 'programming' to seeing the field as an exciting range of possibilities, and women who were enthusiastic and positive about their experiences as CS majors."[133]

In contrast to earlier findings by Jane Margolis and Allan Fisher, they reported "the confidence of most of our cohort's women had increased by their senior year."[134]

More recent work done by Margolis at the University of California-Los Angeles confirms the effectiveness of training teachers to prepare students for Advanced Placement Computer Science exams. A 2004-05 cooperative program between UCLA and Los Angeles schools caused the number of advanced placement computer science courses offered to double, while participation by girls tripled, Latino/a students tripled, and African American students doubled.[135]

Closer to home, hands-on experiences like the Undergraduate Research Opportunity Program at the University of Michigan and the Cooperative Education Program at Kettering University improve retention of women and minorities by giving students real-world exposure, early mentoring, professional connections, and the ability to see themselves as working professionals.[136]

Numerous universities, including Rutgers, the State University of New Jersey, the University of California-Berkeley, the University of Wisconsin, Purdue and the University of Michigan have created residential programs for women in science and engineering, which may include the opportunity for students to take courses together and to have designated labs and discussion sections, access to lab instructors and study partners, or mentoring, tutoring, study groups, and lectures.

Child care and other child-related policies and supportive services are an important component of academic success for many women (and men) in all kinds of postsecondary institutions. For low-income women, especially single mothers, access to safe and affordable child care is a make-or-break issue. A relatively new childcare model at the University of Michigan incorporates a sponsored network of family day care homes, in addition to several on-campus child care centers.

The advantages of the day care homes include vastly less institutional investment than construction of centers, lower cost to users, capacity to significantly increase infant and toddler care, greater flexiblity with regard to scheduling, and location of homes in a variety of areas where students are concentrated. This model should be readily replicable on other campuses interested in increasing childcare capacity at relatively modest cost.[137]

Out of concern that its graduate women experience high rates of attrition and that its "pool of applicants for assistant professor positions . . . [has been] disproportionately male—across disciplines—when compared with pools of women receiving Ph.D.s, Princeton University announced in April 2007 that it has instituted a new package of benefits designed to support and retain graduate students who have children." The benefits include three months of paid maternity leave and extension of academic deadlines and fellowships, child care support for up to two children, additional child care funds for travel, and support for back-up child care.[138] While this is a particularly rich package from a wealthy university, the needs it addresses are common to graduate students everywhere and require attention, with solutions appropriate to the institution.

Universities can increase retention of graduate students with children by factoring the cost of

caring for dependents into stipends or fellowships, raising private funds to do so, if necessary.

Options for part-time study, whether temporarily following childbirth or other urgent circumstance, or as a permanent feature of a program designed for adult learners with full-time jobs, are another way to enable women to have children and continue to pursue degrees.

In Michigan, maintaining and increasing targeted outreach and support programs remains important in encouraging participation by girls and underrepresented minorities.

Call to Action

The federal government should:
- Implement the recommendations put forth by the National Academies in *Rising Above the Gathering Storm.*
- Conduct Title IX audits of colleges and universities to ensure that female students and faculty do not suffer from bias and discrimination.

The Educational Testing Service should:
- Revise the Advanced Placement Computer Science test to capture learning in areas other than programming that are important to success in introductory computer science classes.

The state government should:
- Adopt tax policies that recognize the economic importance of expanding access to higher education.
- Expand access to higher education by increasing need-based financial aid.
- Support educational innovation with the goal of encouraging state residents to pursue education throughout their working lives.
- Support creation of more early and middle colleges through which students earn a high school degree and a college certificate or associate's degree.
- Raise the age limit for mandatory schooling.

Local school boards should:
- Encourage all students to pursue rigorous science and math courses in both middle and high school; educate students and parents about the consequences of taking or not taking 8th grade algebra.
- Mandate that high schools report on enrollment in courses by race and gender and take steps to redress imbalances.
- Create math and science magnet schools. Engage in targeted outreach to ensure equitable enrollment by girls.

- Create programs bringing scientists, engineers, computing professionals and business people into the schools.
- Ensure that teachers and counselors are trained to guard against the stereotyping and gender bias that can inhibit girls' pursuit of and persistence in STEM fields.

Colleges and Universities should:

- Partner with middle and high schools and with community-based organizations to educate students and families about careers in STEM fields and about women's history of success in those disciplines. Use resources like those available through the Sloan Foundation's website on education and careers in science and technology.[139]
- Provide leadership for change from the top of the institution, with deans and department chairs held accountable to create positive organizational climates conducive to learning and inclusion. Use a variety of media and opportunities to "signal" the importance of women's participation as students, faculty and administrators.[140]
- Assess the commitment to and climate for women in STEM fields at institutional, school/college and departmental levels.
- Train faculty members to identify and avoid unconscious gender bias; the

STRIDE approach developed by the ADVANCE Project at the University of Michigan provides a successful model.[141]

- Create high-school-to-college and undergraduate-to-graduate bridge programs for students who want or need additional preparation to succeed.
- Tighten linkages between community colleges and four-year institutions to improve rates of transfer. Provide outreach, financial aid, and counseling to encourage and facilitate transfers.
- Adopt educational innovations demonstrated to improve women's recruitment and retention in STEM fields, like those in place at Carnegie Mellon, the University of Virginia, the University of California-Santa Cruz, the University of Michigan, and elsewhere. Successful innovations include designing targeted outreach to middle and high school students, developing admissions criteria that reflect the desired student body, creating living-learning communities for women in science and engineering, demonstrating the social utility of STEM degrees, creating multiple entryways to computer science programs, supporting or requiring collaborative learning, emphasizing in-class discussion, offering early research opportunities and other modes of experiential learning, and

establishing professional organizations targeted to women students.

- Provide all students with effective advising and mentoring.

- Create family-friendly policies that will improve the persistence of women throughout the post-secondary pipeline: undergraduate to graduate, graduate to junior faculty, and junior faculty to associate, with tenure. Policies include assisting students with child care and other child-related costs, permitting temporary and permanent part-time study, offering time "off the clock" for graduate students or junior faculty members who have babies or adopt, providing modified duties for faculty members who give birth, and providing flexibility in the timing of tenure reviews .

- Increase students' access to child care, whether by building centers, sponsoring a network of family day care homes, or partnering with community agencies.

- Provide students with child care subsidies.

- Design degree programs to accommodate the needs of working adults.

- Offer educational programs designed for K-12 teachers returning for degrees or certification in the STEM fields they teach.

- Offer training for teachers to help them prepare students for Advanced Placement Computer Science exams. As part of the training, address gender and racial gaps in the field.

Employers should:

- Adopt the recommendations put forward by the Michigan Council of Women in Technology Foundation in *Best Practices for the Advancement and Retention of Women in Technology*.[142] These evidence-based recommendations, designed to promote satisfaction, opportunity, and equity, highlight sound management and career development practices applicable in a wide variety of settings beyond IT. They feature workplace flexibility, family-friendliness, clear career paths, self-management, and multiple means of supporting professional growth, driven by leadership from the top of the organization.

The citizens of Michigan should:

- Tell leaders in government, education, business and civic life that the challenges of revitalizing the Michigan economy and Michigan communities demand that we make the best possible use of women's talents and skills. Tell them that diversity and inclusion are not just feel-good slogans but economic imperatives!

- **Resist accepting or spreading the stereotype that girls don't do well in STEM fields.**
- Encourage girls to explore their interests in science, math and computing, take 8th grade algebra, and persist in studying science and math during all four years of high school.
- Encourage both their daughters and sons to take advantage of Michigan's wide variety of postsecondary institutions by enrolling in college.

Forging Our Future

Building a well-educated Michigan populace that is prepared for the demands of global competition will require the fullest possible development and use of women's interests and talents.

However, increasing women's participation in STEM fields is not only about ensuring an ample supply of workers for the expanding high-tech economy. It is also about promoting the innovation and productivity that arise when people with differing life experiences, values, viewpoints and knowledge come together in research or business enterprises.

Good, and growing, information exists to guide efforts not only to encourage and support girls and women's interest in the STEM disciplines, but also to make our educational institutions and workplaces welcoming and nurturing for them.

The economy and the people of Michigan face a challenge and a choice. In the words of Lt. Governor Cherry's Commission on Higher Education and Economic Growth:

"Michigan's residents, businesses and governments can either move <u>forward</u> to a future of prosperity and growth fueled by the knowledge and skills of the nation's best-educated population or they can drift <u>backward</u> to a future characterized by ever-diminishing economic opportunity, decaying cities, and population flight—a stagnant backwater in a dynamic world economy."[143]

In order to thrive, we must be committed and creative in developing the talents of all our citizens to the fullest extent of their desires and abilities.

Appendix A

Percentage of Degrees in Selected STEM Disciplines
Awarded to U.S. Women, 2004

Percentage of Degrees in Selected Physical Sciences Awarded to U.S. Women, 2004

	Bachelors	Masters	Doctorates
Chemistry[144]	51.1%	46.2%	31.7%
Physics [145]	21.8%	25.2%	15.5%

Source: National Science Foundation

Percentage of Degrees in Engineering Fields Awarded to U.S. Women, 2004

	Bachelors	Masters	Doctorates
Aeronautical and astronautical[146]	17.8%	17.1%	11.9%
Chemical[147]	35.3%	27.7%	23.9%
Civil[148]	24.2%	27.2%	19.6%
Electrical[149]	14.2%	19.6%	13.5%
Materials & metallurgical[150]	31.2%	25.0%	17.7%
Mechanical[151]	13.6%	12.4%	11.1%

Source: National Science Foundation

Appendix B:

Percentage of Total Degrees Awarded in Selected STEM Fields

to Michigan Women,

By Race, in 2005, 2000 and 1995

Percentage of Degrees Awarded to Women by Race/Ethnicity at Michigan 4-Year Public Universities

	Bachelors			Masters			Doctorates		
	1995	2000	2005	1995	2000	2005	1995	2000	2005
Computer & Information Sciences									
Caucasian	65.6%	60.1%	51.7%	26.4%	19.4%	21.5%	25.0%	---	50.0%
African American	7.3%	8.1%	13.3%	1.1%	2.3%	3.5%	0.0%	---	0.0%
Hispanic/Latina	0.0%	2.7%	1.4%	0.0%	0.8%	0.0%	0.0%	---	0.0%
Asian	6.6%	14.2%	12.6%	9.2%	27.1%	29.7%	0.0%	---	0.0%
Native American	1.3%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	---	0.0%
Race unknown	4.6%	4.1%	4.9%	1.1%	3.1%	1.2%	0.0%	---	0.0%
Nonresident alien	14.6%	9.5%	16.1%	62.1%	47.3%	44.2%	75.0%	---	50.0%
Total degrees to women	151	148	143	87	129	172	4	0	2
Engineering									
Caucasian	74.9%	72.4%	68.6%	52.3%	45.1%	38.4%	40.6%	38.6%	25.0%
African American	8.7%	7.8%	5.5%	4.6%	3.8%	4.4%	3.1%	4.5%	4.5%
Hispanic/Latina	1.3%	1.8%	1.5%	1.1%	2.9%	3.6%	0.0%	0.0%	2.3%
Asian	6.9%	10.0%	13.5%	7.8%	28.5%	16.2%	12.5%	15.9%	18.2%
Native American	0.3%	0.8%	0.1%	0.4%	0.0%	0.3%	0.0%	0.0%	0.0%
Race unknown	5.1%	2.3%	3.4%	5.7%	5.5%	3.3%	6.3%	9.1%	2.3%
Nonresident alien	2.8%	4.8%	7.3%	28.3%	14.2%	34.0%	37.5%	31.8%	47.7%
Total degrees to women	610	769	673	283	344	365	32	44	44
Physical Sciences									
Caucasian	83.2%	78.2%	82.5%	53.4%	53.3%	54.3%	50.0%	51.2%	50.0%
African American	4.8%	8.8%	7.3%	2.7%	5.0%	3.7%	0.0%	2.3%	4.3%
Hispanic/Latina	2.4%	0.6%	0.6%	1.4%	0.0%	2.5%	0.0%	2.3%	4.3%
Asian	5.4%	7.1%	5.1%	5.5%	18.3%	8.6%	8.3%	14.0%	8.7%
Native American	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Race unknown	1.2%	2.4%	3.4%	2.7%	3.3%	1.2%	0.0%	0.0%	0.0%
Nonresident alien	2.4%	2.9%	1.1%	34.2%	20.0%	29.6%	41.7%	30.2%	32.6%
Total degrees to women	167	170	177	73	60	81	36	43	46

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