A Place at the Bench: Women in Biomedical Research

Marla V. Broadfoot

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Introduction

In 2009, the Burroughs Wellcome Fund commissioned a series of articles by science writer Marla Broadfoot to look at the landscape for women in the biomedical sciences. Broadfoot was given free range to explore the subject area, and the articles were published in the Fund's FOCUS newsletter.

The first article appeared in July 2009 and was circulated through social media. Given the popularity of the articles, it was decided to compile them in the hope that they would inspire more thought and discussion.

The Burroughs Wellcome Fund has long supported the careers of women scientists and continues to strive in its program areas to create a supportive environment.

We would appreciate any feedback. Please feel free to email news@bwfund.org

Author Preface

In many academic disciplines the numbers of women may be finally reaching those of men, but the ranks in science and engineering are still a long way from displaying gender equity. This disparity has implications not only in terms of social justice, but also for the quality of science pursued in this country.

Diane Halpern, one of the many researchers quoted in these pages, stressed that it is essential that people talk about the rhetoric of choice, recognizing that whether women choose to stay in science is shaped in many ways by the confines of the society in which we live. The contributions of women continue to be undervalued, by both men and women alike. And until there are some good institutional programs to keep women doing research at universities and institutes, flooding the pipeline at the front end will never be enough.

This series examines some of the unique challenges faced by women in science, such as lack of mentoring, the biological clock and unconscious institutional bias, and will explore possible solutions to retain more talent in this important field.

"Our struggle today is not to have a female Einstein get appointed as an assistant professor. It is for a woman schlemiel to get as quickly promoted as a male schlemiel."

Bella Abzug, U.S. Congresswoman, lawyer, social activist

Chapter One
Why It Matters

The Case for More Women in Science

Amy Wagers knows that she is a rarity. It's not because she is a scientific stand-out, though she received a Career Award in the Biomedical Sciences from the Burroughs Wellcome Fund (most recently she was named a Howard Hughes Medical Institute Early Career Scientist). Rather, she feels different because she is one of only two women among the 15 faculty in her department at Harvard. Wagers readily admits that she has few female peers or mentors, but says she doesn't think that as a woman she has been held to a tougher standard than her male colleagues. "I don't know the real reason" said Wagers, an assistant professor in stem cell and regenerative biology. "It is what it is, and hopefully over time that disparity will go away."

Clearly, women have come a long way from the days when they were not considered fit to do science or were discouraged from pursuing graduate degrees in the discipline. While they may have earned their place at the laboratory bench, female scientists remain greatly underrepresented in the highest ranks of academia. For instance, a National Science Foundation (NSF) survey found that only a little more than a fourth of the deans in colleges and universities are women. Some researchers—men and women alike—believe that equality is simply a matter of time, arguing that the increasing numbers of females going into the pipeline will push more and more of them down the line. But thus far, that theory has not held true, says Halpern, a professor of psychology at Claremont McKenna College and chair of a Department of Education taskforce on encouraging more women to go into science and mathematics.

Halpern says plenty of women and girls are stepping onto the ladder leading to an academic career in science. Females have made up the majority of students enrolled in college for the last 25 years. But obstacles—such as family obligations and subtle yet damaging gender biases—do remain to their ascent to higher positions in academia, causing many women to stumble along the way. In the biological sciences, the NSF shows that women are earning 56 percent of the Ph.D.'s and postdoctoral fellowships. However, females hold just 19 percent of tenured full professorships in science, engineering, and technology.

Pretty Good, for a Girl

Because the factors underlying this inequity can be subtle, it wasn't until Nancy Hopkins, now a prominent biologist at Massachusetts Institute of Technology (MIT), had worked for 25 years in what she described as a "man's profession" before she believed her situation to be unjust. Hopkins then became an outspoken advocate for women's rights, eventually conducting a controversial study on gender inequality at MIT that found widespread bias against female professors in everything from salaries and promotions to office space and interactions. When Hopkins looks back on her early years in research, she doesn't recall feeling discriminated against at the time. However, she does remember a particular incident that occurred while training at Harvard under James Watson, a mentor who had fervently pushed her to stay in science. One of the researchers that Watson had invited to campus stopped by the laboratory before giving his talk.

"I said to the Daily Tar Heel I hope there comes a day when it doesn't make the front page that a woman is named dean. At least in Charleston it will never be the case again that someone is the first woman, I will be the first woman and then hopefully it will make it easier after that for the next woman."

Etta Pisano, Vice President for Medical Affairs and Dean of the College of Medicine, Medical University of South Carolina

He walked up behind Hopkins, inappropriately touched her, and nonchalantly asked what she was working on—catching her completely off guard.

"I just thought it was very embarrassing—I tried to get out of the situation as best I could and use the fact that he was interested in me as an opportunity to talk to him about science," Hopkins said. "You didn't think about it as sexual harassment, it certainly wasn't illegal because the term didn't exist and we just didn't know what it was. Nor did you understand that when a man treats you that way he is probably not going to treat you as an equal scientist."

While overt discrimination in the United States is illegal, if not obsolete, women's abilities do continue to be underestimated and undervalued. In her book *Why So Slow? The Advancement of Women*, Virginia Valian explains that expectations of men and women in our society are different, and those expectations—"gender schemas"—skew our perceptions, even among the very scientists whose livelihood is based on their objectivity. Because of the influence of these gender schemas, the abilities and contributions of men tend to be overrated whereas those of women go underrated. A large body of research exists suggesting that each disadvantage—not getting credit for an idea, not being invited to a scientific meeting—can add up over time, so that men reach the top faster and in greater numbers than women do. As Valian later writes, "Well-meaning observers may tell the woman not to make a mountain out of a molehill. What they do not understand is that the notion of the accumulation of advantage encapsulates. Mountains are molehills, piled one on top of the other."

Researchers have spent decades on the topic of women in science, exploring every possible explanation for why females may not choose to go into science, or do not stay there, or are not able to achieve at the highest levels once in the career. Are girls wired differently, so that verbal skills come more naturally than mathematics? Are they socialized to go into more nurturing professions? Does the burden of child-rearing get in the way of their achievement? Or is the culture of the workplace toxic to women? But one question that has not received as much attention as the rest is why it matters that there are not as many women as men in the scientific profession.

Not Just Numbers

"It is a pure and simple question of equity," says Phoebe Leboy, president of the Association for Women in Science. "It is not fair to set up any barrier to women that you don't set up to men." No matter what the true cause for the dearth of women in science may be—and most researchers cite a number of factors—the end result is that women deserve an equal opportunity to make a living from science. Leboy, who is also a professor of biochemistry at the University of Pennsylvania, has found in her personal research that the proportion of women going on to apply for biomedical faculty school positions in medical departments is about half of what the Ph.D. levels would predict. She says that many women report leaving science because of an environment that is too difficult, too competitive, and too stressful. As part of the Committee of the Status of Women in Physics, Meg Urry, a professor of physics at Yale, has participated in several site visits to physics departments across the country in order to assess the climate for women. Urry says that many women report being substantially unhappier than men in similar academic posts. "The disparity between what some of these women had actually accomplished and their own assessment of whether they should do research is a real mismatch that is just drummed into them," says Urry.

But for many researchers, having equal numbers of women and men in the scientific ranks is less of a priority than having a system that is fair and furthers science itself. "I frankly don't care how many women do science," says Hopkins. "I just care that the ones who want to do it can do it without worrying about this problem." Yet other researchers are concerned that by losing women in science, they are systematically losing half of the talented people in an area that is in constant need of fresh ideas. *Beyond Bias and Barriers*, a 2006 report by the National Academy of Sciences exploring the status of women in science, stated that the United States will have to aggressively pursue the innovative capacity of all of its people—women and men—in order to maintain its scientific and engineering leadership amid increasing economic and educational globalization.

The real issue becomes one of excellence, says Yale's Urry, who has advocated for increasing the number of women in the physical sciences. "Most people think to get women and minorities you have to lower standards, and that just drives me batty," Urry says. "First of all I start from the assumption that men and women are equally good at doing science. If that isn't true, then prove it to me, but there's no evidence that that isn't true. So by hiring more men than women, you are going deeper into the pool of talent than if you were equally open to hiring both sexes. That means you have less talented faculty than you could have had otherwise."

Furthering the Field

When diversity is lost in any discipline—whether in terms of racial diversity, ethnic diversity, or gender diversity—a certain amount of intellectual content is lost as well, says Leboy. She and other researchers like Harvard's Wagers agree that it is an undeniable waste of resources to have invested so much time and money in educating talented women who then opt out of research. "In effect you are training a huge amount of people who have creative, important thoughts who are never going to continue to contribute to scientific discovery," Wagers says. "That then limits the pool of creative thought that goes into science."

Generally speaking, women do tend to gravitate toward certain areas of science. According to statistics from the NSF, women make up two-thirds of psychologists, less than half of biological and life scientists, a quarter of mathematical and computer scientists, and just one-tenth of engineers. "Certainly there are women who do sewage engineering, but they are much more likely to go into other fields of science," says Claremont McKenna's Halpern. "It is not a matter of one field being better than another, but rather it is important that we are covering diversity in the kinds of questions that people ask about science." And it is not only the questions that women ask, but the way that they ask them that may make female researchers a particular asset to the scientific process. Women may have a different style of interaction than men, one that could foster the collaboration and cooperation needed for the success of today's large-scale research endeavors.

"I don't think that this is intrinsic, but I do think that we as women have been socialized this way, so why not take advantage of it?" says Urry. "It is imperative that if we are going to continue to make breakthroughs, we have to figure out how to make our profession diverse. Otherwise we are just cloning ourselves and we are going to die out very soon."

But while such characteristics may be true at a population level, Wagers is afraid that applying them on an individual level could feed a dangerous stereotype that there is a fundamental difference between male and female scientists. Just the same, turning a blind eye to such differences could do more harm than good. Rather, the answer may be to recognize and embrace different approaches, while also addressing possible gender biases that undermine efforts to keep more women in science.

"Science can be so difficult with all of the obstacles standing in the way of women. It is like telling people to run a marathon in the Olympics and then telling them they will be carrying a five pound brick. I mean, that would be absurd, wouldn't it?"

Nancy Hopkins, Amgen, Inc. Professor of Biology, Massachusetts Institute of Technology

Chapter One Appendix:

Is the US losing its edge in the sciences?

The loss of highly skilled women scientists from the pipeline is not simply an issue of parity. True, it might be nice to have equal representation of both sexes in any given discipline. But perhaps more important is that the United States train and retain all the talent that is at its disposal to keep itself competitive in the global marketplace.

"For me and for the country, this is a critical issue," said Ana Mari Cauce, dean of the College of Arts and Sciences at the University of Washington. "If you look at what has grown the economy in the last couple of decades, innovation in terms of science and engineering technology has been the real driver. We are competing with countries like China and India investing heavily in this area. To not think of women as part of the solution is going into a fight with one arm tied behind your back. It simply doesn't make any sense. You can't take half the world out and take half the world off the table and think that you are going to be competitive."

Bleeding talent and resources from this critical area is certainly not the way for the country to get ahead.

"In my head I did a rough calculation and estimated that it takes half a million federal dollars to support a student through a Ph.D. and then a postdoc, tuition plus stipend for so many years," said Mary Ann Mason, co-director of the Center, Economics and Family Security at the Berkeley School of Law.

In 2011, President Barack Obama signed into law the American COMPETES Reauthorization Act, which authorized $46 billion for research and education in science and mathematics and contained a number of provisions to reduce gender barriers in these areas.

Tenure, the Golden Ticket

"The thing that was difficult in my generation, in my era was that when you made a discovery you couldn't really get credit for it," said Nancy Hopkins, a molecular biologist at MIT and a member of the National Academy of Sciences. "I tried to talk to my friends who were male scientists about it and they said oh, no, it's the same for everybody; nobody gives me credit for my ideas. But I knew it was different for men and women, I absolutely knew it. I knew it from an early stage and wondered how in God's name could any woman ever get tenured because even when you make a discovery and even when you publish it, people won't reference you, they won't give you credit for it, they won't acknowledge it, so how can you get tenure? And the only reason I thought it would be possible was there was a woman ahead of me who was successful and I thought okay, it can be done. I went to my mentor Jim Watson and told him the problem. He told me to just keep going, not to give any attention to the people who are walking all over me and not giving me credit and that I'd see what happens. He said that if I did enough good work then they were going to have to give me tenure. So I kept going, but I was pretty doubtful it was going to be possible. And you can imagine how stressful that was, the unfairness of it all, I was told if you don't make enough discoveries you aren't going to get tenure, but if you do make them and still can't get credit for them how on earth can you survive?"

Mary Ann Mason, author of "Mothers on the Fast Track," has extensively analyzed data by the NSF to pinpoint more closely why there aren't more women in the higher ranking, tenured positions of academia. She and her colleagues have found that married men with young children are 50 percent more likely to enter a tenure-track position than married women with young children. And after securing a tenure track position, men are 20 percent more likely to achieve tenure than women. The reasons for this disparity are complex and the subject of investigation of many other researchers in addition to Mason. Clearly, women have come a long way. But there is still a long way to go.

Chapter Two
Mentoring and the Importance of Peers

A Spot at the Bench

When Pae Wu recently attended a workshop designed to encourage more women to become professors, she couldn't help but notice that the discussion seemed more negative than positive. The engineering graduate student had been fairly torn on whether or not to stay in academia, and the presentations on the rigors of the tenure process didn't make her any more confident that she wanted to face those tough first years of a career in science.

"People were questioning why there weren't more women in science, and I had to point out that we are not going to be banging down the doors to enter a profession that just sounds so awful," said Wu, who just completed her doctorate at the Pratt School of Engineering at Duke. "While I do love science, I just don't know that I can be the heart and soul of it."

Your Worst Critic

It can be difficult for women, even those who have spent their whole lives gunning for a spot at the bench, to stay on the career path when they have so few female mentors to light the way. And while many scientific disciplines are enjoying equal numbers of women and men in their training programs, when it gets to the faculty level women are still in the minority. Part of the problem stems from societal influences that may cause women—and men, for that matter—to view their abilities, responsibilities and career options through a rather narrow lens.

"If all you know about scientists, if the vision of a scientist is a brilliant white man with glasses and funny hair and a lab coat, then none of us are going to feel like we match that model," said Mary Wyer, who has championed the advancement of women in science and engineering through the integration

of women's studies into the undergraduate and graduate curriculum at NC State University. "The truth of the matter is that women and people of color have made substantive contributions to science and that these are forgotten, they are lost history."

One concept she teaches is that of stereotype threat, or the risk that a negative stereotype about one's group—such as being female or African-American—will lead to self-doubt and affect academic performance. In the classic study of this self-fulfilling prophesy, social psychologists Steven Spencer, Claude Steele and Diane Quinn told a group of students that they were going to take a very difficult math test. When they scored the exam, they found that on average, the women earned ten points, whereas the men got twenty-five.

When they administered the exact same test to a different class—again telling them it was very difficult but also typing at the top "this test has been designed to be gender neutral"—women doubled their score with an average of twenty points, and the men also scored twenty points. This experiment, and over a hundred others like it, indicated that it was not simply innate ability, but rather the perception of one's ability that can make a significant difference in how women scientists perform.

Molly Carnes, co-founder of the Women In Science & Engineering Leadership Institute (WISELI) at the University of Wisconsin, thinks that it is important that people recognize these biases, even within themselves, and try to overcome them. "We are not going to do away with these stereotypes, they have been there for centuries," said Carnes. "But if the pervasive message that came across was that in spite of these stereotypes, all research has shown that men and women are equally capable of being leaders, scientists, architects, and so on, well that in and of itself would probably be the most powerful way to mitigate the damage from stereotypes."

Those with the confidence to continue in science can go on to face a whole new set of challenges as the token female in a laboratory, on a thesis committee, or even in an entire department. And being the token in the situation can mean that you are seen as woman first and a scientist second. Carla Koehler, who investigates how defects in mitochondria lead to disease, says that there are often only one or two female speakers at scientific meetings on the topic. While she recognizes the scant number of women in the field, Koehler claims it has never factored into her career choices.

"If I was going to be the only woman in the department that would have been fine, I just wanted to go to the best place to do science," says Koehler, one of several female faculty in chemistry and biochemistry at UCLA. "Ultimately, I want to do my science; sure it would be nice to have some more female colleagues, but it isn't a requisite."

But the number of women in the profession does matter, not just in terms of equity, but also because they serve to recruit—and retain—budding female scientists. A study of two dozen Virginia colleges and universities compared the characteristics of computer science and biological science departments to better understand the elements needed to prevent women from leaving a discipline. They found that being surrounded by same-sex peers was the single most important factor for the retention of females. "Tons of students leave graduate school not because they aren't good at the subject but because they feel like they just don't fit in," said Carol Frieze, associate director and program coordinator of the student organization Women@SCS.

> ""I think numbers do make a difference, but numbers alone won't do it. I think girls and women have got to enter a community that is open to diversity and well managed. Because if you just have numbers coming in to a very traditional environment that has been male-dominated and a particular kind of culture exists, then it is not going to be so easy. You have to make sure that they get integrated into whatever culture they are coming into. I see that in my job, working with students here."
>
> **Carol Frieze**, associate director and program coordinator of Women@SCS at Carnegie Mellon

Power of Peers

While women are in the minority in most areas of the sciences, their numbers are the fewest by far in engineering, computer science and physics. Women studying computer science at Carnegie Mellon University created Women@SCS with the idea that some learning—mentoring, networking, study groups—occurs outside the classroom. For example, men sharing a dormitory floor are likely to interact and help each other with homework, but that might not be happening for the small number of women spread around campus. The program creates opportunities for women by bringing in invited speakers, sponsoring seminars that are of interest to both males and females, conducting outreach for middle school girls, educating guidance counselors about the breadth of computer science and connecting female students with mentors.

"These women know all too well that you can go a whole day without seeing another woman, so it is important that they have opportunities to get together and talk," Frieze said. "Our intellectual capability may be the same, but our life experiences and the culture we live in can be different."

Mentoring often occurs informally, but many universities and national organizations have created programs to formalize the process. The Association for Women in Science (AWIS) has almost 50 different chapters around the country that bring women scientists together to network, and the organization also partners with MentorNet, an online system that links up experienced scientists with junior people, anywhere from undergraduates and graduate students to early career faculty.

"It is not just mentoring the women so that as square pegs they will stick to round holes, but mentoring the faculty about what their thought processes are and what are the characteristics of inadvertent gender inequity," said Phoebe Laboy, president of AWIS. While speaking at a conference to help set the research agenda for the National Institutes of Health (NIH) Office for Research on Women's Health, Laboy told the NIH to do a better job of valuing mentoring. "They should not fund some guy with a multi-million dollar grant that is supporting ten graduate students and postdocs without worrying about what kind of mentoring is going on there," she said.

As someone who has worked as a postdoctoral fellow for that scientist with the big grant (Irving Weismann), Amy Wagers says she owes her success in large part to the great mentors she has had throughout her career. "They never made me feel like there was something I couldn't or shouldn't do because I was a woman, it just never factored into the equation," said Wagers, who is an assistant professor at Harvard Medical School. "In fact, my graduate advisor had more confidence in what I was doing than I did at the time."

Still, she admits that she has recently sought out female mentors. "It is a huge issue that there haven't been as many female role models for women to look at who are going up through the training program to say yes, you can do this—it is possible to have a family, a personal life and a great career," Wagers said. "I think that as you see more women succeed then it encourages the women who are in training to continue on that track and it shows that it can be done."

How it's Done

One of those success stories belongs to Claudia Gunsch, a scientist whose work integrates genetics and environmental engineering. In addition to conducting her research, she mentors high school students, undergraduates and graduate students from underrepresented groups within her own laboratory, and she volunteers for programs to introduce girls to science and engineering, such as the Women and Math Mentoring Program.

Recently, Gunsch has begun developing individual classes as part of a National Science Foundation (NSF) award to give middle school students a hands-on experience that may spark an interest in environmental engineering. She will start by giving the classes at Rogers Herr Middle School, a predominantly African-American school in Durham, NC, and hopes to eventually disseminate the program to other schools. Gunsch's goal is not only to convey her passion for research but also to show that a woman can be an engineer, and succeed at it. "Unfortunately, with one school you are targeting so few people that making sure that everyone gets this message can be difficult unless it is integrated into the curriculum from a very early age," Gunsch said.

She also has another job altogether—as a mother. Gunsch had three children within five years of starting her faculty position at Duke. She could easily say she has too much on her plate to volunteer as a mentor to young women, but she doesn't. "I think you have to make that decision whether or not it is important to you, and I have decided it is," Gunsch said. "One of the reasons I went into teaching was I wanted to help people, and make sure that next generation of women is well represented. I know I have plenty of colleagues who have decided the outreach activities are not a priority, but I view them as a nice perk because I enjoy giving back."

But in a field where the mantra is publish or perish, taking time away from research to give back could actually hurt one's career. Gunsch herself admits that she doesn't know what is going to happen when she goes up for tenure in a few years. Meg Urry, who has achieved tenure as a professor of physics at Yale, stresses that mentoring is a necessary burden for female faculty. "As women we spend a huge fraction of our time working with undergraduates and graduate students who need extra encouragement and who come to us because we're the role models," said Urry, a professor of physics at Yale. "That means we have that much less time to write a proposal grant or write a paper."

Urry has advocated for supplemental research funds to help women scientists continue to provide mentoring and do good science. One provision of the America COMPETES Act requires that all NSF grant applicants must describe how they mentor their postdocs. However, it may take similar provisions for the NIH, and other steps like inclusion of mentoring activities in the evaluation of faculty at universities, for women to get the mentoring they need to remain in the discipline. As Urry says, if we continue year after year to educate women who don't have female professors to look up to, why should we expect them to go into science?

Chapter Two Appendix:

Encouraging the other 50 percent

Many girls lose interest in science and math because they are not given the same opportunities as boys. And many women that choose to pursue a career in science against all odds find themselves suddenly alone, without appropriate mentors to guide them up the ladder of academic life. A number of programs do exist to encourage girls to go into science, and to hook them up with mentors later in life.

"Our faculty hosts a number of programs to get young girls excited about science, and they are all a runaway success," Meg Urry, professor of physics at Yale and a strong advocate for women in science. "Those things have a big impact because they intervene early enough that the girls have not yet been told that they shouldn't be doing science. I think the programs for youth, programs to mentor women higher up, and everything in between are very important."

Below is a sampling of some of these programs:

National Girls Collaborative Project
www.aauw.org/connect/ngcp/index.cfm

Thinking like a Scientist
www.human.cornell.edu/hd/outreach-extension/tlas.cfm?CFID=490288&CFTOKEN=59334013

Creative Technology Nights for Girls
www.women.cs.cmu.edu/technights

Females Excelling More in Math, Engineering and Science (FEMMES) www.duke.edu/web/FEMMES/index.html

MentorNet, The E-mentoring Network for Diversity in Engineering and Science www.mentornet.net

Collaborative for Gender Equity
www.genderequitycollaborative.org/

Rosalind Franklin Society
www.rosalindfranklinsociety.org/

Computer Science Barbie

Budding young scientists now have an unlikely role model to look up to: Barbie. The latest career choice of the iconic blonde bombshell—the first selected by a half million fans—is that of a computer engineer. The doll's color scheme has not strayed far from the usual pink on pink, but now she sports a t-shirt covered in binary code, retro spectacles and a shiny laptop. Only time will tell whether the chic geek will influence little girls decisions on what they want to be when they grow up. But those already immersed in the computer science field are happy to see any attempt to break the common stereotypes about who is best suited for the job.

"One of the things I always stress again and again to the Women in Computer Science (Women@SCS) here is you are not here because you are different in any intellectual way, your potential is just the same, your capabilities are just the same. It is something we are always up against," said Carol Frieze, who directs Women@SCS. "We want women to have the identity of being a computer scientist first and foremost, not of a female computer scientist. If the stereotype is that Asians are good at math and women are bad at science, what happens if you are a female Asian? Many of these stereotype threats are not deep-rooted inside of us, it is not this existentialist thing. It all just depends on the context, on the situation in which you find yourself. There are several studies where prior to the test you subtly raise gender or race and see that it affects the test score. This is one of the best examples to show that culture, context, environment are what make a difference. And how we need to change what is going on at a deep subconscious level."

Chapter Three
The Effect of Family

Juggling Science and Motherhood

Reading through Etta Pisano's CV is not a trivial undertaking. She is a member of the Institute of Medicine, has published over a hundred scholarly articles and has received numerous awards for her contributions to the improvement of breast imaging and its role in cancer diagnosis. But her list of accomplishments doesn't include what is arguably her most important role: the mother of four children.

Pisano embarked upon her career in the middle of the feminist era, when women no longer felt forced to choose between family and career and instead tried to have both. Yet despite Affirmative Action, family-friendly policies and the increasing role of fathers in child-rearing, many women are still struggling to find the time, the resources and a culture supportive enough for them to do it all.

"Nobody told me how to do it, I just figured it out on my own," said Pisano, who is the vice president for medical affairs and dean of the college of medicine at the Medical University of South Carolina. "There is nothing magic about having a career and kids—it just takes hard work and support and some luck."

But finding that right combination can be a challenge in a culture where scientists are faced with a limited amount of time to prove themselves worthy of tenure.

The Cost of Kids

A 2010 study by Berkeley researcher Mary Ann Mason and investigators at the Center for American Progress (CAP) found that marriage and childbirth accounts for the largest leaks in the pipeline between Ph.D.

receipt and the acquisition of tenure for women in science. The paper reported that single women without children are just as likely as married men with children to enter and take on the first academic research job. Compare that with married women with children, who are 37 percent less likely to enter academia. The women who did have babies, either as graduate students or postdocs, were very unlikely to continue.

And part of the reason they were very unlikely to continue is that only 13 percent of the 62 member institutions of Association of American Universities (AAU) surveyed had any paid maternity leave for graduate students, with only a slightly better 20 percent with policies for postdoctoral fellows. A dismal 43 percent had no paid leave policy at all.

"We have to reconsider the rhetoric of choice," said Diane Halpern, past president of the American Psychological Association. "When you have women who are graduating with science doctorates and then opting not to go into academia, you have to wonder whether it is because of personal choice or because they did not see a choice that realistically accommodates the intensive demands of academia and the desire to have a family."

Halpern says the problem is that tenure clocks and biological clocks run on the same time zone. The average age for receiving tenure in the sciences (according to Mason's report) is around age 39, well past the peak child-bearing years. Having a child before tenure has been secured means adding on responsibilities to an already intense make-or-break period in one's career. Waiting until tenure has been achieved means facing the challenges of decreased fertility and high-risk pregnancies, as all pregnancies over age 35 are currently designated.

"What they say is you can have it all, just not at the same time. Life can be pretty long, so you can do things in succession. You need to realize you'll get there, and you just need patience."

Emily Monosson, environmental toxicologist, writer

Lisa Wolf-Wendel, a professor of higher education at the University of Kansas, studies issues of motherhood and academic life. She says one of the greatest preoccupations of women scientists—and she has interviewed over 120 women on the tenure track—was the question of when was the right time to have a baby.

"They wonder if they have the baby early if it will hurt their chances of tenure, or if they wait until they get tenure if it will be too late," Wolf-Wendel said. "When we interviewed their male colleagues, they hadn't considered timing to be an issue—they had never even thought about it."

Timing has become less of an issue with the inception of stop the tenure clock provisions, which allow tenure-track faculty members to postpone their tenure reviews for a year for the birth of a child or other family event. Although at least 86 percent of research universities are reported to have stop the clock policies, many women don't know that they exist. And even those women who are aware of the policy are often afraid to take advantage of it in case they appear needy or incapable of handling the demands of their post, says Wolf-Wendel. From her own work, she estimated that fewer than half of women scientists took advantage of their institution's stop the clock policy.

In response, most policies are now crafted in a way that women—and men alike—no longer ask to have their tenure clock stopped, it just happens automatically. For those universities where the policy is still optional, it is the climate and tone set by the senior faculty that usually determines how many women elected to stop their clocks. If department chairs or tenured professors freely talk about babies, family life and family-friendly policies, it has a trickle-down effect to those just starting out.

Claudia Gunsch, an assistant professor in civil and environmental engineering at Duke, has stopped her tenure clock twice. Because she will be the first female with children to be considered for tenure in her department, she is curious to see how the process will play out.

"I know women ahead of me who waited until they got tenure to have children," Gunsch said. "That was something I was not willing to do —I had already waited this long. I really don't know how that is going to play into the tenure evaluation or if it even will. Everyone tells me that I will

be evaluated the same way as someone who just has six years of experience, but somehow in the back of my mind I keep thinking that I had eight years, so how are they going to evaluate that? I guess I'll know soon enough."

The Second Shift

Stopping the clock may help women balance family responsibilities when their children are infants, but when the clock turns back on, those responsibilities do not magically disappear. Scientists on average work about 50 hours a week until retirement age. When you add to that care-giving hours and housework, women faculty with children in the University of California system report a weekly average of over 100 hours of combined activities, says Mason, who is also co-director of the Center for Economics & Family Security at the University of California, Berkeley School of Law. That is in comparison to 86 hours for men with children.

"Women are expected to do the second shift, but it works against them" says education researcher Wolf-Wendel. "Many of the women I interviewed gave this example of leaving a meeting to pick up their kids from day care. When the woman did it, she felt like their colleagues believed that she cared more about her kids than her work. When a man did it, everyone seemed to respond that he was such a great dad. So the same action is criticized when one type of person does it and lauded when another type of person does it."

According to Mason's research, the increased pressures of juggling what are essentially two jobs—and the possibility of having one's science taken less seriously because of it—can greatly reduce the chances of getting tenure. Her report shows that women who are married with children are 27 percent less likely than their male counterparts to achieve tenure upon entering a tenure-track job.

Some women find those statistics too daunting and instead look for ways to continue their science outside the sphere of academics. Emily Monosson, editor of *Motherhood, the Elephant in the Laboratory*, says that it can be a real struggle to keep up a high-profile academic career and take care of your family.

"As one of my contributors said it best, you can't be superscientist and a supermom," said Monosson. "It is the rare person who really has it all. You just have to know that up front, and make your decisions from there."

For Monosson and the other women who contributed their stories to *Motherhood*, that often meant choosing nontraditional careers—as consultants, writers, lecturers. An academic post may be considered the gold standard, but many other—often unrecognized—opportunities do exist that enable women to continue to contribute to science without dropping out completely. Still, many of the women who leave academia express guilt and a sense that they let down their advisors or other women in the process, says Monosson.

According to the National Science Foundation (NSF), there are more than one hundred thousand women doctoral degree holders in the United States employed in the sciences, one-fifth of them working part-time. And while women may want to take part-time work while their children are young and then return to academia later, they may find that coming back is not that easy.

"You either dive in and go with the flow, or step out of that water realizing that you may never be able to get back to the research university setting," says Wolf-Wendel.

Women who are serious about returning to the academic workforce can take a step in that direction with a special career-reentry fellowship. These fellowships—such as the National Institutes of Health (NIH) career reentry supplement—help provide funding to investigators who have taken time off for family as they transition back into their research careers. In 2009 NIH put almost 17 million dollars in grants to study factors that influence the careers of women in the sciences, such as the impact of family-friendly policies in retaining women in the scientific workforce.

Tough Choices

Those afraid of stepping off the tenure track altogether may find a way to accommodate the needs of their family and their research through part-time tenure-track positions. Such posts, which have been endorsed by the American Association of University Professors (AAUP), are cropping up at universities all over the United States. But the number of applicants for such positions remains low, as many women are uncertain of the expectations and possible stigmas attached a job that takes anything less than 100—or 110—percent.

Pisano started her twenty-year tenure at UNC on the part-time tenure track. While chair of the Committee on the Status of Women, a task force that reviewed and corrected gender-based salary inequities at the university, Pisano stressed that this option is vital to keeping women like herself in the pipeline. Once such policies are in place, Pisano says, institutions must be diligent about promoting them and educating their scientists about what family-friendly policies are available.

"There is this impression that the only way to be a good scientist is to work 80 hours a week—that it is not a part time job, not something you could turn on or turn off," said Wolf-Wendel. "If you want to win the Nobel Prize or if you want to cure cancer you need to be doing it all the time—you are either devoted to it or not. Many women today are fighting that notion. In my opinion, it serves everyone, not just new mothers, if institutions recognize that you can't do science 80 to 90 hours a week, whether it is because you have kids or because you want to ride your bike or just do something to take care of yourself."

Research and parenthood are both greedy, time-intensive endeavors. Undoubtedly, the demands of running a lab can affect one's family structure just as easily as the stresses of parenting can affect one's career trajectory. In their "Do Babies Matter?" project, Mason and her colleague Marc Goulden discovered a big gap between men and women in terms of their family configurations, with 50 percent of tenured females being married with children compared to 78 percent of males. The difference could be attributed to any number of factors, but when asked, the women faculty were more than twice as likely as men faculty to indicate they had fewer children than they wanted.

"That is really an important issue, because when we talk about gender equality we generally only count the heads that made it, we look at the families of those individuals as another measure of women against men," said Mason. "They have gotten there, but for many at some sacrifice. There are various reasons, but a lot of it is just waiting too long in their career to have children. And many women have come to believe that they won't be able to combine them both."

Chapter Three Appendix:

Toward a Family-Friendly Workplace

"When I give talks to my graduate students on how to do it all, I say here are the institutional policies, and marry well," said Lisa Wolf-Wendel, a University of Kansas professor of education who specializes in gender and academia. "By that I mean someone who wants to take care of the kids. But the internalized gender norms always come into play—the expectation is if you are going to be a mom, you want to be a good mom, right? There is a certain amount of guilt, pressure, and internal talk that you have about what it means to be a good mom. You have that same internal talk about what it means to be a good scientist, and the problem is both are pretty greedy. Both take 100 percent of you, so how to be 100 percent a good mom and 100 percent a good professor simultaneously is a real internal struggle."

Family-friendly policies can make a difference—supporting scientists during maternity leave, extending the tenure clock, helping locate child care. But many still feel that the gender gap will remain unless the way academic research is conducted and evaluated is dramatically restructured, an idea that demands a strong cultural shift in thinking.

"Family friendly policies in and of themselves aren't going to do the job, but if the culture recognizes it as an issue it is encouraging," said Berkeley researcher Mason. "Then we can have more flexibility even for those in a university setting. People work collaboratively, so you don't necessarily need to have someone there—it's not like a cashier where you need someone there the entire time. More flexible schedules make sense, like the part-time tenure track option. It is something that could be done, if the culture put its mind to do so."

AAUW Family Friendly Workplace Policies
www.aauw.org/act/issue_advocacy/actionpages/upload/worklifebalance111.pdf

Family Friendly Edge
ucfamilyedge.berkeley.edu

The Role of Society

"I have absolutely met resistance when I have promoted the idea of a flexible tenure-track system," said Diane Halpern, director of the Berger Institute for Work, Family and Children at Claremont McKenna College. "It is like I have slain sacred cows and made hamburger meat out of them."

"But there are only a few professions that have early up or out decisions and there is no reason that academia cannot change the way it does business that in fact improves quality as the outcome. But it will obviously take some brave people to get that ball moving. Needless to say, it is not going to be an easy sell. Just like selling equality at home. I have students who tell me that they will have a husband who will share equally in child care and I think lots of luck. Certainly some will. But we have a long way to go. It is far easier to change laws and institute changes in schools than to change our beliefs about women and men, but they have got to change."

It may take seeing more role models of women succeeding in science; it may take seeing more role models of men spending more time on child-rearing. And it may be that these societal beliefs of men's and women's roles are so deeply ingrained that they will never change completely, and will always be there, to some extent, influencing decisions on a subconscious level.

"I believe biases can certainly be removed from the equation and from people's thinking, and will be over time," said Wendy Williams, editor of the book "Why Aren't More Women in Science?" "But women will likely remain underrepresented due to their choice of other professions and the demands of motherhood. This is not bias—it is free choice mixed with biological reality. One can love it or hate it, but it is not bias."

Chapter Four
Unconscious Institutional Bias

Making Visible the Invisible

Molly Carnes picked an odd time to shut down her laboratory. After years of medical training, grant writing, and bench work, she had achieved tenure. But she quickly discovered that she was the only woman with that distinction in her department, which happened to be the largest department—medicine—at the University of Wisconsin-Madison. For the first time, Carnes says, she felt what it was like to be part of a stigmatized, marginalized group.

So she did what any good scientist would do, she set out to understand why—why it was that more women weren't advancing in science. Armed with a mid-career leadership grant from the National Institutes of Health (NIH), Carnes went back to school, earning a master's degree in epidemiology so she could study the problem from a disease perspective.

"I wanted to know what could possibly be "killing off" these women students before they ever got to be full professors," said Carnes, who went on to co-found the Women In Science and Engineering Leadership Institute (WISELI) at her university. "There is no disease in Western society that has the mortality rate that we see in these poor women scientists."

The Ugly Truth

Women may enter the sciences at near equal numbers to men, but they are lagging far behind when it comes to coveted tenure-track positions in academia. According to data from the National Science Foundation (NSF), women are twenty-four percent less likely to become a full professor. That translates to only around a quarter of tenured and tenure-track positions in science and engineering disciplines being held by women. So what is keeping women from succeeding in science?

"I think it is actually clear what the problem is, and I think we pussyfoot around it with all of these alternative explanations that have to do with our biology or desire to raise a family, things that none of us can fix," said Meg Urry, a professor of physics at Yale who has sat on a number of national committees on the status of women in science. "The real truth is these fields are elitist and hierarchal and competitive in ways that are off-putting to women. And that women's abilities are underestimated and undervalued."

Urry references a wealth of experimental literature from a number of fields—industrial organization, psychology, management studies—in support of her argument. One such study examined the peer review system of one of the major funding agencies for biomedical research in Sweden, a nation where women are awarded 44 percent of doctoral Ph.D.s but go on to occupy only seven percent of professorial positions. In their analysis, researchers Christine Wennerås and Agnes Wold found that a female post-doctoral applicant had to publish at least three more papers in a top science journal, or twenty in lesser-known journals, to be judged as productive as a male applicant.

The measures of success that underlie the current "meritocratic" system in academia are often arbitrary and applied in a biased manner, states Beyond Bias and Barriers, a 2006 report by the National Academy of Sciences. Men and women alike tend to overestimate male achievements and underestimate female performance. But many in the hard sciences are still quick to discount research that calls into question their own objectivity.

"As scientists, it is our job to observe the natural world and draw deductions," said Urry, who reviewed the report. "We believe our ability to come to objective conclusions from the data is the most important thing of all. So if I go tell my colleagues that they are biased, they freak out because if they are biased they are not good scientists."

As a well-respected molecular biologist and senior faculty member at MIT, Nancy Hopkins was among the first scientists to recognize there was a problem. But even she admits that it took almost two decades for her to realize that it extended beyond the biases affecting her own life and actually was affecting virtually every other woman in the field.

"If you are undervalued every time you present, every time you speak, every time you express a thought, every time you publish a paper, think of the impact of that," said Hopkins. "I started out believing the only barrier for women would be having to compete with people who work 70 to 80 hours a week when you are also the primary care giver of your children. So I thought if I made the choice not to have children, there wouldn't be any barriers, but that is not true."

Hopkins chaired the First Committee on Women Faculty in the School of Science, which is credited with sparking a national discussion on gender equity. She says that when she later became co-chair of the Council of Faculty Diversity and a member of the Academic Council, she was the first woman at MIT to ever see tenure, promotion and salary data. Now the current president is a woman, and those numbers are reviewed every year by equity committees at all five schools at the university.

"Just getting the data and understanding the problem is an important first step," said Hopkins. "I don't think there is any bad will intended, I think it is just invisible. That's why it takes so long to create real solutions. You need people who have experienced these things to tell you what the problem is, and then you need someone to come up with the solution, and then you need to implement it."

"Prejudices are always at play; there is no such thing as being blind. Blind just means deluding yourself,... living in cultivated ignorance of the fact that none of us can be without social values and attitudes about gender. Scientists are fully human participants in our world. You cannot, nor would you want to train that out of people. There is a purpose for it. The point is and the struggle is to become self-conscious about it."

Mary Wyer, Assistant Dean, Interdisciplinary Studies
College of Humanities and Social Sciences

First Steps

Recognizing that self-awareness of such biases is half the battle, Mary Wyer has been working to incorporate gender literacy into the curriculum at North Carolina State University. Wyer, a professor of Women's and Gender Studies, says that men and women could stand to benefit from thinking in more nuanced ways about how they interact in research environments.

"The logic is that if we want the next generation of scientists to behave differently, we have to teach them different stuff," said Wyer, who co-edited a book called Women, Science and Technology. "The traditional science and engineering curriculum, in its starkest terms, cultivates the ignorance of scientists and engineers about the social processes that are a part of everyday life. Social attitudes and values are inescapable. The fact that they are sometimes invisible or unspoken to the people who are engaging in them can be problematic because if you can't see it, you can't fix it."

A report released April 2010 by the American Association of University Women (AAUW) found that it is such unseen problems—stereotypes, gender bias, and the climate of science and engineering departments—that continue to hold women back. The report, titled Why So Few?, stated that college departments that work to integrate women faculty and enhance a sense of community are also more likely to recruit and retain female talent.

"Women can improve their situation, but only by institutional changes can women as a group move forward," said Virginia Valian, a Distinguished Professor of Psychology at Hunter College and a member of the research advisory committee on the AAUW project. "Women don't negotiate as much as men, but one reason is that they are responded to more negatively than men when they do negotiate. Similarly, women tend not to be as aggressive as men, but they are responded to very negatively when they are aggressive. Only by changing what we reward can women get ahead. It's tempting to suggest fixing the woman, but we need to look at the harder job of fixing the institutions."

Valian, who also co-directs Hunter's Gender Equity Project, says that if people first recognize that they are all biased to some extent, they can then put into place policies and procedures that will buffer the most negative effects of those biases. On an individual level, it can be as simple as doing a conscious double-check—like adding a list of numbers bottom-up and top-down to make sure we haven't made an error. Things like giving credibility to a new technician or committee member, verifying that a roster of colloquia speakers represents all of the available talent, or making sure that letters of recommendation do not disadvantage females, can all help.

But changing the system—not just the individual—takes even more manpower and substantive funding. In 2001, the NSF started offering very large grants for what they called "institutional transformation." The ADVANCE (Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers) Institutional Transformation awards went to major academic institutions that were willing to make sustainable changes to their culture. Now there are nearly 40 institutions with such large institutional transformation grants and even more with smaller ones. Many of these programs have been successful, and they are just beginning to be evaluated.

With the support of one multi-million dollar award, Carnes founded WISELI to address gender equity for women scientists at the University of Wisconsin-Madison. The Institute offers a number of workshops to increase the diversity and improve the academic climate, including one that trains members of search committees on how to bring in the most diverse pool of candidates.

"Because there was no other training, the workhop was filling an institutional need to train researchers serving on hiring committees," said Carnes. "So within the context of that training—which includes very task-oriented stuff like how to run a meeting and what an open record was—we also included a session on how unconscious biases against various social groups could play out to undermine your explicit egalitarian goals in hiring."

A number of measures indicate that their workshops are working. Departments where at least one member participated in at least one hiring workshop went on to hire more women than departments that had not participated. The faculty hired into those participating departments reported being significantly more satisfied with the hiring process. And the participants seemed to appreciate that evidence-based approach of the workshops that relied more on number-crunching than finger-pointing.

But not all programs focused on institutional transformation entail data-driven workshops or PowerPoint presentations. Theater is an unlikely tool being used at the University of Michigan to drive discussions around the themes of gender and power. Jeffrey Steiger, who directs the Center for Research on Learning and Teaching (CRLT) Players at UM, says the benefit of using theater is it can engage people on a different level, drawing them in emotionally to a story or its characters.

The self-described theatrical anthropologist has written a number of sketches—with input from the faculty—portraying scenarios of academic life, from faculty advising, to tenure and promotion, to a search committee. Following each sketch, the audience interacts with the characters, who are played by both professionally trained actors and graduate students or faculty in various disciplines.

"People often walk in skeptical, and personally I don't blame them," said Steiger. "But it can actually be helpful when some people don't relate to the sketch and some people do, because that is when the dialogue can really begin. If they are all from the same department and discover that they have had completely different experiences, they can start talking about the implications of that. And sometimes the aha! moment doesn't come until months after the sketch, when participants finds themselves observing the exact same biased behavior in a meeting that they had seen portrayed on stage."

Toward Equal Footing?

Though Ana Mari Cauce, dean of arts and sciences at the University of Washington, tries to remain alert to potentially biased behaviors, she hasn't spent a lot of time worrying about whether she personally has been at a disadvantage. She does, however, admit that certain biases may affect the

way people view her. "I am Latina, I am lesbian, and I am a woman, so in some ways I feel like those three sets of prejudices kind of cancel each other out, because folks have no idea what to expect," said Cauce.

Cauce is in charge of UW's Center for Institutional Change, which runs a number of workshops and programs aimed at creating a good academic environment for women. She says that the faculty were skeptical of their work at first, but quickly realized that being seen as a friendly place for women scientists gave their institution a competitive advantage.

"I am a psychologist, so I am apt to say that faculty members are good rats—they tap the lever that delivers the pellets," said Cauce. "And I really think that as administrators we have at least some—not total—but some control over the reward structure, and I think the way that you change the culture and change the behavior is by rewarding people who promote gender equity."

Women's representation at UW is among the best in the country, and it continues to increase. Between 2001 and 2007, the university saw a 28 percent increase in the number of tenured or tenure track faculty and an 18 percent increase in women full professors in their ADVANCE departments. Cauce prefers to measure success one scientist at a time, and is particularly proud of how she lured a new mother of twins, a computer scientist named Yoky Matsuoka, to UW by helping her think through day care issues. Since joining the university, Matsuoka has had another child and been named a MacArthur fellow.

Equity, in and of itself, may not be a particularly strong motivating factor. But when equitable behaviors result in more talent staying in the field, which in turn result in more discoveries being made, it can be self-reinforcing. So when will we know that true gender equity has been reached, if it is even attainable?

"I think it important to recognize that being on equal footing doesn't necessarily mean 50-50," said Cauce. "There are always going to be gender differences, people are going to be attracted to different things and there will be some gender component to it. I also have no doubt that we will get to the point that there will be a good critical mass of women across probably every scientific discipline. But I am not sure that there is some magical 50-50 that once we reach it we will know everything is fine."

Chapter Four Appendix:

Are You Biased?

The implicit association test was developed by scientists at the University of Washington, the University of Virginia, Harvard and Yale, to measure the subconscious biases that most of us have but often don't recognize. The test assesses reaction time to look at your bias when it comes to age, weight, sex, and race, and then feeds the results in to a national study. Of the 4.5 million surveyed so far, some 70 percent hold implicit stereotypes associating science and math with men more than women.

"It is humbling," said Molly Carnes, director of the Center for Women's Health Research at the University of Wisconsin. "Bias is an ordinary part of society, but if we can recognize these processes, we can name them and at least try to deal with them. We view prejudice as a bad habit that we can regulate if given the right tools."

Go to implicit.harvard.edu/implicit to give it a try.

The Gender Pay Gap

A report by the American Association for University Women (AAUW) Educational Foundation titled Behind the Pay Gap (www.aauw.org/learn/research/upload/ExecSummary_PayGap.pdf) found that men still earn more than women in STEM fields. Not surprisingly, the gap is smaller in some disciplines than in others: women computer and information systems managers typically earn 87 percent of what their male colleagues earn compared to the overall gender pay gap of 77 percent for all occupations.

When Etta Pisano, now dean of the Medical University of South Carolina, was still at the University of North Carolina at Chapel Hill, she helped to conduct a salary equity study to determine which salaries were fair and which needed to be readjusted. She recommends that a similar process be put in place on an annual basis at all institutions of higher education. "What is interesting is once you tell the person who sets the salary that you have to adjust it, usually there is no discussion," said Pisano. "Once you are watching it, analyzing it, and figuring it out, people can be respectful of the fact that you have found a problem. I've been doing this for a long time and lots of people have had salary adjustments because of it. The chairs don't want to be in the position of paying people less than they should be paying them. So it is a positive experience all around, and it is the right way to do things."

Chapter Five
Well Worth the Bother

Lisa Wolf-Wendel was aware of the challenges faced by women in the workplace. Because her research was dedicated to issues of diversity and equity in higher education, she knew—perhaps better than anyone—how bleak and depressing the literature could make a life in academia appear. Yet there she was, on the tenure track with two kids, happy and fulfilled.

Struck by the incongruity between the statistics and her personal experience, Wolf-Wendel and colleague Kelly Ward, also a mother, decided to do their own research on the topic. Rather than studying why women fail, they decided to research how they manage to make it work. The question became a long-term project that gave insight into the choices and occasional compromises women—in the sciences, the humanities, and the social sciences—make in order to excel at the field they love.

Some women delay child-bearing or choose not to have kids at all in order to advance their academic careers. Others make smaller sacrifices, traveling to fewer academic meetings or forgoing homemade birthday cakes and Halloween costumes in order to make time for it all. But for the women who make tough choices or miss opportunities to stay in the pipeline, the eventual thrill of discovery can be well worth the bother.

For the Love of Science

Nancy Hopkins is an accomplished professor at MIT and an outspoken advocate for women in science. She once considered quitting her career to become a housewife because, as she says, that was what women of her generation were expected to do. Yet when it came time for her to follow her husband, Hopkins realized she couldn't leave science.

"I could see that science was the future and I was drawn to it just like to a magnet," said Hopkins. "This turned out to be true of the other women I met at MIT, that we were so passionate about science that it was almost like a religion. It was something we just couldn't live without. I think everyone who does science has a passion for it, but I think back then it took an entirely different level for women to stick it out."

The professional climate has undoubtedly changed since then, in part because women like Hopkins did stick it out. After her husband left her, Hopkins decided not to remarry and have children but instead to become a career scientist (after many years spent as a "nun to science," she did remarry in 2007).

According to data from the National Science Foundation, the percentage of tenured or tenure-track science faculty positions held by women with children is creeping up from 14.3% in 1993 to 24.4% in 2006. Some women do wait until they have achieved the security of tenure to start a family, but others take a gamble and have kids earlier in their career.

"Lots of people say that women get discouraged about going into academia because of juggling your family life and going up for tenure at the same time," said Claudia Gunsch, an assistant professor of civil and environmental engineering at Duke, and a mother of three. "I make a point to tell my students that one doesn't exclude the other, that you can in fact do both. I think it is important for my female students to see me go through it and see that you can manage it all—it isn't going to be easy, but you can find a way to make it work."

For Gunsch, good on-site child care and the stop the clock provision have helped relieve the stress of her busy lifestyle. She will be up for tenure after eight years instead of six, having "stopped the clock" one year for the birth of her first child and another for the birth of her twins.

"The one thing that may put me at a disadvantage when I go up for tenure is that I made a conscious decision after I had kids not to travel as much, so I haven't wined and dined the people who will be writing my recommendations," said Gunsch. "I decided that I am going to do everything I can, and if that is still not enough, so be it. There are certain things that are more important, though I am not sure men would hold that same view."

Scientists seeking balance often have to find such places to cut corners in order to make all of the pieces in their lives fit. Etta Pisano has been known to say that "perfection is the enemy of good enough"—odd words for a woman who has pioneered breast imaging technology and raised four kids. Currently the dean of the Medical University of South Carolina School of Medicine, Pisano has always chosen which areas of her life needed her focus, and which do not. For example, her house is notoriously messy, but she manages to find time to play Scrabble with her family.

Pisano's approach was much like that of the 120 women who Wolf-Wendel interviewed for her study "Faculty Life and Family Balance: Achieving Both Realms." Two telling (and somewhat trivial) examples of compromise to emerge from the study were Halloween costumes and birthday cakes. A woman striving for perfection might think that such items had to be made from scratch, whereas those willing to cut corners don't see the harm in running to Target so long as there is time for homework or working on a grant. Certainly not a big deal in the scheme of things, but those little sacrifices could make a big difference in an otherwise harried life.

"It is not perfect yet, but it is moving in a positive direction and I feel that frankly there are fewer of those impediments now than ever. I think a lot of it just has to do with figuring out how to do all of the things that we do. After all, academic medicine is not famously a place of short hours and lots of free time."

Lisa Carey, Associate Professor of Medicine, University of North Carolina–Chapel Hill

Don't go it alone

For women trying to do it all, having a supportive spouse to share the load is a great asset.

"When I give talks to my graduate students on how to do this I say' know the institutional policies, and marry well,'" said Wolf-Wendel, meaning that if there isn't equality at home, it will be even harder to achieve it at work.

In Wolf-Wendel's study, she found women married to stay-at-home dads to be the happiest group by far. Conversely, the most "miserable" group of women were the ones married to other academics, because the spouse understood the flexibility in their lives and could take advantage of it. Nonetheless, Meg Urry, a Yale professor of physics and astronomy (who was not involved in the study), has managed to find a supportive spouse in astrophysicist Andrew Szymkowiak.

"My husband does at least half of the child care, and there is no way I could have come this far without him. But it is important to note that it is not my job that he is helping me with, it is *our* job that we are splitting," said Urry, who has worked to improve the climate for women scientists. "The science is fun, and the family, well thank god I did it, that's all I can say. I know many women made painful choices about it, thinking they couldn't do both, but I wouldn't have missed being a parent for anything."

Even among women who have chosen to forgo the parenting route, a supportive environment can be a vital component of success. Many women, once they have achieved tenure, are paying it forward by creating new policies and making current policies known for the younger generation. They are also forming informal social networks of women to celebrate each others' accomplishments, share lessons learned and cultivate future successes. For example, Dean Pisano was instrumental in the development of a number of family-friendly initiatives at her former institution, UNC-Chapel Hill, where she also advised a number of junior faculty on how to juggle their many responsibilities. She said women should not be afraid to speak up for what they need, even if it means taking on stereotypical male characteristics, like assertiveness.

"You have to stand up for yourself along the way, you have to believe that you are worthy of whatever it is you are asking for, and you have to be willing to ask for it," said Pisano. "I think a lot of young women feel that they shouldn't ask for anything. I didn't feel that way; I felt that I had gotten these credentials, I had competed with men to get to the point I was and if I needed a little more free time to help me succeed, that I should ask for it. There were times that I felt battered down by the system and I would go talk to my mentors, most of whom were men, and they would encourage me to speak up for myself."

Freedom and flexibility

Pisano has not only spoken up for herself, but also for other female academicians. She has been credited with helping to create a culture where researchers have the freedom to do their jobs their way, setting their own hours and agendas. That independence has always been a big part of an academic career, but today it is particularly attractive to people who are trying to lead more balanced lives.

"I can't think of very many careers where you have the same degree of flexibility and autonomy that academics do," said Wolf-Wendel. "So while we have intense pressure to publish and to do our jobs well, compared to other professions it isn't so bad. The downside is if you have that flexibility and autonomy you can find yourself working 24 hours a day! Historically, academic life was designed on a monastic tradition, the idea being that you are not supposed to have things outside your life except for being an academic. Thankfully, that is changing."

For women who have stuck with science, the path can be just as rewarding as it is challenging. It is fun, it is flexible, it could rewrite textbooks or be translated into new medicines. And through their resilience, women are already beginning to tip the scales in favor of other females in the workplace. Claudia Gunsch, for one, is hopeful for the future and is already beginning to wonder if her oldest daughter will go into science.

"She will never be told she can't do it because she's a girl," Gunsch said. "I will make sure no one ever makes her feel that way. I would love for her to follow in my footsteps."

"Having a kid gives you perspective. So you hit a wall at work, then you go home and your kids give you big hugs and talk to you or say I love you mommy and you read a book and it is very fulfilling and you get some down time. Then your kid starts screaming and won't eat and won't sleep and then you get to go back to work and you get to work on an article and your students say that was an amazing lecture and you make some progress and then you get a rejection letter and you go home and your kids still love you. I think having that perspective of being away from it and having the pluses and minuses of each other, buffering each other, I think is really important. I personally think that it makes me a better person. And I think I am echoing the other people we interviewed."

Lisa Wolf-Wendel, Professor of Educational Leadership and Policy Studies, University of Kansas

Further Resources

Further Reading

Why So Few? Women in Science, Engineering, Technology and Mathematics. Catherine Hill, Christianne Corbett, Andresse St. Rose. 2010. American Association of University Women.

Staying Competitive: Patching America's Leaky Pipeline in the Sciences. Marc Goulden, Karie Frasch, and Mary Ann Mason. 2009. Berkeley Center on Health, Economic & Family Security.

"Beyond Bias and Barriers: Fulfilling the Potential of Women in Science and Engineering." Committee on Maximizing the Potential of Women in Academic Science and Engineering. 2006. National Academy of Sciences.

"Using Theatre to Stage Instructional and Organizational Transformation." Matthew Kaplan, Constance E. Cook, and Jeffrey Steiger, vol. 38,3:33-39 (May/June 2006) Change, The Magazine of Higher Learning.

Why Aren't More Women in Science? Top Researchers Debate the Evidence. By Stephen J. Ceci and Wendy M. Williams.

Motherhood, the Elephant in the Laboratory: Women Scientists Speak Out. By Emily Monosson.

Why So Slow? The Advancement of Women. By Virginia Valian.

Women, Science, and Technology: A Reader in Feminist Science Studies. By Mary Wyer, Mary Barbercheck, Donna Giesman Cookmeyer, and Hatice Ozturk.

Relevant Websites

American Association of University Women
www.aauw.org

Association for Women in Science
www.awis.org

NSF ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers
www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383

NIH Career Re-entry Supplements
grants.nih.gov/grants/guide/pa-files/pa-08-191.html

NIH Working Group on Women in Biomedical Careers
womeninscience.nih.gov

About the Author

Marla Vacek Broadfoot writes about various aspects of biomedical research, from gut bacteria to the circadian clock to fertility tests. Before becoming a writer she was a postdoctoral fellow at the National Human Genome Research Institute and was awarded board certification in clinical molecular genetics by the American College of Medical Genetics in 2005. Marla received her Ph.D. in genetics and molecular biology from the University of North Carolina at Chapel Hill in 2003.

When the Burroughs Wellcome Fund initially approached Marla to write about women in science, the intended focus was on how to persuade more girls to go into the field. But Marla's feeling was that there was not a dearth of young women interested in and majoring in science, and she found plenty of data to back her up. She came to discover that the real issue often doesn't emerge until subtle disadvantages begin to pile up, causing many women to reach a breaking point and leave the academic track altogether.

In Marla's case, that "breaking point"—if there was one—came after continually being frustrated by the pace of research, in which the failure of an experiment seemed to be the norm rather than the exception.

She struggled to find role models who had it all—a successful career, a loving husband, a family. Even in her postdoc, her wonderful and brilliant female mentor (who had a husband and a family, check!) admitted to going back to work two weeks after the birth of her first child. In the end, Marla happily left research behind to have babies and pursue her passion for writing. She hopes that this series can help women whose passion lies in research to stick with the discipline, and to excel to its highest level.

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