CAREER TRENDS Running Your Lab

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CONTENTS

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Introduction

The success of the scientific enterprise depends on creating a creative community of scientists who maintain the highest ethical and scientific standards, while ensuring that public resources are efficiently distributed and used. Ultimately this depends on those individual scientists who lead each small laboratory group of researchers and trainees. It is therefore critical that we prepare young people in ways that not only produce excellent scientists, but also generate the type of laboratory heads who will be needed to guide and mentor the next generation of scientists.

Most of the advanced training of a scientist occurs in the form of apprenticeships in the laboratories of older scientists, and it is often assumed that the skills needed to run a laboratory effectively can be learned simply by observing how one's own mentors run their laboratories. In this view, all of the leadership skills that will be needed in the future can be transferred implicitly, with no intentional training needed. This assumption is incorrect. As in the rest of life, explicit advice from those who have successfully mastered a difficult transition can do a great deal to help those who are struggling with the same type of task. In this booklet, you will find articles that should help you in running your own laboratory. Hopefully, they will also spur you to consider how we might improve the preparation of the younger scientists in your own institutions, so that they can do an even better job than we have done in carrying on the great enterprise of science that we have all been privileged to inherit.

With my best wishes for future success,

Bruce Alberts, Ph.D.
Editor-in-Chief, *Science* magazine

Business Sense:
Starting an Academic Lab

By Sarah Webb—*July 17, 2009*

One of the most exciting parts of moving to an academic job is the opportunity to build research independence. But that independence comes with new financial needs and responsibilities. First you need startup funding and lab space. Then you need to figure out how to use your resources effectively—and to keep the revenue flowing. Running an academic laboratory is "equivalent to running a small business out of the university," says Sean Stocker, a professor of physiology at the University of Kentucky College of Medicine in Lexington. Acquiring the resources you need to be successful, and using them well, requires careful budget planning, good negotiating skills, wise spending decisions, and generally good business sense.

Making a list and checking it twice

Even before his first job interview four years ago, Stocker made a detailed list of the equipment and supplies he thought he would need to build a successful research program. Having that information handy at a job interview looks very good to a potential employer. And it can help you negotiate, observe, ask appropriate questions, and learn what resources—core facilities and other shared equipment—might already be available at the institution. After all, the job interview, Stocker notes, is not a one-way process: "You're also interviewing them to see if you can develop your own research program at that institution," he says.

So how do you make such a list? Stocker advises thinking hard about what you want your lab to look like in five to 10 years. Think in terms of categories, adds Katharine Huntington, an assistant professor of geology at the University of Washington, Seattle. Your categories might include laboratory equipment, computers and office furniture, personnel costs for the first two years (don't forget to budget for benefits), supplies and other recurring laboratory expenses, and travel to conferences and for fieldwork. You'll need to do some research to find out how much these things cost: Read catalogs, call vendors, and consult experienced academic scientists about the cost of hiring graduate students, technicians, and postdocs.

Huntington consulted faculty members with different levels of experience and asked four friends in different subfields, at different types of institutions, to show her their startup lists. "It made me think of things to ask for that I wouldn't have thought of. Part of it is informing yourself on what the norms are, what other people ask for," she says. Mentors can offer helpful suggestions. Stocker e-mailed his startup list to his graduate adviser to get feedback. He estimated some of his costs based on expenses in his postdoctoral laboratory.

Although it's a good idea to keep a best-of-all-worlds list, any list you present to a hiring committee needs to take into account the institution type and the resources that are likely to be available, says Scott Fendorf, a professor of environmental earth system science at Stanford University in Palo Alto, California. A reasonable startup package for a mainly undergraduate institution, a state university, and a private university with a large endowment will vary widely. If you insist you need $300,000 at an institution that typically offers $50,000, you're not doing yourself any favors. If you really need that kind of startup budget to get your work done, you've probably applied to the wrong institution. And if you estimate you need $300,000 but the institution offers $200,000, Fendorf says, you may have to ask yourself if there are creative ways to get by with less.

That creativity is especially important when thinking about startup costs at a liberal arts college or other institution where research budgets are usually small, says Rachel Beane, an associate professor of geology at Bowdoin College in Brunswick, Maine. Her laboratory would be incomplete without a petrographic microscope for examining rock samples, she says, but "I wasn't going to ask for certain equipment to date rocks" or others "that required technicians and research support." Instead, she asked for travel funds and other support that would allow her to work with collaborators at larger institutions.

Of course it's hard to build a startup list before you are ready to go out on your own—that is, before you have a clear, specific idea of the research questions you intend to pursue and how you intend to pursue them. Yet, you don't have to be completely ready to start interviewing or to begin making your list, Stocker says. Stocker took his first steps toward independence as a postdoc, but when he started interviewing for principal investigator posts, he was still learning, he says. What he learned at the interviews made him a better candidate, with a more complete and definitive startup list, than he was in the beginning, he says.

Running an academic laboratory is "equivalent to running a small business out of the university."

Negotiating for what you need

Even though you'll want to be thinking about your needs and gathering information as you're interviewing, you'll want to tread lightly when talking about money. Never bring up money—salary or research support—at a job interview. Wait for a department chair or dean to bring up the topic of startup funding, experts say. "When I was chair of a department, when we got to the second interview, I would ask the person to put together what their startup needs were," says Lynn Wecker, a professor at the University of South Florida College of Medicine in Tampa. "And then when an offer is made, it would be negotiated." Realistically, you ask for more than what you actually need, she says, with the knowledge that you won't get everything that you ask for.

Common mistakes in startup negotiations come in two extremes, Fendorf says. You might be thrilled to be hired, he says, but if you accept your employer's first startup offer, you are likely to end up with a package that does not meet your needs. Once you have an offer, be reasonable but bold—"honorable and strategic," as one *Science* Careers writer put it. After you get the offer, Fendorf says, you have to step back and say to yourself, "I'm 90 percent sure I'll take it. But before I accept, I'm going to have to go through to make sure that I can be successful there."

The other mistake is to fixate inflexibly on a dollar amount. Put yourself in the shoes of the person who will be giving you the money, Fendorf suggests. Excessive demands that aren't justified with a compelling rationale, or that don't consider the resources likely to be available at a particular institution, can be a real turnoff, he says: "Even if you ultimately come to some agreement, you can cause some ill will." A department chair or dean wants you to succeed, he says, but the money that an institution gives you is money that it can't spend elsewhere.

> "Money is a means to an end, and that end should be doing great science."

So what's the best approach? Huntington met with an expert in negotiations at the California Institute of Technology, where she was a postdoc, to get advice. First, she learned, know what you really need and what you're willing to concede. Next, inform yourself about resources available in the department—which you therefore don't have to pay for. If you learn that institution-funded teaching assistantships are readily available in your department, you might give up some student support in favor of a piece of equipment, given that some of your graduate student researchers will be able to earn their stipends by teaching.

Frame the discussion in terms of what you need to be successful, with a clear justification. Even though there were indications that his startup requests might be high, Stocker says, he got much of what he asked for, in part, because his big-ticket items were equipment and he made a convincing case for why he needed them.

And don't forget about space. You need to know where and how large your laboratory space will be and get that in writing, Fendorf says. If renovations are needed, find out whether those will be included in your startup expenses or paid for from other sources, Huntington adds. Renovations can be expensive. You'll also want to negotiate your office space and location so that you're close to your colleagues and your laboratory. "Being close to your colleagues is most important," Huntington says.

When to spend

A detailed list is a great start, but you have to also consider the time axis. You need to decide what you'll need when and make it happen then. You also want to know exactly when the money will be available—will it be spread out over two years or available all at once—and how much time you have to spend it. Spending deadlines, though, ought not to be an issue because you should be eager to get your lab up and running as soon as possible.

Think of setting up your laboratory as a marathon broken into 1-mile chunks, Fendorf suggests. When Huntington started her lab last year, she organized it into workstations: sample preparation, sample analysis, and general computing. Figure out what you need first, she says; if you can send samples away for analysis, set up your sample-preparation area first. If fieldwork can't wait, purchase the needed equipment early.

Pay close attention to lead times on major purchases and the time it takes to set up equipment; some items may need to be ordered several months, or even a year, before you need them, Huntington says. If your new employer allows it, try to do as much as possible before you arrive on campus, Stocker adds. Although manufacturers will deliver and may help you set up major equipment, the responsibility of that final setup is likely to fall to you, even if you have some staff help, Stocker says. So factor that time into your startup plans.

Choose your equipment carefully, Fendorf advises, and don't be taken in by bells and whistles. A hot-rod instrument might give a few spectacular readings, but it might also break down more often. You might get more productivity out of a more basic instrument—a "pickup truck," as Fendorf calls it. You can also think modular, buying a basic system at first that you can add onto later, Wecker says. Look for academic discounts, and always try to get a company to demonstrate the instrument and train you in its use.

It's not always necessary to do everything yourself. Huntington hired an undergraduate to help her research equipment and supply prices when she was setting up her laboratory. As your lab grows, you'll probably delegate supply ordering to a trusted member of your laboratory, maybe a technician, while monitoring monthly statements for errors, checking them against your budget, and making adjustments.

Supplies and other recurring costs can be hard to predict, even after talking with mentors and colleagues. Still, you have to estimate your monthly expenses—your "burn rate," says Jeffrey Bode, an associate professor of chemistry at the University of Pennsylvania. His monthly expense list included chemicals, consumable supplies, analytical instrument time, and personnel. That's hard to sort out at the beginning, he says. And even the most careful planning won't eliminate budget-breaking surprises. "Filters are something that totally blindsided me when I first started as a professor," Fendorf says. Sample preparation for one project required individual filters for 800 samples. At more than $1 each, he quickly burned through $1,000 in filters. Don't forget about animal care costs, which can be significant, says Stocker.

Saving money makes sense. "For my first three years as an assistant professor," Bode says, "I certainly knew everything that was ever bought and probably had it memorized." If you can save $5,000 or even $10,000 in the early stages of setting up a laboratory, you can use that money to hire a student for a summer, which might make a big difference, he adds.

But don't pinch your pennies too hard. New discoveries require creative freedom, room for failure, and inevitable waste, says Virginia Miller, a professor of physiology at the Mayo Clinic in Rochester, Minnesota. You don't want to stifle creativity, she says, "by micromanaging costs and by worrying about the number of pipettes that you're using." Don't hoard your startup fund, Huntington adds. "Spend it in the ways that will make you successful," from getting seed data for your next grant proposal to traveling to a conference to make valuable connections. Startup funds are not typically restricted to particular uses, and you might tweak how you choose to spend them as you get started.

People

Staffing your laboratory brings a variety of management issues. When trying to decide on the appropriate mix of graduate students, postdocs, and technicians, consider the tradeoffs of cost and the role that you'd like those scientists to play in your laboratory, Miller says. Graduate students are often the least expensive personnel, but they may need a lot of training to become productive. Postdocs might come with grant funding but probably won't stay long. A lab manager or a technician, although more expensive, could provide long-term continuity, quality control, and help with record keeping and expense tracking. If you're at a predominantly undergraduate institution (PUI), take heart: Certain gifted undergraduates can become competent researchers faster than you might think. Still, if you want to maintain a serious research program at a PUI, and if you can afford it, hiring a technician is a very good idea.

Even though the financial responsibility of starting up a lab can seem overwhelming, it's important to keep your eyes on the ultimate goal: your own brand of science. "I've found it enormously rewarding to be starting something of my own," Huntington says. "Don't lose sight of the fact that this is all aimed to let you do the science that you want to do." Bode adds, "Money is a means to an end, and that end should be doing great science."

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You've reached a career milestone: managing your own lab. This recognition of your achievements attests to your hard work, attention to detail, commitment to a goal—and outstanding science. But be prepared. You're about to face challenges you may not have considered.

Lab Management:
The Human Elements

By Carol Milano—*March 12, 2010*

As Frank Slack, a Yale University professor of molecular, cellular and developmental biology, quickly discovered, "To be successful at running the lab, being a good scientist isn't enough. It suddenly becomes all these different roles we weren't trained for, like psychiatrist and personnel manager."

Those responsibilities often require new skills. Here's how some of your peers are mastering the "human elements."

Networking and collaborating

When you run your own lab, "networking" isn't just about finding the next job. It means cultivating productive relationships, which succeed only when they are reciprocal. Mutual trust grows through willing exchange of information or services.

Start by developing contacts inside and outside your own institution—locally, nationally, and even internationally. Find your professional association's nearest chapter. Ask your mentors and colleagues which organizations they belong to. Once you join one, get involved. Volunteering for a committee or writing for the chapter newsletter, for instance, makes you much more visible.

"You and the people you're managing will have to speak in public or mingle effectively at meetings and conferences," says Susan Morris, president of Morris Consulting Group, which coaches research scientists. To minimize uneasiness and build confidence if you're shy, she suggests:

- **Network in small chunks.** Set a maximum of two carefully chosen events a month, ideally at your highest energy time of day.
- **Arrive early.** Entering an uncrowded room is less unnerving than a noisy one, where most people are already conversing.
- **Go with a "buddy."** Preferably someone who can introduce you to several people.
- **Talking to a stranger can be intimidating.** Safe "starters" include asking their current job, how they got it, why they chose this event, or other groups they belong to. Seek topics of mutual interest, such as that gathering's focus. If you can offer information about anything that's mentioned, jot a note on the person's card. Follow up promptly.

Frequently traveling to give lectures, Jennifer Lippincott-Schwartz, chief of cellular biology metabolism at the US National Institutes of Health (NIH), National Institute of Child Health and Human Development, values professional meetings, despite the time drain. "I make contacts, hear things that would be difficult to pull out just by reading the literature, and meet people doing things relevant to our work." Almost without trying, she says, collaborations develop.

Taking part on national panels "is a responsibility as senior members of the scientific community," believes Kelly Frazer, who heads the new Division of Genome Information Sciences at University of California, San Diego School of Medicine. She finds those she's on, like the expert scientific panel for the genomewide association program (a trans-NIH initiative led by the National Human Genome Research Institute), "very beneficial because of the contact with people and with what's going on." In a rapidly moving field, Frazer uses these events to stay connected through informal exchanges over coffee, lunch, and dinners. I listen to the science, give input, have discussions, hear others' ideas, and look at the work."

Lippincott-Schwartz prods every lab member to attend at least one professional meeting a year. "People don't realize how social science is! By talking science during these trips, you learn what's important to the field, what the major questions are, where your science fits the broader, bigger scheme, and how what you're doing interests other people, or not."

"People don't realize how social science is! ... [Y]ou learn what's important to the field, what the major questions are, where your science fits the broader, bigger scheme, and how what you're doing interests other people, or not."

Acquiring people skills

- Ask if your university holds workshops for new supervisors on management, delegating, interviewing, or other interpersonal responsibilities.
- Use available books, like *Academic Scientists at Work*, by Jeremy Boss and Susan Eckert (Springer-Verlag, 2002) and Kathy Barker's *At the Helm: A Laboratory Navigator* (Cold Spring Harbor Laboratory Press, 2001). Frank Slack of Yale, impressed with how "it spells out all you need to run your own lab," gives a copy of the Boss-Eckert book to each postdoc progressing to the next position.
- Look for a special interest group on campus or nearby, such as Women in Science and Engineering. Members are often generous with support and information.
- Consider a few sessions with a private coach. Morris Consulting Group trains individual scientists seeking stronger managerial skills, and it recently published, *Leadership Essentials for Women Scientists: Tips, Tools and Techniques to Advance Your Career* (equally relevant to men).
- "People skills are teachable," Susan Morris assures. "Make a commitment to learn consistently, not in fits and starts."

Every network needs ongoing maintenance—allocate at least one hour a week for brief steps that keep your name in front of people. "Make a follow-up call, meet for coffee, or send a handwritten note," says Morris.

You'll probably work with departments and scientists inside and outside your own institution. Lippincott-Schwartz encourages collaboration within her group. "Each person is an equal part. I try to get people talking to each other in small groups, making sure to include everyone who's interested in this topic. It's so cool to see people with different expertise working together—their energy feeds on each other."

"I know our lab isn't able to do everything," Slack acknowledges. "We seek collaboration where we think someone could be constructive in a project. Fortunately, Yale is very collaborative; its 400 bio labs have most of the expertise we've needed. It just takes a few e-mail rounds: 'Do you work on X?' They may say 'No, but try Y'. "

Finding academic science increasingly interactive, Frazer sees large collaborations encompassing diverse skill sets. Her new international grant has five M.D. clinicians and five Ph.D. biologists, plus genomicists and informatics specialists, in San Diego, Vancouver, and Toronto. Beyond monthly phone meetings of all 20 researchers, Frazer has frequent contact with other genomicists. The entire group will meet in both Toronto and San Diego annually.

Joerg Schaefer directs the Cosmogenic Dating Lab at Columbia University's Lamont-Doherty Earth Observatory. His lab collaborates with scientists on related projects, all over the world, including with a New Zealand team for nearly a decade. They stay in close contact through Skype and other technologies. The complexity of establishing a partnership in a distant country calls for exceptionally resourceful networking. Through another Lamont lab, Schaefer was able to join a collaboration, the Asian Monsoon Project, with the nation of Bhutan.

Sustain previous collaborations, recommends Michel Tremblay, director of McGill University's Rosalind and Morris Goodman Cancer Center, with 300 students, postdocs, and technicians. "When you leave a lab and get out on your own, it may be a different kind of project. Your [previous colleagues] won't follow you. If you had a good relationship with your ex-mentor, maintain it. "

Which collaborations thrive? Setting mutual goals fosters strong, honest, productive interaction. "Especially with virtual relationships, take incremental steps to build trust," Morris recommends. Spell out communication pathways at the very beginning: how often, in what form, and who gets to know what? "With a global team, have at least one face-to-face meeting to establish ground rules."

Mentoring

"There's a big difference between mentorship and directing research," explains Tremblay. "Don't micromanage—mentoring isn't telling the scientist what to do. Like a good parent, offer guidance, but let the [mentee] develop. Give freedom. Treat individuals as partners." Good mentors, he adds, know their way around the university and understand how to get to the right people.

"Learn to juggle many different things simultaneously, but keep emotionally steady because people in your lab really look to you," says Lippincott-Schwartz. "It's a huge roller coaster every time you send out a paper—everyone's going through emotional ups and downs. To be cheerleader is critical." When a project isn't working well, talk through options, brainstorm new ideas, and ask, "So if we get this result, then what?" Lippincott-Schwartz doesn't prevent anyone from trying a new idea they feel strongly about. "I might argue against it, but I won't say, 'No, don't.'"

"My door is always open," declares Slack, inviting everyone to see him whenever they want, show him data, or call him to the microscope. "I don't go to them every day, or even every week. I tend to encourage by steering, not forcing, and giving a little space to find their own way."

To Frazer, it's vital for managers "to be open, honest, and straightforward, but simultaneously kind and compassionate. The fun stuff is easy. Deflecting a potential problem is harder."

"Learn to juggle many different things simultaneously, but keep emotionally steady because people in your lab really look to you,"

When one new postdoc was, as Frazer described it, "all over the place," she discreetly intervened. "It was important for him to stay on track and learn to get things done, or else he'll have a tough time in future jobs." In giving well-defined assignments, she would emphasize, "This is the task," then thank him warmly upon completion. After four months, things are improving. "Now when we have a conversation, he realizes, 'I have to focus, not be distracted,'" Frazer reports.

In academia, teaching is central, Tremblay observes. "Promote your young faculty members through lecturing responsibilities, such as teaching fourth-year undergraduates. That makes them better known to students deciding which laboratory to choose for graduate studies." Remind research students to make a career plan. Instead of directing where to do further training, you might say, "these few labs are the best in their fields. The PI is well known for mentorship. These are some I wouldn't choose because of track record, funding, field of research, or networking."

One touchy situation: a young researcher with consistently disappointing performance. "Some PIs won't get involved at all. It's very hard to say, 'academia is not for you,'" Tremblay finds. "Sometimes you must tell your mentee, 'These are your strengths. Here is where you are weak. I think you might not make it as a faculty member at a top university. You have good expertise in other aspects of research, such as administration. You would be great in translational research or clinical trials.'"

When a postdoc heads toward another job, "Leave space for them to start their own program. It takes generosity," says Tremblay, "to allow this best trainee in the last year to start a new one to bring along. Have an open discussion with each trainee about what they'd like to do next. Provide tools for them to move forward," including the time and resources to carve something from the current project.

Motivating and managing

A corporate lab's objective is meeting the business goal. An academic lab's goal "is whatever the PI got money for," Morris notes. "Every department meeting, every printed document, every conversation should reinforce that 'the mission of this lab is to….' Constantly remind people that we're not here to do our individual experiments. This is part of something bigger."

Morris cites the "complex demographics of lab personnel. Managing and leading require respecting differences between cultures and generations. Accept that work can be done in individual or innovative ways," Morris suggests. "One person may complete projects by setting a timeline for each day's work, while another needs the adrenaline of last-minute pressure, completing the project by several all-nighters. Yet both produce a quality product."

To promote a team's trust and cooperation, Tremblay advises setting clear expectations for your lab, staying aware of what's going on there, and quickly resolving conflicts within your group.

What constitutes conflict? Hogging a piece of equipment or writing notes in a native language instead of lab language affects everyone. Ideally, Morris advises, let lab members resolve minor tensions, stepping in only when something escalates enough to disrupt the research. “Establishing and following performance guidelines that define appropriate versus inappropriate lab behavior is essential to becoming an effective lab manager. Make every employee aware of guidelines and consequences for not complying,” says Morris.

Clarify academic realities, too, Tremblay stresses. A researcher may be the inventor of a discovery, and receive acknowledgment through an ensuing patent with his/her institution, but the university owns everything done in any lab on its property. “To make sure everyone is treated fairly, keep your lab well organized so you’re clear about who’s done what, who started what. People should get the credit they deserve. That’s what justifies the hard work, especially on licenses, patents, and publications.”

Some of Schaefer’s lab members go on lengthy field excursions, to locations as far-flung as Patagonia or New Zealand. “Working globally, the areas we study are always beautiful, and we post wonderful photos. Then the researchers come back and share their adventures on the field trip. It makes everyone feel very involved.”

Schaefer’s team-building has a firm foundation: “I make it clear that I expect everyone who works here to have fun. We have lunch together once a month, off campus. Every week, one group goes out after work, for beer.”

Slack’s lab prefers champagne, popping open at least one bottle a month to celebrate a birthday, new grant, or accepted paper. He cooks an annual dinner for all 17 researchers at his home. The team takes one day trip each year, like canoeing.

Slack’s annual State of the Lab address “honestly assesses where we are in terms of new money, new people, our papers, our goals for that year. We’ll all know what our colleagues are working toward. I give information and want them to tell me what they think. They get to speak up about direction, or any area where they think we should focus or add effort.”

His entire team gets involved in hiring. “Any postdoc I consider comes to the lab for a day, meets everyone to talk about science one-on-one, and has lunch and dinner. Each of my people reports on the interaction. We check motivation, interest, and personality,” Slack confides. “We have few interpersonal issues because we try to encourage smart, socially adept people to join. And we demand they each be a good lab citizen.”

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Mind Matters:
In Defense of Downtime

By Irene S. Levine—*December 4, 2009*

When I was first employed by a government research organization some years ago, my supervisor, although bright, kind, and productive, was so committed that she regularly labored into the wee hours of the morning and on weekends. She rarely took vacations. No one who worked with her could keep up with the pace, certainly not me.

Typically, I would leave work at about 6 or 7 o’clock each evening after crossing off most of the items on my to-do list. Invariably, when I returned the next morning before 8, my in box was overflowing.

Lacking control over my workload, I felt stressed. My productivity suffered, as did my morale. Other employees became so dispirited and worn out that they left. (These were days when jobs were abundant.)

Nonstop work—without sufficient downtime for family, friends, and solitude—violates the natural rhythms of life and nature. My supervisor was a perfectionist: obsessive, competitive, extremely mission-driven, and excessively failure-aversive. These traits made it difficult for her to set healthy boundaries between work and the rest of her life. And those traits affected not just her life but also the lives of all the members of the team.

Smart phones, laptops, and ubiquitous Internet connections have compounded these tendencies in driven people, enabling them to work nonstop and to drive their subordinates to do the same. The depressed economy has made things worse still, leading many workers—the ones lucky enough to still have jobs—feeling vulnerable to job loss and pressured to work harder.

A lot of people assume that the key to productivity is hard work, and of course hard work is essential. But there are limits to how much work is useful. Research suggests that working harder and longer doesn't necessarily mean getting more done.

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Lessons learned about time off

A four-year study by professor Leslie Perlow and research associate Jessica Porter, both of the Harvard Business School, published in the October 2009 issue of *Harvard Business Review*, demonstrates that time off can have a larger, positive effect on individual and organizational productivity than more hours on the job. They looked at the effects of something they called "predictable time off" on employees of the Boston Consulting Group, an international consulting firm comprising consultants, bankers, accountants, lawyers, and information technology professionals. During designated periods, even some periods of high work demand, employees were *required* to take time off. In a first experiment, employees had to take at least one day off in the middle of the workweek; they weren't given a choice, regardless of the pressures of their jobs. In a second, less extreme experiment, employees weren't allowed to work past 6 p.m. on one night each week, and they were not allowed to check e-mail or voice mail on those evenings. These "predictable time off" arrangements were in addition to any time off that occurred because of periods of light workloads, vacations, and personal leave.

Initially, the consultants and their supervisors were anxious and resisted the changes. But the results of the study were overwhelmingly positive: greater job satisfaction, improved communication, greater trust and respect for colleagues, increased learning and self-development, better products for the firm's clients, and a better work/life balance.

In a separate study, the same researchers found that 94 percent of professionals work at least 50 hours a week and that half of them work more than 65 hours a week. The researchers found that the study group monitored their smart phones at home 20 to 25 hours a week.

"What we discovered is that the cycle of 24/7 responsiveness can be broken if people collectively challenge the mind-set," write Perlow and Porter in their publication. "Furthermore, new ways of working can be found that benefit not just individuals but the organization, which gains in quality and efficiency—and, in the long run, experiences higher retention of more of its best people." Although not all supervisors are yet convinced, a converging body of research suggests that downtime can be a boon for employers and employees.

Get some rest

By now you might be thinking, "Gee, I wish my department or laboratory was part of this study. Where do I sign up for paid time off?" Or maybe not: Whether it's due to nature or nurture, scientists tend to make work a priority, working long hours (independent of whether they're required to) and responding quickly to new demands, even unreasonable ones, imposed by supervisors, colleagues, and subordinates.

If this describes you, you might want to do your own experiment modeled on the ones by Perlow and Porter. Resist the impulse to work constantly. It's likely to be hard at first as you feel as though you're neglecting your responsibilities. But you may find that, over time, you end up getting more done than before.

"Focus, willpower, and the ability to tackle difficult projects all draw from a limited reserve of energy," writes Kelly McGonigal, a health psychologist based at Stanford University in Palo Alto, California, in an e-mail to *Science* Careers. "When you deplete these reserves—whether through sleep deprivation, which alters how the brain and body use energy, or through pushing too hard on too many projects—the quality of your work plummets, along with the usual pleasure of

"No one can afford to skip rest, and anyone's work will be refreshed and restored from some time off."

working on something important, such as doing good science." It's biological. "No one can afford to skip rest, and anyone's work will be refreshed and restored from some time off."

One simple means of addressing an energy deficit is a good nap. An article in the November 2009 issue of the "Harvard Health Letter" reviewed dozens of experiments conducted over a decade that have shown the value of sleep—including brief catnaps—in improving learning, memory, and creative thinking. Citing the finding that napping makes people more effective problem-solvers, Harvard sleep researcher Robert Stickgold urges employers to encourage napping. Some companies, such as Google, have created NapPods, or nap rooms, where their employees can catch some restorative shuteye during the workday. Can't see yourself sleeping on the job and can't sleep enough at home? You might think that a vacation can offer the energy burst you need. It can, but according to a meta-analysis published in the December 2008 issue of the *Journal of Occupational Health*, the results of vacations are short-lived, fading out between two to four weeks on average after the subjects returned to work. More research is needed to figure out how to make the gains of a vacation last longer. Sign me up for that study.

Probably the most feasible and easily implemented approach to reaping the benefits of downtime is to seize time off regularly, whenever you can. Modest changes in the routine of work allow a busy multitasker to slow down, recharge, and return to work with more focus, energy, and creativity. There are numerous ways to add more free time into a busy life, including work-free weekends, postlunch catnaps, days off, vacations from technology, no-work evenings, and regular 10-minute work breaks.

A season for everything

"Having an office full of workaholics is like having a yard full of moles," writes Eric Darr, executive vice president and provost at Harrisburg University of Science and Technology in Pennsylvania. "Workaholics focus so much on finishing the project that they do not strategize, prioritize, or seek more creative solutions. And, like moles, they start tunneling but not in the same or best direction. Blinded by getting to the finish line, they miss opportunities."

In Judaism there is a custom called the *Shmita*, a sabbatical year occurring cyclically every seven years when the land is allowed to rest; those who observe the Shmita are promised a bountiful harvest afterward. Those who fail to observe a fallow period—and this goes for scientists—are bound to feel depleted.

Need proof that's closer to home? Consider how many of your most creative thoughts occur not in front of a computer screen or at the bench but while your are showering, golfing, lying in bed, or taking a jog in the park?

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Available online at: **bit.ly/duKB62**

"Publish or perish" is the scientist's maxim—with good reason. Career advancement hinges on publications. But data generation requires dollars. And as the time it takes for investigators to become financially independent grows, the old adage may also motivate early-career researchers to capitalize on their youth.

Funding Your Future:
Publish Or Perish

By Virginia Gewin—*September 11, 2009*

Science is one of the few vocations in which a mid-life crisis could coincide with a career gaining traction. A National Academy of Science report highlighted that the average age for a biomedical researcher to secure the famed R01 grant is 42 (www.nap.edu/catalog.php?record_id=11249). The R01 grant is considered the gold standard of biomedical funding, and is often a criterion to gaining tenure. And as the pressure to secure funding mounts, an early-career researcher may forego risky aspirations for a more bankable application. Unfortunately, this may reduce the potential for scientific breakthroughs.

In recent years, several funding programs have been created specifically to help young investigators reach funding goals during the critical two to eight years when a researcher is expected to launch independent lab operations. In fact, the Howard Hughes Medical Institute (HHMI) established its early-career scientist efforts to help researchers focus on their laboratory research. "HHMI thought it was ironic that researchers were spending a decade of their most productive years—when the energy level to make new discoveries is highest—on grant writing," says Jack Dixon, HHMI vice president and chief scientific officer.

Getting a grant funded as soon as possible is one way to prevent creativity from becoming a casualty. Yet, as the number and types of funding mechanisms grow, so does the competition for them. Therefore, early-career investigators should mount multiple strategies as they master one last talent—the ability to secure a funding stream.

Early-career awards

"Failing to take advantage of designated early-career programs is one of the biggest mistakes that early-career scientists make when applying for grants," says Thomas Blackburn, a former program officer with the American Chemical Society Petroleum Research Fund and now president of Science Funding, a Washington, D.C.-based grants consultancy for early-career science faculty.

Most of the largest, often government, funders—for example, US National Institutes of Health (NIH), US Department of Energy, HHMI, and European Molecular Biology Organization (EMBO)—sponsor early-career fellowships. These awards are highly competitive given their national scope. The prestige that comes with these high-profile grants is a key stepping stone to secure future grants funding.

But, says Blackburn, focusing only on the high-profile funders is limiting. "Researchers should not neglect smaller, private foundations that may provide seed money to collect the data and publish papers that will help a person later secure larger grants," he says.

In fact, many of the private, often smaller, funding foundations offer a valued component: freedom. "We created our program to give those newly selected scientists the freedom to pursue their most creative, often risky, ideas," says HHMI's Dixon. Freedom, apparently, is coveted among young researchers; over 2,100 people applied for the 50 early-career awards given out in May of 2009.

The McKnight Scholars Award was implemented in 1976 by the McKnight Foundation, a Minneapolis, Minnesota-based family foundation started by the long-time leader of the 3M Company, specifically to identify and encourage creative experimental neuroscientists. "The scholars program has had an impressive impact on experimental neuroscience over its 30-year existence—including advancing the careers of future Nobel Prize winners and members of the National Academy of Sciences," says Thomas Jessell, a Columbia University neuroscientist in New York City and member of the McKnight Board of Directors.

A growing number of philanthropies are particularly motivated to sponsor early-career investigators eager to conduct exploratory research. Often these organizations focus specifically on one disease or technological area. The Alliance for Cancer Gene Therapy, the Lance Armstrong Foundation, Leukemia Research Foundation, and the Scleroderma Foundation are just a few examples of the organizations supporting new investigator grants.

Philanthropies, however, are often looking for potential cures as well as pioneering science. "The most important thing at this stage of a young person's career is to

"Researchers should not neglect smaller, private foundations that may provide seed money to collect the data and publish papers that will help a person later secure larger grants."

make an important scientific discovery. If you have the wherewithal to make that in a more narrowly defined area of research supported by philanthropy, do it," says Dixon.

Collaborations are key

Collaborating is essential to long-term success as science becomes increasingly interdisciplinary. And building fruitful scientific collaborations can offer an effective strategy to making career-defining connections. In fact, the European Research Council now offers the Starting Investigator Research Grant Scheme. Based on the European Science Foundation's (ESF) previous European Young Investigators Award, this program may supercede it by providing a larger number of awards. The ESF is currently placing a greater focus on creating opportunities, such as workshop and conference participation grants, to promote the integration of young investigators into collaborative research networks. "In Europe, research is all about collaborative networks of researchers working together to optimize resources efficiently," says Ana Helman, a science officer in the ESF Physical and Engineering Sciences Unit based in Strasbourg, France.

Indeed, some funding organizations place great emphasis on helping early-career researchers learn how to form productive collaborations. For example, EMBO, based in Heidelberg, Germany, offers networking and mentoring resources which can often mean more than the three-year €45,000 research award given to young investigators. "Our strategy is not so much to award a single project, but rather to help talented young scientists grow," says Gerlind Wallon, manager of EMBO's Young Investigator Programme.

The Human Frontiers Science Program (HFSP), a funding organization based in Strasbourg, was created to foster international collaboration and training in life sciences. It awards postdoctoral fellowships that encourage those trained in classical life science or biology departments to broaden their skills by moving into a new research field. "We want to help molecular biologists move into crystallography or physiologists to become geneticists," says Guntram Bauer, HFSP director of fellowships.

That mission became the basis for a cross-disciplinary fellowship program designed to help mathematicians, physicists, chemists, or material scientists bring new expertise to a biology-based laboratory.

Because HFSP wants to see these young researchers have a chance to establish independent laboratories, the fellows are then solely eligible for career development awards. Having funded nationals from over 60 countries, these awards are a way for international scholars to build collaborations that will later help them become established in their home countries.

Some areas of science, such as nuclear physics, are driven by collaborations. Often, projects are simply not feasible with only one or two researchers. However, Brad Tippens, program manager at the US Department of Energy's Office of Nuclear Physics, says while most of these collaborations are not hierarchical, they can create an environment that fosters mentoring of early-career researchers and accelerates their maturation as scientists. As a result, early-career scientists develop a reputation in the community more rapidly, which helps them make a mark in the field.

In fact, mentoring can greatly speed career independence. Vaia Papadimitriou, scientist and assistant division head of the Accelerator Division at Fermilab in Batavia, Illinois, says Lederman fellowships, Wilson fellowships, and postdoctoral positions are designed to help a researcher obtain an assistant professor position. "We prepare them to apply successfully for a job by making sure they cultivate a broad spectrum of experience," says Papadimitriou. For example, she says, young investigators are encouraged to work on both hardware and software and to hold leadership positions, to best advance their careers.

The fact that organizations make mentoring a priority is a strong sign that they have a vested interest in an awardee's career longevity. The NIH K, or career development, awards, particularly the so-called Kangaroo awards (dubbed that because of their K99/R00 nomenclature), are designed to offer a pathway to independence by providing mentored research positions to help a postdoc become a stable independent researcher.

As well, the Helmholtz Association of German Research Centres, a collective of 16 research centers throughout Germany, also offers management training to its early-career awardees. While the €25,000 award offers five years of stable funding, it also provides access to the association's extensive laboratory infrastructure. Helmholtz is also unique in that it offers a career option not typically found in Germany: tenure.

Teaching tactics

Wherever it is granted, tenure is a lifetime contract based on the expectation that the grantee will secure grants to support research over the long term. So the pressure to sustain funding levels remains strong. Consequently, competition among new faculty is fierce and tends to reward candidates able to bring in research dollars, resulting in less emphasis placed on teaching.

But teaching aspirations can prove lucrative. In fact, teaching is an important component of some funding awards. A number of early-career awards exist to help the researcher who wants also to be an outstanding teacher. For example, the Research Corporation for Science Advancement, a Tucson, Arizona-based philanthropy created in 1912, offers scholar awards to those scientists working at research institutions. "The foundation's idea was to fund people with impeccable research credentials who were destined to be leaders on the research front and are also breaking new ground in teaching," says Jack Pladziewicz, the organization's vice president.

In a similar way, NASA's Earth Science program's new investigator funding scheme—which promotes interdisciplinary research—includes a provision to conduct educational activities related to research. "We want to instill the attitude that a researcher's job is not simply publishing papers," says Ming-Ying Wei, manager of NASA's Office of Earth Science education program in Washington, D.C.

US National Science Foundation (NSF), based in Arlington, Virginia, offers CAREER awards to individuals who view themselves as teacher-scholars. These are challenging applications because they require a research plan integrated with an education plan, including an assessment of activities, all in 15 pages. As such, these awards require backing from the applicant's institution, and are considered the most prestigious award for young faculty that NSF gives, says program director Mary Chamberlin.

"More proposals are denied for being too safe than for being too risky."

Strategic success

Whether an applicant has five pages or 50 in which to propose research, the successful grant application must include two things above all else: a clear problem to solve and a novel way to solve it.

"Early-career scientists often present a continuation of their doctoral work without a clear distinction of how the research will advance the science to the next stage," says Heather Macdonald, a geoscientist at the College of William & Mary in Williamsburg, Virginia. Macdonald runs two career development workshops each year for early-career geoscientists. She says early-career investigators need to find creative ways to differentiate their future work from their past mentors.

In this regard, as NIH's acting deputy director for extramural research, Sally Rockey, describes it, young investigators often face a catch-22. If they propose a safe research idea, they can get rejected for not distinguishing their evolution as a scientist; and if they propose risky research, they can get rejected for overestimating their abilities. "Being both a young investigator and proposing risky research is a double whammy when the proposal is being considered," says Rockey. "But we do promote high-risk research if the applicants can mitigate concerns about their ability," she adds.

Science Funding's Blackburn warns early-career investigators not to play it too safe, however. "More proposals are denied for being too safe than for being too risky."

But, he continues, applicants have to make sure a proposal reflects both prior experience and achievements as well as a demonstration of how one is growing beyond them. "This combination credentials you as someone who proposes research that you are capable of carrying out and that is worth carrying out," he says.

Rockey advises applicants who have doubts about a proposal's possible merit or appropriateness for the program to contact the relevant program officer for advice.

Beyond relevance, clarity is key in proposal writing. "If you do not write clearly, you may not be thinking clearly, and that may not allow a reviewer to evaluate your ideas clearly," says Blackburn.

Finally, persistence pays. It will be disheartening when proposals are not funded, but persistence is critical. Says HHMI's Dixon, "Lots of good ideas have champions who persisted even when they didn't get research funded on the first try."

Do's and don'ts for grant applications

- **DO** make a compelling case for why the question is important and must be addressed, and place this early in the proposal; after one page, the reviewer should be excited about the proposed research.
- **DO** describe in detail who will provide the requisite expertise needed to accomplish the proposed research; establishing a collaboration is one of the easiest ways to ensure that the proper expertise is represented on an application.
- **DO** write the proposal in such a way that any reviewer can understand it. Applicants should remember that proposals are evaluated by multiple reviewers with varying scientific expertise and backgrounds.
- **DO** follow each and every rule of the funding guidelines.
- **DO** make the proposal relevant to the program's core objectives.
- **DO NOT** present a continuation of doctoral work without a clear distinction of how this will advance the science to the next stage.
- **DO NOT** propose too much; it is easy for a young investigator to become overly ambitious—and to be criticized as a result.

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If at First You Don't Succeed,
Cool Off, Revise, and Submit Again

By Lucas Laursen—*August 15, 2008*

The sting of rejection was just as sharp the fourth time around for Marcus Bischoff, a postdoc at the Laboratory of Molecular Biology at the University of Cambridge, UK. "There's a lot of disappointment," he says, when your manuscript gets rejected by a journal. After a year of trying, he was both relieved and pleased when the fifth journal—a "good journal," he says—accepted his paper.

Academic assessments focus on publications—and overwhelmingly favor publication in a few widely cited journals—so the pressure's on to publish and publish well. Yet all scientists have manuscripts rejected at all stages of their careers. So it's best to get used to it, and learn to deal with it effectively to give your manuscript another chance. Look at submission, revision, and resubmission "as an iterative process," suggests Phil Corlett, a postdoc at the Brain Mapping Unit at Cambridge.

The elusive hole in one

Occasionally, a manuscript will be accepted on first submission with no or few and minor required revisions. But it's rare. At prestigious journals, the majority of manuscripts are rejected. "We reject something on the order of 90 percent plus, and that's the same for *Nature*, *Cell*, and *Science*," says Robert Shields, an editor at *PLoS Biology*, and editorial rejections—rejections by the editor without sending the manuscript out for review—make up the majority of those rejections.

There are two common reasons for editorial rejection: Editors have decided the work does not fit the journal's purview, or the experimental approach was judged inappropriate or unconvincing. "It should be obvious from the letter" which one is the case, says Simon Young, editor of the *Journal of Psychiatry and Neuroscience*.

Once the manuscript makes it over this first hurdle, it may still fail to pass muster with the referees. In that case, the referees' reports, or selections from them, will be included with the rejection letter. The rejection letter plus those referees' reports are the key to deciding your next move. "The important thing is not to react emotionally," Young advises, noting that his two most widely cited papers were rejected without review before being published in different journals.

To rebut or not to rebut?

Often before the disappointment fades, a scientist's fighting instinct kicks in, provoking an appeal. Many journals consider rebuttals, but you need to make a compelling case. Don't just fire off a snide reply to the editor.

"The majority of appeals are unsuccessful," Shields says. "Usually, the outside person we consult will agree with the editor." Bischoff challenged the first rejection of his mouse embryogenesis manuscript because he thought it had received unfair reviews by subscribers of a competing school of thought. The rebuttal failed.

"You very often get mixed reviews," says Bischoff, "and there's always a temptation for rebuttal." But it's usually best to move on, which is just what Bischoff did. You can consider a rebuttal if you think an editor or referee misunderstood your methodology or arguments, and you can make a compelling case. In those situations, you have legitimate grounds for a rebuttal, says Andrew Sugden, international managing editor of *Science*. Still, given that rebuttals are rarely successful, it's worth being sure that there are "major errors" in the reviewer's letter, he adds.

Submit at a different journal

It is hoped that you carefully considered the appropriateness of the journal before you submitted your manuscript. But if your article was rejected because the editors or referees judged it unsuitable or not novel enough for their journal, you may want to submit it intact without revision to a more suitable journal. Too often, "young scientists argue for a high-profile journal, perhaps even higher than a group leader thinks is likely to succeed," says Peter Lawrence, Bischoff's supervisor in the Laboratory of Molecular Biology at Cambridge. The result: lost time and even publishing priority, if a competing group places similar work at a more suitable journal first.

"Read the other journals and see the sort of stuff that they're publishing," Shields advises. Choose a more appropriate, less competitive journal, or one like *PLoS One* that publishes any experimentally sound result. "Sometimes people are very happy to do that; they just want to get their stuff out," Shields says. Even if you resubmit without substantive revision, always recast the manuscript in the new journal's format. Editors expect it, and laziness never makes a good impression. "You can tell when [a manuscript has] been around the block," Shields says, because the format is that of another journal. It's not a good idea to tip off the editor that your manuscript has already been rejected.

Revise and (re)submit

If the editor and reviewers had major criticisms, you'll want to consider them carefully and use them to strengthen your manuscript. Those reviews are, after all, expert feedback on your research. Your revisions may require substantial changes to the experimental methodology, additional experiments, or analyzing the data over again in a different way. Sometimes even the journal that rejected your manuscript will reconsider it after some additional work; usually, this is specified in the rejection letter. If it isn't, ask the editor who handled your manuscript. If you're resubmitting to the same journal, it's all the more important to make sure you have convincingly dealt with all of the criticisms.

When Corlett had a paper rejected recently, it "made me more motivated to get it right," he says. He took his inspiration from a senior postdoc in his lab who, after getting a rejection for another manuscript, incorporated the "useful things from the review and within three days he'd resubmitted," in his case, to a different journal. So, Corlett reanalyzed his data and resubmitted at another journal, which accepted it.

The example taught him that "you can't afford to dwell on rejections," Corlett says, and that it is possible to use rejections to your advantage. When a rejection letter comes back, he discusses it with his colleagues to see if "there is another way of marshaling the data we have." Reviewers' comments provoke useful insights that are incorporated into future drafts.

Whether you're resubmitting to the same journal or a different one, a thoughtful and well-written cover letter is second only to the revision itself in shepherding a rejected manuscript into the fold. In addition to addressing all the issues raised by referees, it pays to maintain a professional tone. "We do sometimes get knee-jerk reactions," says Sugden, which "don't go down very well with editors." Shields adds, "You can say respectfully that you don't think the referee's right."

Authors may save time using the presubmission process available at many journals, to which authors submit an abstract, and editors provide a quick and dirty assessment of suitability. The system may help scientists gauge the needs of each journal, says Shields.

And many experts say that a young scientist's best strategy is to consult supervisors for advice. "In my experience, graduate students are shy about doing that," says Young.

Bischoff did consult his supervisor who advocated patience and prioritizing the discoveries over the publishing. "If you're keen and good, you do discover things," Lawrence says. "It's not as if there's nothing out there!"

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Your Research in the Headlines:
Dealing with the Media

By Elisabeth Pain—*September 12, 2008*

Final-year Ph.D. student Molly Crockett got more than she bargained for when her first-author paper was published in *Science* three months ago. Her university circulated an embargoed press release about a week before publication, and within a couple of hours, "I started getting tons of e-mails and phone calls" from journalists, Crockett says. All told, she appeared in four radio or podcast interviews, a dozen newspaper stories, and five magazine articles. "The week the research went out [was] pretty much devoted 9 to 5 to dealing with the press," she says. It was "crazy."

Crockett received some coaching from her supervisor and feels she prepared for her interviews fairly well. Still, entering the limelight was "a sink-or-swim learning experience." That hardly makes her unique; few scientists have the luxury of training before they confront the media for the first time. Yet an understanding of how the media work, an awareness of what could go wrong, and a bit of preparation can help you deal with a sudden tide of media interest and can ensure that your scientific work is disseminated accurately to the public.

Why should I agree to an interview?

Talking to the media is a fairly common experience among scientists. In a recent survey of epidemiologists and stem cell researchers in the United States, Japan, Germany, the United Kingdom, and France, nearly two-thirds said that they had been interviewed at least once in the past three years. Almost all did so, they said, to help educate the general public and to promote a more positive attitude toward research.

But there were other incentives for talking to the media. Almost half the surveyed scientists felt the exposure had helped them advance their careers, compared with 3 percent who found it damaging. Four out of 10 of the surveyed scientists also expected their media appearances to enhance peer recognition. "Being in the media goes hand in hand with being published. I got invited to conferences as a direct result of this paper," says Crockett, a Gates Scholar at the University of Cambridge in the United Kingdom.

Interacting with the media may also be a good opportunity to look at your science through a different lens. "It's great to be forced to consider the broader implications of your research at an early stage," Crockett says. A broader perspective may help you generate new ideas or convince funding bodies of the worthiness of your research.

What could go wrong?

Talking to journalists is not risk free, however. In the same study, Hans Peter Peters, a communication researcher at Forschungszentrum Jülich in Germany, and his colleagues found that about 40 percent of researchers were concerned about critical reactions from peers resulting from their media involvement. Usually, "researchers recognize the need for publicity for their own research field," but depending on the situation, interacting with the media can also be looked upon badly, Peters says.

If you're not careful, your expertise could be used for topics you'd rather not be associated with. Some time ago, "a tabloid journalist called an astronomer at the Max Planck Institute. He wanted to know when Venus, Mercury, and Saturn would be especially close to each other. The next morning, the name of the scientist could be found in the same breath as recommendations regarding the best time to have sex according to the planets," says Diane Scherzler, who gives media training courses for academics and is an editor in the online department of Suedwestrundfunk, a German public broadcasting company. Before agreeing to an interview, "it is very important to make clear with whom I am talking, what is this journalist working on, what kind of story, for which magazine or program," Peters adds.

A one-off interview with a tabloid or local newspaper may be easier to turn down than requests from a horde of major newspapers and TV stations. The risk, of course, is that if you choose not to tell the story of your science, someone else will—and will do it poorly. Whomever you talk to, "if the scientist doesn't trust the journalist or is not happy about the direction in which his questions are going, then it is better to stop the conversation," Scherzler says.

There's a chance, of course, that journalists won't represent your research accurately, and this concerns many scientists. Nine out of 10 researchers Peters surveyed worried about being misquoted, and eight out of 10 thought journalists were unpredictable. In Crockett's experience, the "popular press's takes on the paper [can be] quite far removed from what the research presented," she says. In her *Science* paper, Crockett and her colleagues found that healthy people are more prone to retaliate to unfairness when their brain serotonin levels are reduced through diet. In some accounts, the coverage "somehow inferred that we should eat more chocolate so we can be nicer to each other," Crockett says.

Indeed, scientists frequently complain about mistakes and inaccuracies. “Scientists regard different things as being incorrect: first, the fact that particular aspects are omitted; second, simplifications; and third, actual errors,” Scherzler says. Scientists need to understand that communicating science to the public is very different from communicating it to one’s scientific peers. “Omissions are always necessary in journalism, because space or airtime is restricted. Simplifications are also inevitable so that the audience can follow the topic. Errors are, of course, annoying,” she adds.

And there’s much a researcher can do to reduce the number of errors. “The quality of an article does not only depend on the skills of the journalist but also on the source,” Scherzler continues. “One should, therefore, do everything in one’s power to ensure that the journalist understands what one is trying to communicate and that he has received all the information required for a good article.”

Preparing for good media interactions

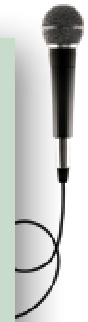
Some journalists will send you interview questions in advance, but if they don’t, try to anticipate them. Knowing in advance what you want to convey will help you to react to questions and to take an active part in shaping your media appearance, Scherzler says.

“The main thing that I was asked [for] was a short summary of the research that is understandable to everyone: what you did, what you found, and what it means,” Crockett says. Part of the job of a journalist is to explain to members of the general public how science will affect them. So “expect questions that do not focus on the research itself but on the implications and social context,” Peters adds. Because such implications are vague or hard to predict, and because part of journalists’ job is also to grab readers’ attention, this is one area in which journalists often make mistakes. Stick to the facts and don’t hesitate to put the journalist straight if he or she misinterprets or overstates the importance of your research, Crockett says.

Restrict yourself to a few take-home messages. Generally, journalists don’t “know what’s really the important and the not-so-important information. So a scientist shouldn’t bombard them with facts but instead try to concentrate on the quintessential points of his or her statement,” Scherzler says.

It’s not just substance; the challenges are also rhetorical. Try to picture yourself explaining your science to a friend or family member who is not a scientist. “A first basic skill is to understand that you need to recontextualize what you are doing in other ways, using metaphors, using analogies, and try to explain this with a language that other people can understand,” says Vladimir de Semir, science journalist and director of the Science Communication Observatory at the Pompeu Fabra University in Barcelona, Spain. Know the public you are trying to reach and accept some concessions. Try to find a compromise in representing the research that is acceptable to the scientist and useful for the media, Peters says.

After the interview, make yourself available for further inquiries the journalist may have, Scherzler says. There’s nothing wrong with asking if you can review and comment on quotes and technical passages, but don’t expect a journalist to comply with every request. Showing the article to interviewees violates the editorial policy of some publications. “You have to respect [this],” Peters says. Accept that “journalists insist on being independent, on making their own judgment. They are the author of the article and program and not the scientist,” Peters says.



Hone your skills

American Association for the Advancement of Science,
Mass Media Science & Engineering Fellows Program
aaas.org/programs/education/MassMedia/

British Science Association Media Fellowships
britishscienceassociation.org/Science-Society/Media-Fellowships

Media training courses organized by the Royal Society in the UK
royalsociety.org/Communication-and-Media-Training/

Standing Up for Science: A Guide to the Media for
Early Career Scientists
senseaboutscience.org/resources.php/13/standing-up-for-science

Getting your message across takes practice—and training. Increasing numbers of research centers, professional societies, and funding bodies offer media training courses for scientists (see “Hone your skills”). Also, “every scientist can get a feel for what is necessary to produce good scientific articles in the media” by reading the popular media regularly, Scherzler adds.

When interacting with journalists, “there are a lot of things that can go wrong, but in the end it seems to work,” says Peters. In his survey, 57 percent of the researchers said they were generally pleased about their latest media appearances, and only 6 percent were dissatisfied. “On the whole, it’s good for young scientists to get your name out there,” Crockett says. There are some risks, but Crockett puts them in perspective. “I think other scientists who have been through the process understand that something gets lost in translation, and if some journalist somewhere misquotes me or represents my research inaccurately, they won’t hold me responsible because they know how it works,” she says. Do everything you can so the journalist gets it right, but accept that some of it is out of your hands, she adds.

“In general, the scientist should not regard the journalist as an enemy. Such a distrustful attitude drains a lot of the scientist’s energy that would better be spent on a good interview. Working with the mass media should be seen as an opportunity and not a hazard,” Scherzler says.

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- Tooling Up: Four Must-Haves for Convincing Communication
  bit.ly/djDJgq
- The Pathway to Independence Awards: Early Returns
  bit.ly/9e7pRi
- Academic Scientists at Work: Negotiating a Faculty Position
  bit.ly/bkgbsS
- Toolkit: Designing Your Laboratory
  bit.ly/cnGeSg

Additional Resources

- Howard Hughes Medical Institute's *Making the Right Moves*
  hhmi.org/labmanagement
- Burroughs Wellcome Fund's *Staffing the Lab*
  bwfund.org/pages/55/Career-Development/

Books

- *At The Helm: A Laboratory Navigator,* Kathy Barker
  ISBN-13: 978-0879695835
- *Lab Dynamics: Management Skills for Scientists,*
  Carl M. Cohen and Suzanne L. Cohen
  ISBN-13: 978-0879697419

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Science *Careers*

There's only one

DR. SHIRLEY MALCOM

To Dr. Shirley Malcom, born and raised in the segregated South more than 65 years ago, a career based on her studies in science seemed even less likely than the launch of the Soviet's Sputnik. But with Sputnik's success, the Space Race officially started and, in an instant, brought a laser-like focus to science education and ways to deliver a proper response. Not long after, Dr. Malcom entered the picture.

Although black schools at the time received fewer dollars per student and did not have sufficient resources to maintain their labs at a level equivalent to the white schools, Dr. Malcom found her way to the University of Washington where she succeeded in obtaining a B.S. in spite of the difficulties of being an African American woman in the field of science. From there she went on to earn a Ph.D. in ecology from Penn State and held a faculty position at the University of North Carolina, Wilmington.

Dr. Malcom has served at the AAAS in multiple capacities, and is presently Head of the Directorate for Education and Human Resources Programs. Nominated by President Clinton to the National Science Board, she also held a position on his Committee of Advisors on Science and Technology. She is currently a member of the Caltech Board of Trustees, a Regent of Morgan State University, and co-chair of the Gender Advisory Board of the UN Commission on Science and Technology for Development. She has held numerous other positions of distinction and is the principal author of *The Double Bind: The Price of Being a Minority Woman in Science*.

Of her active career in science, Dr. Malcom says, "I guess I have become a poster child for taking one's science background and using that in many other ways: we ask questions; we try to understand what we find; we consider what evidence we would need to confirm or refute hypotheses. And that happens in whatever setting one finds oneself."

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