

Microbiological Moms, Their Sisters and Brothers—the Give and Take

Women can have rich scientific and domestic lives, with the quest to understand nature balanced by the biological instinct to nurture

Marlene Belfort

“... if I had a public voice, it was as a scholar, and I shied away from putting too much of myself on the line.”

—Jill Ker Conway, *A Woman's Education*
(Alfred A. Knopf, New York, 2001)

The Committee on the Status of Women in Microbiology invited me to address the question of “how to become a successful microbiologist”—a challenge that I accepted and then cast into personal terms when I spoke about these issues during the 2002 ASM General Meeting, held in Salt Lake City, Utah.

In principle, I might have dropped the word “microbiologist” and considered more generally the difficulties faced by women who seek to become successful scientists or, for that matter, professionals of any sort. Many women face similar obstacles. In any case, when I was preparing my talk, “Molecular microbiology, motherhood, and mentoring,” I asked myself two pointed questions: *What does it take?* and *Why bother?*

The short answers are, respectively, *supreme effort* and *enormous rewards*.

Early Hurdles—Hours, Schedules, Geography, Money

Before addressing what it takes, let us consider the hurdles to overcome. As for any professional, the hours are long—10-, 12-, 14-hour days are the norm. Worse yet, work schedules are often irregular and unpredictable. We need to be at the lab at awkward intervals over days and nights—when the growing cells are “ready” for harvesting, or for taking measurements.

Those early, exhausting career days were quite a challenge for me.

Restricted employment opportunities can also be very limiting. Not only are we institution-bound, without the possibility to set up private practices in our neighborhoods, but also, once we are employed, our work is often dependent on external funding. Although work in a service laboratory or industrial company does not usually require extramural funding, as at a university or research institute, all these options are limited by geography. Hospitals and private companies, like universities and research centers, are mostly situated in urban areas, a limiting circumstance often compounded by the two-body problem, where both domestic partners are seeking employment simultaneously.

Then, during the early years, the relatively low income of postdocs and assistant professors further limits lifestyle choices and child-care affordability. At that stage, it behooved me to focus on the “enormous rewards” part of the cost-benefit equation—a focus that was not then always easy to maintain.

What Is Needed for Women Scientists To Overcome Special Challenges?

So, what does it take to become a successful female scientist? And a mother, if that is one's choice? Basically, all of the attributes required to be a successful male scientist and a father, and many more, for reasons of biological load (child-bearing and breast feeding), historic convention (women primarily as homemakers), and discrimination (real or perceived). The impor-

Marlene Belfort is Director of the Division of Genetic Disorders at Wadsworth Center, New York State Department of Health, Albany, N.Y. (belfort@wadsworth.org) and Professor of Molecular Genetics, School of Public Health, SUNY, Albany. She was the 2002 recipient of the ASM Alice Evans Award for mentoring and promoting the careers of women in science.



tant ingredients fall into six, mostly mixed, categories:

- Competence, commitment, constructive attitude, and comfort with nonconformity
- Decision-making ability—choices, compromises, and sacrifices
- Gender-neutral education, good mentoring, and role models
- Good fortune
- Passion, persistence, patience, and stamina
- Support— domestic and institutional

First, competence is a *sine qua non* for any woman pursuing a career as a professional microbiologist. Enough said. Commitment and hard work are also essential, while a constructive attitude is a great bonus. Scientific careers are fraught with hard knocks—rejected papers, unfunded grant proposals, adverse promotion decisions, and other pitfalls. There is little to be gained by second-guessing who wrote those negative evaluations or by whining about unfair peer reviews. Using the criticisms constructively to submit a better paper, a stronger grant application, a more complete promotion package, and moving on, is far more productive.

Amid these challenges, feeling comfortable with being a nonconformist allows one to go against the grain of both societal and scientific convention. There is real value in the ability to withstand the huge pressure, both external and internal, to be a stay-at-home mom. We must certainly satisfy the critical needs of our children and our own desire to help them, but we must also be content with spending only bits of time with them, with a minimum of guilt. The good news is that there is little if any reliable evidence that children who are well loved and cared for and who spend small amounts of time with fulfilled parents are at all disadvantaged. Likewise, out-of-the-box thinking is a critical component of creative science.

Second, decision-making ability helps one to make the right choices. Regrettably, we cannot do it all, given the complexity of our domestic and professional lives. Therefore, making good choices about what to pursue and what to drop gives us the biggest return for the amount of resources we have available—time, energy, and money. Part of it is compromising, which often means sacrificing pleasures that can be postponed for times when life is less occupied, so we can accomplish the essentials when we have to,

always taking care of the greatest needs first. Part is seizing those moments that will never come again, be they in the domestic or the professional arena.

Third, gender-neutral education is important in the development of a woman's confidence. Equal attention, opportunities, and rewards for girls and women (and also boys and men) in a coed context nurture self-esteem and a sense of justice. Experts tell us that women who spend critical years of their school or college education in all-female environments tend to perform well. There is a growing literature from studies in the United States and Europe indicating that girls in single-sex contexts perform substantially better than those in coed environments when conducting similar tasks in the basic and computer sciences. I spent my K-12 years in a girls' school. Not only does such an environment allow one to feel non-nerdy as a bright female, but it also removes any relationship between gender and performance, given that both the laggards and the leaders are women.

Gender aside, there is no substitute for good educators and mentors. But female teachers, principals, and professors provide valuable role models in life as in science, and thus are critically important. So is family. My mother was an excellent role model. She did not have a high school education, but she was a woman who was serious about what she did, despite very meager beginnings. She started out as a seamstress, and persisted until she rose in her profession to direct a small company.

Even as my mother pursued her chosen career path, she continued to provide crucial support to our family, and therefore my assumption was that this is what women do. She also gave me the impression that there was nothing that I could not achieve if I really put my mind to it. I carry that sense with me to this day. Likewise, we need good scientific role models who live balanced lives, to inspire in our female students, postdocs, and emerging professionals the sense that it *can* be done and that *they* can do it.

Fourth, for women, as for men, good fortune is not to be relied upon, but is to be nabbed when it comes along. Chance favors the prepared mind. A lucky break in our experiments or a discovery, sometimes referred to as “molecular serendipity,” often goes a long way. There are many other aspects to good fortune, such as tranquility, good health, and steadfast support

Marlene Belfort: Scientist, Mother, Juggler

Marlene Belfort is not only a scientist. She is also an inveterate “juggler” who has turned her versatility with juggling competing schedule demands and responsibilities into a high art. Belfort, who is 58, directs the division of genetic disorders at the Wadsworth Center of the New York State Department of Health. But she is equally an eloquent advocate for combining motherhood with a career in science.

After all, Belfort explains, these endeavors overlap more often than many people realize. For example, “creative cooking isn’t too far removed from doing original experiments in the lab,” she says. “Coping with the antics of children is a lot like dealing with the idiosyncrasies of grad students. The pain of childbirth disappears just as fast as the torture of grant writing. Not only can women do both, but doing so can help, rather than hurt, their careers.”

And so on. “What could be

more refreshing than to plunge into science after countless hours of driving carpools and helping with homework?” she asks.

Belfort credits her husband Georges, a professor of chemical engineering at Rensselaer Polytechnic Institute, with being “absolutely key in my success as a mother and scientist,” although “he will probably say I am absolutely key in his success as a father and scientist. It’s optimal when you can share the load.”

They have three sons, now 33, 29, and 27. All three live in Boston, where the eldest is a lawyer, the next is an M.D.-Ph.D. student, and the youngest works as an engineer and product designer. Even though they are now adults, “it’s never-ending,” for their parents, Belfort says. “When they’re little, they have a lot of physical demands, and one can usually help them and can exercise a great deal of control and influence. When they grow up, they’re out

there taking care of themselves, but they still place emotional demands — however one is less able to fix things for them.”



Like many two-income couples, the Belforts had help caring for their children when they were young. But the family observed an unbreakable rule: at least one parent had dinner with the boys every night. This meant no out-of-town scientific meetings together for the Belforts. “I think that golden rule paid off really well,” she says. “It provided focus for us, a time when we traded stories and unloaded. We still like to eat together.”

Belfort regrets not being home in the afternoons “when my kids came from school hungry and tired and needy. That couldn’t ever happen. I had to be satisfied

Continued

in our domestic lives. And of course, good fortune in financial terms also does not hurt. We are all aware of the enormous expenses associated with paying for childcare and maintaining a comfortable lifestyle.

Fifth, passion is a force that can propel both men and women over the obstacles that they encounter during their scientific careers and personal lives, and it can foster the endurance required to stay on course when the going gets rough. One needs to love science and family to persevere. Also, patience is indispensable. Successful female scientists sometimes project a smooth journey, but such trips are rare. There are many dark moments along the way, and many doubts. Patience, persistence, and a sense of optimism carry us through these down times.

Finally, we need support, with a capital “S.” We can derive support in a number of ways,

with that from our partners being ideal. Certainly, other family members, friends, and community can be most helpful in sharing the burdens and in lightening the loads imposed by science and family obligations.

Another critical source of support for professional microbiologists is institutional. It is crucial that our employers grant flexible work schedules, adjustments of tenure timelines during childbearing years, and gender equity in academic and fiscal policies. It is also helpful if our colleagues pitch in when we are out with a sick child or an ailing parent. Shared responsibilities within our professional families as with our domestic kin can provide enormous support and relief from that “wimping-out” feeling when life’s responsibilities tear one away from a task one “should” be doing. We have a lifetime over which to return these favors.



with not being able to do that. But I tried to give them what they needed in the short amount of time available every evening.”

Belfort grew up in South Africa, the child of German refugees who did not have the benefit of a higher education. Her father graduated from high school, but her mother did not. However, both parents displayed unflinching enterprising spirits and, ultimately, pursued successful careers in the clothing business. “They went into the rag trade,” Belfort says. “She would sew buttonholes for a penny each... He would buy a pair of socks from a wholesaler and sell them for a profit.”

Belfort was not exposed to much science in school, except for high school biology. “In the little bit of biology I was taught, I realized I just loved it,” she says. “My mother then hired a tutor to teach me physics, chemistry, and mathematics—and he became my husband.” This was when she was 17 and he was 22. They married six years later,

and they still collaborate domestically and scientifically.

Belfort earned B.S. and M.S. degrees at the University of Cape Town in South Africa and her Ph.D. in molecular biology at the University of California, Irvine, in 1972. Subsequent research and teaching fellowships took her to the Hebrew University-Hadassah Medical School in Jerusalem, Israel, and Northwestern University in Evanston, Ill. She moved to the Wadsworth Center in 1978. She was elected to the American Academy of Arts and Sciences in 1994, and to the American Academy of Microbiology, and the U.S. National Academy of Sciences in 1999.

Belfort and her collaborators study the biology of introns, dynamic sequences that interrupt genes and disrupt the flow of genetic information. Her work ranges from basic studies about intron function and how introns might have evolved, to ways in which they could be used in biotechnol-

ogy. Introns exist in almost all life forms, from simple bacteria such as *Escherichia coli* to more complex species, including humans.

Within a very few years of arriving in Albany as a junior investigator, Belfort and her colleagues identified the first intron in a prokaryote. Later she discovered that these introns move from place to place on the genome. Then she identified different molecular pathways in which introns splice and move by recruiting proteins of unusual structure and function.

Last year, one of her sons wrote a letter to a well-known scientific journal correcting misinformation it had published about introns. He cited published research as documentation—his mother was one of its authors. “It’s been a long time since I uttered these words,” he wrote. “But I couldn’t be more proud to say: ‘Mommy told me so.’”

Marlene Cimons

Marlene Cimons is a freelance writer in Bethesda, Md.

Rewards Can Be Diverse and Plentiful

And now to the many rewards. High among these is the sense of space afforded by intellectual and academic freedom in research, the fulfillment of serving the community in a clinical laboratory, and the satisfaction of bringing a product to market in an industrial setting. As a researcher, I have several recollections of exploration within that “space.” While a graduate student, after pursuing several dead ends, it was extremely exciting to dream up a hypothesis relating to my microbial genetics experiments with phage, testing it, crunching the numbers, and proving myself correct. Even more exhilarating, in later years, was taking the same route to disproving my hypothesis, and using the data to bring me to unanticipated findings and new directions.

That leads me to another reward. We micro-

biologists usually love what we’re doing, gratifying our deeply felt curiosity by finding answers to inquiries into perplexing problems. Certainly for me, the excitement of discovery is paralleled only by the thrill of falling in love or the elation of giving birth.

We are also rewarded by the opportunity to travel. What different career paths in microbiology have in common is earning us membership in a global alliance, since ours and other scientific societies typically cross national boundaries. Not only can we travel to exotic places on every continent, but also, with colleagues in remote places, we can feel at home attending a conference in Tokyo, giving a workshop in Sydney, or conducting a collaboration in Jerusalem. Often deep friendships grow from interests shared around the globe. We become citizens of the world.

The Dual Role—The Greatest Reward of All

I consider the mutually reinforcing functions of parent and professional, of mother and scientist, to be the ultimate prize. To me, these two roles represent what I call the “win-win potential” of motherhood and science (see additional reading below). Thus, instead of confronting these two roles as if they were twin obstacles, I look at the skills that we learn from organizing a household or running a laboratory and see them as inherently similar and mutually reinforcing.

Specifically, the juggling, multitasking, and discipline that are required to run an efficient laboratory are pretty much the same as those needed to maintain a well-functioning home. Likewise, problem-solving skills that we acquire to help our children are useful in a laboratory to mentor students and postdocs. Juggling tasks and nurturing dependents in the two places strengthens the way in which one does them in either place.

Also, the pain and the pleasure created by the two activities weave together to form a solid and richly textured fabric of life. The acceptance one learns while raising children serves one well in the workplace, and *visa versa*. I recall that sinking feeling I had when I learned from my children that they had traded their nutritious sandwiches, prepared with care at the crack of dawn, for Twizzlers or Twinkies. When registering my dismay, I was told lovingly “Suck it up, mom.”

Learning to do just that made it easier to swallow the disappointment of graduate students sharing data prematurely with colleagues, or worse yet, competitors. I had become conditioned to accept disappointment and move on.

Then there are the sine waves of life that penetrate our homes as they do our laboratories. In the jumble of struggling with an illness, celebrating acceptance of a paper, fixing a leaking roof, opening a good report card, consoling a disappointed graduate student, or proving a discovery, one gains a healthy perspective, while balancing the trials and triumphs of the workplace and home. It is as great a comfort to be welcomed home when a grant has been triaged and one feels defeated, as it is to escape from moments of family turmoil by retreating to the lab “to save the world.”

Not only is it possible to lead fulfilling scientific *and* domestic lives, but for women, as for men, lives that straddle those two arenas can provide a wonderful balance. This nature-nurture argument differs from the usual ones. In this version, the biological instinct to nurture helps to stabilize our quest to understand nature. I am thrilled to have led a rewarding professional life while deeply engaged in fulfilling my lifelong dream of being a good mom. To my microbiological sisters and brothers, I say that we *can* and we *will* make it possible for our scientific daughters and sons to live this life.

SUGGESTED READING

Belfort, Marlene. 2001. The win-win potential for motherhood and science. *Curr. Biol.* 11:R41-R42.