CAREER BASICS

Advice and Resources for Scientists from *Science* Careers

2009 edition

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Science Careers

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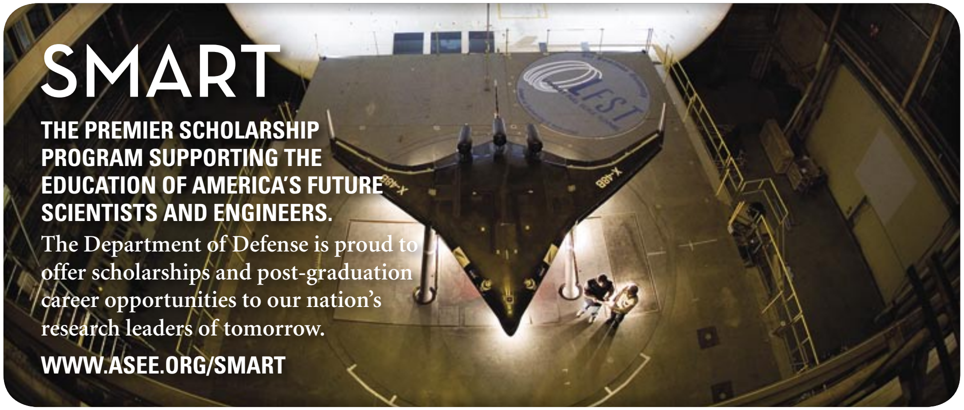

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Introduction

Today's scientists have many intriguing opportunities for career paths, and the purpose of this book is to offer advice and guidance that can add vital skills to your formal education, wherever your journey leads.

Any job search career track, whether in academia, industry, government, or nonprofit organizations, always begins with the basics. The articles in this book cover CV writing that opens doors and interviewing techniques that result in offers; how to write grant proposals and find funding sources; connecting through networking; specific strategies for underrepresented minorities and women; moving up to lab management; navigating the publishing maze; and other valuable information.

Science, one of the most prestigious and highly cited scientific journals in the world, and AAAS, the world's largest multidisciplinary society for science-related professionals, are dedicated to helping guide qualified scientists to meaningful careers at all stages. *Science* publishes special international careers features detailing new opportunities in various countries and regions. The AAAS Center for Careers in Science & Technology (www.aaas.org/careercenter), a collaboration of our departments and affiliated organizations, offers a wide range of career development options, including fellowships and internships, as well as links to our programs and partners.

The articles throughout the book have been carefully selected from AAAS's ScienceCareers.org, the most comprehensive international resource for job postings, career development tools, and links to the Minority Scientists Network, GrantsNet and other *Science* resources. The freely accessible site also offers information about career outreach forums and courses held in locations across the United States and Europe.

Training and retaining a superb S&T work force is a top priority for AAAS. We work to advance science by advancing the careers of scientists who serve global society. We hope you find this book to be a valuable resource.

Alan I. Leshner
CEO, AAAS
Executive Publisher, *Science*

1. Finding Your Way

Mastering Your Ph.D.: Mentors, Leadership, and Community

From: dx.doi.org/10.1126/science.caredit.a0700123

By Patricia Gosling, Bart Noordam—First published August 31, 2007

One of the best things you can do at the start of your scientific career is find a mentor. A wise and caring mentor can mean the difference between wandering around aimlessly and striding purposefully down the path of academic life and beyond.

But don't you already have a mentor, you may wonder? Won't your research adviser play that role? Perhaps, but mentors and advisers aren't usually the same thing. For one thing, an adviser directs, a mentor guides.

If your research adviser is a natural mentor and is willing to take on that role in your life—and if that relationship works for you—count yourself lucky. Not every graduate student is fortunate to have such readily available guidance and counsel from a more senior person. So, chances are you'll need to look beyond your lab to find a good mentor. What should you look for, whom should you ask, and how can you help your adviser—and yourself—be a good mentor?

Mining for Gold: Defining Mentorship

Before you start looking around, you first need to take stock of what a good mentor is and what you hope to get out of the relationship. A good mentor has many characteristics but must first and foremost care about your professional development and have an interest in guiding younger scientists as they move through their careers.

This sounds time-consuming, and it can be. Why would anyone want to take time out of a busy schedule to mentor you? It's not all about "taking" on your part. Many good mentors cherish the role of guiding younger colleagues. They gain something by giving back to the community of professionals from which they themselves were nurtured. Now that they've moved up in their careers, these scientists believe it's time to help others make the trek to the summit.

Mentorship is a lot about experience and wisdom. So it goes without saying that a good mentor will be someone who is further along on the career path than you are. Before approaching another person and asking him or her to act as your mentor, however, you need to think carefully about the kind of person and professional you wish to emulate. On a more specific level, is there someone whose career choices you admire? Who has a great work/life balance or is particularly good at getting work published in top-tier journals?

Importantly, a good mentor should have no ulterior motive in helping you (beyond the intrinsic satisfaction that mentorship provides). He should be able to help you meet your own goals (not follow his own agenda) by providing you with support and guidance, modeling successful behavior, introducing you to a strong network, and helping you identify your strengths and weaknesses as a scientist and a person.

Choosing a Mentor

When choosing a mentor, you'll need to be honest about your own needs and what you think a mentor can do for you. Do you want your mentor to offer you regular advice on how to negotiate graduate school and your career beyond? How specific or general do you want this advice to be, and how much of a time commitment will you require? Do you want your mentor to offer you detailed career and networking advice? Or are you just looking for someone who is a good listener and can act as a sounding board when you find yourself on shaky ground?

If your research adviser is also your mentor, you may want to establish clear goals for your relationship as both a Ph.D. student and a mentee. For example, you may want to meet on a regular basis just to discuss issues outside your research. A good, comfortable relationship with your adviser, as well as a certain amount of personal chemistry, will be key for the mentor/mentee relationship to flourish.

But what if your research adviser isn't able or isn't willing to act as your mentor? If you find yourself in this situation, you need to take the initiative and find someone else. The first place to start is your own lab. How about a postdoc or even a fellow Ph.D. candidate who has more experience than you in the lab? If no one in your lab is a suitable candidate, someone else in your department may be. Some institutes even have a mentor program in place for those who are unable to find a mentor for themselves. Even if such a program is in place, however, you'll still have to do some work. Mentor/mentee rela-

tionships are largely personal, so it's important to have a mentor for whom you have great respect and warm personal regard.

If you do look outside your lab, be sensitive to possible rivalries or politics between research groups. Even within the same institution, many lab heads are in competition with each other for funding, lab space, and equipment. You won't want to risk angering your adviser by seeking guidance from a direct competitor. The same is true if you consider possible mentors in your field at other institutions; you may collaborate with them on some projects, but they could still be seen as a competing lab.

When you've identified one or two individuals who could act as your mentor, it's up to you to approach them. Some people may feel flattered that you've asked for their guidance. Others will turn you down out of fear that mentoring will take too much time, or that you will become overly dependent on them for all your decisions. Don't be hurt if your preferred mentor turns you down. It's most likely not personal, so be gracious and move on to someone else suitable.

Once someone agrees to be your mentor, hold up your end of the relationship by respecting your mentor's time and professional responsibilities. You and your mentor should decide how to move forward and how much interaction you will have. Perhaps you'll meet over lunch once a month or touch base regularly via e-mail, or your mentor will be available whenever you have a specific issue. Whatever you decide, remember that your mentor's role is to provide you with professional guidance and to help you develop independence, not to hold your hand every step of the way.

You and your mentor should decide how to move forward and how much interaction you will have. Perhaps you'll meet over lunch once a month or touch base regularly via e-mail, or your mentor will be available whenever you have a specific issue.

Working with What You've Got

What do you do if you try all these things but fail to find a suitable mentor? You may want to take a second look at your supervisor. Even if he or she seems less than willing, think of ways you can help your supervisor become a (better) mentor. Start by making an appointment to talk about your needs. Recognize that time is in short supply and make it clear that you don't intend to add to an overly long to-do list. But be up front about your needs. Is it regular discussions you're after, an open-door policy, or just open lines of communication so you feel you can go to your supervisor when you need a bit of guidance and support?

Encourage your supervisor to involve you in group meetings and discussions, and state that you are willing to do whatever extra things need to be done to learn and grow in your field. Volunteer to give a presentation to the department, or offer to spend time with a visiting scientist as a way to expand your network. When it comes time to write your first paper, offer to write the first draft and meet with your supervisor for comments and suggestions.

Develop a Community of Peers—and Become a Mentor Yourself
Professional success doesn't begin and end with having a mentor. Your time in graduate school is an excellent chance to strengthen your professional and social networks and create a community of your peers. Some of these professional relationships will develop into lifelong friendships and be a source of support throughout your professional life.

Be a leader among your peers. Participate in group meetings and encourage quieter members to speak up. If you don't already have one, start a journal club in your group and invite others in your department to join. Set up social activities or team-building activities to help strengthen relationships outside the lab.

As you move up the lab food chain, become a mentor yourself by offering to supervise an undergraduate's research project. Offer to teach when possible or provide tutoring sessions for undergraduates interested in pursuing an advanced degree.

As you progress through your career, you'll find that the mentoring you received as a graduate student and postdoc and the networks you developed as a young scientist will provide both a firm foundation and a strong scaffolding for your career to grow. When the time comes for you to mentor others just starting out, use your insights and hard-earned wisdom to give junior colleagues a boost. It's also another way of giving back and saying thank you for the help you received early in your career.

Mastering Your Ph.D.: Preparing for Your Post-Ph.D. Career

From: dx.doi.org/10.1126/science.caredit.a0800028

By Bart Noordam, Patricia Gosling— First published February 22, 2008

Among the most difficult decisions during your Ph.D. is what to do when you're finished. You're probably familiar with the "typical" career track: Ph.D., postdoc, then a climb through the academic ranks of assistant, associate, and full professorship. Any other path is often looked upon with derision by peers, as though leaving academia means you can't handle the academic track.

But this "move up or move out" attitude is a purely academic perspective. Universities don't just train new professors; they prepare people to contribute to society in many ways. In the Netherlands, for example, 60 percent of Ph.D.s leave university right away to take jobs in corporate, not-for-profit, or government organizations.

Most of the remaining 40 percent continue their academic careers as postdoctoral fellows. But within five years of graduating, half of those will wander off the academic campus. The picture is the same in other Western countries. So, your career is likely to take you outside the hallowed halls of academia. Get used to the idea.

Evaluating all the options is a lot of work, so allow time to do it properly and start well in advance.

As you move toward the last months of your Ph.D., consider the full range of employment options. What you do directly after graduation will have a major impact on your professional progression. Evaluating all the options is a lot of work, so allow time to do it properly and start well in advance.

We suggest splitting the job-search process into two parts. First, decide which type of job appeals to you most. Then start the application process, which typically takes several months. You should start evaluating your options at least six months before you graduate.

What Really Makes You Tick?

Your education puts you in a position to find a job that not only pays the bills but also provides satisfaction. To discover what type of job will do the trick, analyze what you most enjoyed while working as a Ph.D. student. Was it working in a team of enthusiastic young people exploring unknown (scientific) territories or working to solve a tough problem? Or perhaps you were most excited by the challenge of mastering particular technical skills, learning the multidisciplinary aspects of your project, or teaching. Maybe you were most enthusiastic about the impact your results have (or are likely to have) on society.

At first glance, you may conclude that your particular research topic makes you want to get out of bed in the morning. But after more careful consideration, you're likely to realize that narrower aspects of your project are more important than the topic itself. Ask close friends what they see as your strengths; friends can often see what you were best at and what gave you the most satisfaction, even when you can't see it yourself.

Map Out Your Options

Somehow you need to make sense of all the possibilities—yes, there are lots of them—and discover which path is right for you. A decision tree will give you an overview and help you sort out your long list of options into a shorter list of opportunities worth pursuing further. Ask around the lab to find out what types of jobs previous generations of students have chosen.

While growing your own decision tree, you may notice that branches you intuitively ignored (e.g., working for the government) have interesting subcategories (for instance, working at the patent office). Maybe you're certain you want to be a bench researcher but thought you'd need to stay in academia. In fact, an accurate decision tree often includes research opportunities in the academic, industrial, and not-for-profit sectors, depending on your research area.

Explore the Unknown

So now you know what makes you tick and have a map of options, but you may have only a vague idea of what some of those jobs entail. So explore the less familiar options on your decision tree. If you're considering a job in industry but don't know much about it, visit one or two companies to get a feel for the culture and gain a sense of whether you would enjoy working in such a place. This research will allow you to base your decision on your own observations rather than those of your colleagues. Such "informational interviews" are also great ways to add valuable people to your network. (Shameless plug: You might also search *Science* Careers for articles about types of jobs that you aren't as familiar with.)

Leverage Your Hidden Network

Your network is a great asset in the job search, but do you even have a network? You do, even if you don't realize it. Many Ph.D. students have graduated from your institute in the past, and your supervisor and other staff members will most likely know how to find them. These people will be happy to discuss their current and past employment, especially if you offer to buy them lunch.

Double-check Your Decision

It may take a while, but it is hoped that your research on the job market will reveal a direction in which you want to head. Double-check this decision by talking to friends, relatives, and close colleagues. Sometimes people who know you have remarkable insight into what will work for you and what won't.

So ask around but keep in mind that some professors may not like the idea of having their star students stray from their own exemplary career paths; they might be biased against jobs outside academia. People working outside universities have lived in both worlds long enough to judge the difference. Yet many people who have left academia are like reformed smokers, pro-industry to the point of tedium. So talk to Ph.D.s working in every sector that you're interested in, then make up your own mind.

Do You Want the Job?

You've been offered a job. Congratulations! But during the job search, you may have become so anxious about getting a job that you lost sight of whether you really want the position that's offered. So go back to your decision tree and to the list of things that were really important to you. Consider whether you will enjoy working for this employer, taking full account of your interactions with the people you met during the interview.

Tempted to say "no"? There is no need to take the first job you are offered, but there is a limit to how often you can say no.

Your Direction Is Not Carved in Stone

If, after working for a while, you feel that you are on the wrong track, consider switching to a different branch of the career tree. There is mobility among the various sectors, so don't feel like you're trapped if you're unhappy. While you restart the job search, make the most of your current job by learning new, practical, and transferable skills.

As a scientist, you are used to tackling complex problems in a systematic way. Finding a job is a complex process requiring a serious commitment of time and smarts. It is worth making the effort to start well before your thesis defense to kick your post-Ph.D. career into high gear.

Grad School Campus Visits

From: dx.doi.org/10.1126/science.caredit.a0800080

By John K. Borchardt— First published May 30, 2008

Cary Supalo visited five campuses before deciding to attend Pennsylvania State (Penn State) University in State College to study chemistry. Some of what he learned might have been learned from a website or a phone call but not all. “The bottom line was the research opportunities,” he says. “I felt confident that I could find a niche in any of three or four research groups” at Penn State. “There were also opportunities for cooperative research with other research groups. Finally, the department was more informal than other departments I visited. I enjoyed the relaxed atmosphere.”

On-campus interviews are rarely required for graduate-school admission, but campus visits are common. James Faubion, chair of the department of anthropology at Rice University in Houston, Texas, estimates that about half of his department’s current graduate students visited before deciding to attend Rice. At other institutions and in other fields, the numbers seem to be even higher. Campus visits allow students like Supalo to learn things about the department and institution that might not be obvious from the university’s marketing materials, such as just how it feels to be on campus. Campus visits also provide an early opportunity to make a good impression on faculty members and administrators.

Choreographed or Improvised

Several departments at Northwestern University in Evanston, Illinois, set aside certain days for campus visits and plan those visits out carefully. Northwestern’s chemistry department, for example, schedules grad-student visits on three weekends in March. “Each student visiting the chemistry department can schedule five visits with faculty members,” says Jonathan Maendel, graduate program assistant for Northwestern’s chemistry department.

The approach of Rice’s earth sciences department runs more toward the ad hoc, helping prospective graduate students schedule visits on an individual basis. “We will help them customize visits to their interests and assist in scheduling visits with particular professors,” says Sandra Flechsig, department coordinator for Rice’s earth sciences department.

Preparation Is Key to Success

One key to a successful visit is choosing which schools to apply to. There’s no point in going to the trouble for a department that doesn’t have at least a couple of professors you might like to work with. If you haven’t even thought about this yet, consider taking a year off to work or travel.

Once those decisions are made, “start preparing early” for your visit “and make contact with faculty members whose research interests you and with graduate school administrators” at least two weeks ahead, Flechsig says. More advance notice is even better, Faubion advises. Plan your visit with the chair of the department’s graduate admissions committee or call the main department office; someone there will make sure you get hooked up with the right people.

Allow at least a day for your visit. Avoid summer and break-week visits because faculty members are more likely to be away then and because it’s hard to assess how well you fit in when so many students are away. Check conference schedules so you don’t visit when key faculty members will be conferencing. If there’s a conference that week that’s likely to be attended by key faculty members, go to the conference and meet them there instead.

Prepare well. A student who arrives with little specific knowledge of the graduate program or its faculty “is bound to make a bad impression,” Faubion warns. Even if you’ve already been admitted, making a good impression is important. “Financial aid is more likely to be offered to students if they have learned about the graduate program, are motivated, and have a prepared list of questions,” says Carl Wainscott, assistant director for recruitment to the Graduate School of Marquette University in Milwaukee, Wisconsin. And professors are more likely to want to work with incoming students who seem well prepared.

During the Visit

Dress neatly. Although some students wear business suits, most dress casually in neat, button-down shirts or blouses and slacks. “Avoid T-shirts and jeans,” advises Flechsig. Wear comfortable shoes because you could be doing a lot of walking during department and campus tours.

“When meeting professors, ask questions related to your own research interests,” Maendel advises. Here’s where you deploy those questions you prepared before your visit—but also listen well and do your best to engage in intelligent, spontaneous conversation.

Don’t forget to talk with current graduate students. Such discussions can help you “develop an understanding of the department’s culture to decide if it is a place you would be comfortable studying and working,” observes Maendel. Grad-student conversations are also an ideal opportunity to find out what it’s really like to work with the professors you’ve targeted, Maendel says. Some researchers want their students in the lab for long hours; others care only that you get the work done. Finally, a few professors have a reputation for being especially difficult to work with for women, say, or gay men. You want to know these things before you make a commitment, and frank conversations with a few graduate students are your best opportunities to learn them.

Also tour other important places on campus you expect to use, such as the student union, graduate student housing, student health care facilities, and dining halls. For some people, exercise is a key to maintaining sanity during graduate school. If you're one of those, make sure the institution's facilities measure up.

If you haven't done so already, now's the time to track down information on fellowships and assistantships, teaching expectations and support, employment opportunities for your spouse, and any other details that are likely to have a positive or negative effect on your decision or your graduate school experience.

Financing the Trip

For many, visiting a graduate school is an expensive, long-distance trip, but some graduate departments will offset at least some of your expenses. Northwestern's chemistry department "will refund up to $400 in travel expenses," Maendel says. Other Northwestern departments are willing to reimburse different amounts. Rice's earth sciences department will pay all travel expenses for domestic students who already have been admitted to the graduate program. Rice also has "funds available to bring to campus those students residing in the United States ... whom we are most interested in admitting" but "before we extend formal admittance offers to them," Faubion notes.

Students admitted to a graduate program at Ohio State University in Columbus can apply for reimbursement of travel expenses up to $250 but only if they have received a university fellowship or been nominated for a graduate school or graduate enrichment fellowship. The University of Washington, Seattle, will pay for campus visits but only if the university's travel office makes your travel arrangements.

Worth the Hassle

"Visiting a campus once you've been accepted, especially if you visit with a group of similarly graduate-school bound students, can help students figure out what it would be like to be a graduate student at a particular institution," writes a professor who has advised many such students. "The only downside to these visits is that they often require missing some classes during one's senior year, just as thesis deadlines are starting to loom. But they are worth the hassles associated with travel. I would not recommend attending graduate school at a place without visiting first."

Additional Articles Online

Informational Interviewing: Getting Information You Can Use
sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2310/informational_interviewing_getting_information_you_can_use

Tooling Up: The Wall
dx.doi.org/10.1126/science.caredit.a0700120

No, You're Not an Impostor
dx.doi.org/10.1126/science.caredit.a0800025

The Postdoc Experience: Not Always What You Expect
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Returning to Academia
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Reclaiming Life From Work
dx.doi.org/10.1126/science.caredit.a0700176

Opportunities: Breadth Versus Depth
dx.doi.org/10.1126/science.caredit.a0700032

The Graduate School Application
sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2006_04_14/noDOI.5474268556298302823

2. Marketing Yourself: CVs, Resumes, and Networking

Tooling Up: Resume Rocket Science 2007

From: dx.doi.org/10.1126/science.caredit.a0700009

By David G. Jensen— First published January 19, 2007

Lots of articles and books have been written about resumes and CVs, including previous pieces on *Science* Careers (see the further reading section below). I generally avoid this topic; in fact, I haven't given a single "CV workshop" in two decades of presentations about science-career issues.

Why? It is often a no-man's-land of bad career advice, with no agreement on anything and books full of information that doesn't work for scientists.

Should it be a one-page resume or a multipage CV for that industry job application? One adviser tells you that only one- or two-page resumes work for company managers, whereas another tells you that you will do best to simply modify your academic CV by adding an "Objective Statement" to the top. In each and every "Q," you will find "A's" that fall into a dozen different camps, editorializing on their preferences and how they would structure it if it were their document. Someone who cares about writing the perfect CV or resume will find enough discrepancy to keep the resume project going for months. Therein lies the problem: There's no such thing as the perfect CV.

So, given my reticence about pursuing this topic, why have I decided to take it on now? I couldn't stay away when I saw the passion in the responses to a recent thread on the AAAS *Science* Careers Forum that takes on this subject. Besides, I have more than two decades worth of experience in looking at what most people agree is the right document, the industry CV. Let's dissect one!

Should You Care About Writing the Perfect Resume or CV?

I may sound unorthodox when I say that you really don't need to be *all that* concerned about writing the perfect CV or resume. If you are interested in an industry job, you want your CV to open doors as it gets routed from person to person inside an organization. But you also want it to represent you accurately when you make a good networking connection.

Industry managers are used to looking at documents that aren't perfect. I'll take a *good* resume or CV over a perfect one any day of the week because the good one can be done in a short time, allowing plenty of time for networking—indisputably the single most important step in a job search—whereas writing the perfect document could take you (*and* your CV or resume) out of circulation for months.

This column uses advice gleaned through dozens of interviews conducted in January 2007 with hiring managers, human resources executives, recruiters, and consultants working in many different science-related niches. As expected, I came across differing opinions—some of my sources contradict each other—but enough common threads emerged to give the reader plenty of confidence that the CV or resume will do its job and not embarrass you. And that's exactly what you want it to do.

CV or Resume? The First Big Area of Confusion

Don't get befuddled by the "resume vs. CV" question. A resume is just a really short CV, with a lot more self-promotion than a CV would dare include. It's something you would use if you were looking for a sales job. A CEO might use a one-pager when looking for her own job. It's more like a really big business card, with just enough sentences about the last great accomplishment to hook the reader.

If you are a scientist looking to get your first job in industry, you should generally send what we'll refer to from this point on as an "industry CV." This document has elements of both a resume and a CV. It needs to attract interest and accurately describe what you can do for the employer. But it's not the same thing as an academic CV, which is an exhaustive, nonselective rehashing of everything you've every done in your life—every publication, every presentation, every time you ever went to the bathroom. Okay, just kidding on that last point.

Cantankerous Issues—and Some Areas of Agreement

The biggest area of differing opinion seems to lie in the recommended length for an industry CV. Academic CVs can run 10 pages or more for a scientist with a decade of experience. Although everyone I interviewed agreed that this aca-

Get a summary statement up front, to describe your area of specialty and a few of your qualifications, and then fill out the detail in the work experience paragraphs below.

demic length would be inappropriate for industry, hiring managers have varying opinions about how much they want to see from their applicants:

- "I'd recommend no more than two pages," said Ken Kodilla, vice president of manufacturing at Neogen Corporation (Lansing, Michigan), "but more importantly, I think that formatting issues are critical."
- "Two or three pages would be OK, just don't send me a too-long academic version. If you have 10 or 12 published papers, just list the three or four most important ones," says Dr. Burt Ensley, an entrepreneur and angel investor who has launched several companies, and who earned his stripes at Amgen.
- "I like to see three or four pages of information that is relevant to the job at hand, plus an appended publications list," said one director of research at a large pharmaceutical company who wished to remain anonymous. "It's not all that different from an academic CV, but please don't forget the personal contact information at the top—home address, phone, and even cell phone."

My own recommendation has always been to write this document as succinctly as possible. The average length for an industry CV for someone coming out of a postdoc and going into industry is three or four pages, including publications, and I don't think any of my contacts, even those above, would have issues with a well-written and nicely formatted three-pager that includes publications.

Modifying Your Academic CV to Work As an Industry CV

Some experts recommend trashing your academic CV and starting fresh with a few new ideas of how to present themselves. Others say that you can simply update and improve it, focusing on the following categories:

Contact information. As mentioned above, make it clear how to connect with you in your personal time. "Put it in bold text. H/R tells us that we can't contact you at your place of work, so you will need to have home address and phone there for this purpose," said one of my anonymous pharma contacts.

Summary. I found considerable resistance to leading off the CV with a statement of your career objectives. This really took me by surprise. That brief paragraph below the contact information is very commonplace (i.e., "Seeking a responsible position in an industry lab doing cancer research.") But I found that most hiring managers believe that a "summary" statement is preferable.

"I like to see resumes that start off with a summary of what they bring to the table," said Donna Dimke, senior director of human resources at Human Genome Sciences (Rockville, Maryland). Pat Abbott, principal consultant at Venture Forward Partners, a Boston biotech consulting firm, agrees with Donna. "Get a summary statement up front, to describe your area of specialty and a few of your qualifications, and then fill out the detail in the work experience paragraphs below."

Education. Jim Calvin, vice president at On Assignment/Lab Support (Princeton, New Jersey), says, "Make sure your educational information is easily decipherable and that it can be gleaned within the first few seconds of viewing the resume, which means up front instead of after the Experience section. Also, it helps to have the Ph.D. following your name at the top—you've earned it." There was wide agreement on this one.

Professional experience. Universally, hiring managers and human resources people want to see your work experience listed in reverse chronological order. Never, ever get into those alternative layouts you see written about in books for the lay public. "I sometimes see all these great things that someone has accomplished, but without the specific detail of where and when they have done those things," said Don Bergmann, senior vice president at Tengion, Inc., in King of Prussia, Pennsylvania. Bergmann is referring to the "functional style" resume so often described in resume books. It is clear from everyone I spoke with, and from my own experience, that you veer from this reverse chronological order only at your own peril.

Publications. Here's another area where you'll find a great variety of opinion. Industry managers, in general, are far less concerned about seeing every one of your publications than the academic hiring committee you were trying to impress when you put together your academic CV. I agree with Burt Ensley, who said that only your most important publications need be present. The goal is to conserve space and keep it short and readable. You can always add, "Full publications list sent upon request."

David Bomzer, a former *Science* Careers columnist and a senior H/R professional, reminded me that an industry CV "doesn't focus exclusively on technical knowledge. Your technical knowledge, education, thesis topic, and publications [sections are] usually *just the price* of entry for being considered." In an industry CV, Bomzer says, there's a subtle point-of-view difference. More on Bomzer's point in this article's closing section.

Skills and techniques. Many people include an area like this on their industry CV, and there is nothing wrong with it unless you go overboard. "Sure, I want to know what skills you have, but I want an honest assessment. If I see that you are 'skilled' in 50 different techniques, I know with some degree of certainty that you are being a bit lenient with the word 'skilled.' If you can do a technique right now without any help, then you are skilled in it," said frequent forum contributor Ken Flanagan of Genentech about this topic area. Most of my hiring-manager friends like to see skills in evidence on the CV, but they caution me that it can paint you into a box, so you should adapt your skills and techniques section to the job you are applying to. Better yet, incorporate this skills information into the brief descriptions you give of the work involved in each job listing.

The industry CV needs to answer questions like these: What can this person do to help us solve the problems we are facing? Will this person bring a set of skills and abilities that mesh with what we have now?

Bomzer's 'Subtle Point-of-Vew' Shift Gives Your Document More Punch

Earlier in this piece, I described a resume as having a great deal more self-promotion in it than a CV. The same is true of the industry CV, which aims to grab a bit of that promotion and focus it on the employer's needs. You certainly don't want to put out a CV that makes you look like a sales rep candidate (unless that's the kind of job you are applying for!), but you must consider the document you've prepared from the viewpoint of the reader. The industry CV needs to answer—or allow the person reading it to answer for him or herself—questions like these: What can this person do to help us solve the problems we are facing? Will this person bring a set of skills and abilities that mesh with what we have now?

In closing, let me pass along the advice of an industry hiring manager, friend, and adviser:

A mediocre CV (stylistically, not with respect to your actual expertise and accomplishments) and a lot of networking is guaranteed to get you a job. A stunning CV and no networking is equivalent to playing lotto.—Kevin Foley, Ph.D.

Writing a Winning Cover Letter

From: sciencecareers.sciencemag.org/
career_magazine/previous_issues/articles/2006_03_10/no
DOI.4819437018278975029

By John K. Borchardt— First published March 10, 2006

Your curriculum vitae cover letter is both an introduction and a sales pitch. "It should show what sets this individual apart from all others," advises professor Jeffrey Stansbury, chair of the faculty search committee at the Department of Craniofacial Biology of the University of Colorado School of Dentistry in Denver. Like any good sales pitch, your cover letter should motivate the customer to learn more about the product—in this case, you.

A good cover letter, like a good sales pitch, has several characteristics. First, like a good doctor, it does no harm; it avoids making a negative impression. Second, it demonstrates that the product suits the consumer's—your future employer's—specific needs. Third, it assures the customer that the quality of the product (you!) is superb. Accomplishing all this is easier said than done. So how do you write a cover letter that will do you justice and earn an interview? First you need a plan.

The Objective

"A successful candidate impresses the committee right off with the cover letter and makes the committee members actually want to dig through the CV and recommendation letters to pull out the details that start to validate the positive claims," says Stansbury. "It also provides a glimpse into the applicant's personality and gives some guidance as to whether or not they can communicate in an organized, effective way."

One of the most important jobs of any good sales pitch is to avoid doing harm. Some cover letters, says Robert Horvitz, chair of MIT's Biology Department search committee, may inadvertently convey negative impressions of a candidate, especially if they "look sloppy or indicate an inability to communicate in English." "These things can kill someone's chances," adds Kenton Whitmire, chair of the Chemistry Department at Rice University in Houston, Texas.

Horvitz adds that cover letters "should be neat and professional" and fit on one page. Whitmire would allow applicants a bit more room; the letter, he says, should be "no longer than one to two pages." To keep it short, "the cover letter should not reproduce the information in the CV, publications list, or other documents provided," says Whitmire, "but it should be used as a vehicle to highlight those things that the candidate believes will make him/her a good match for the position at hand."

The Match

An effective cover letter doesn't just emphasize your best qualities; it also shows how well those qualities are likely to mesh with the open position. "Applicants should begin by reading advertisements for faculty positions carefully and be sure that their background and goals are appropriate for the position in question. You lose credibility if you can't make a case that you fit the ad," says Whitmire."If the cover letter is to be effective, it must definitely be tailored to the particular institution."

"There's no excuse for not writing a cover letter that shows how your education, experience, and interests fit with what the institution is seeking," warns Julia Miller Vick, co-author of the *Academic Job Search Handbook* (University of Pennsylvania Press, July 2001). "Not doing this would reflect laziness," observes Horvitz. At best, adds Vick, "a form letter or one that is generic doesn't accomplish much and leaves how the application is reviewed completely up to the reviewing committee." At worst, a generic cover letter can make you seem undesirable.

"While many people applying for academic positions tend to think that the review process is an evaluation of their previous work—how good is it?—the issue that is as important is the match," says Whitmire. "How will this person fit in here? The former is necessary, but the decision to interview will often be made upon research area or some other measure of fit to the department's needs at that moment in time."

Planning

Begin by learning about the department in general and the open position in particular. Department websites are a good starting point, but don't stop there; go beyond the public information and seek a sense of perspective. "It is best if candidates speak with their advisers/mentors to get some feel for the institution where they wish to apply," Whitmire suggests. Close senior colleagues can serve the same purpose. Read beyond the job ad and figure out what they're really looking for.

Once you've got a fix on the institution, the department, and the open position, ask yourself what abilities or special qualities a candidate needs to excel in that position. Then determine which of your qualifications and accomplishments will particularly interest this department. Think about your research plans, past research accomplishments, special projects, and previous employment.

What evidence can you put forward that your background and plans prepare you well for this opening? How well do your research interests match those described in the advertisement? How well will they complement the work of the current faculty? How will your presence there make the department better? All this information will determine what to emphasize in your cover letter.

Writing the Body of the Letter

Your research accomplishments and plans should constitute the body of your cover letter for a research university position. At institutions where teaching is the primary emphasis, your primary focus should be your teaching experience, philosophy, and goals—and the suitability of your research program to a teaching-focused environment.

"An outline of plans for teaching and research needs to be specific to be meaningful," says Stansbury. Focus on your most important two or three examples of proposed research projects and innovative teaching plans such as developing novel courses. These examples should change from one cover letter to another as you customize your letters for different jobs.

The Opening

After the body of your cover letter has been drafted, you come to the most critical step: writing an attention-getting introduction. Salespeople call this "having a handle." Your handle is what you offer that makes you especially well qualified for a particular faculty opening. For example, summarizing how well your research interests match those the department advertised provides an effective letter opening.

The opening paragraph should be short but more than just one sentence. After you've captured the reader's attention with the handle, clearly but briefly summarize your most important—and relevant—qualifications. Anything less than a sharp focus, and your readers will quickly lose interest and move on to the next manila folder.

Closing the Letter

End your letter decisively. Don't let it meander to an indefinite or weak close. A strong close projects an image of you as an assertive, confident, and decisive person. It never hurts to close by requesting an interview.

Editing

Make your cover letter an example of your best writing by editing it carefully. It must be easy to read. Focus and clarity of expression in your letter imply focus and clarity of thought—very desirable qualities in a faculty member.

Then return to the critical issue—whether your research interests, other qualifications, and personality meet the search committee's requirements. Anything that doesn't accentuate the match should be ruthlessly deleted.

Then set your letter aside for a day or two before editing it again. The detachment you gain from this short break will help you see what you've written more clearly. Detachment makes it easier to determine whether your paragraphs flow smoothly from one to the next. The logic that seemed so obvious when you were writing may seem much less so a day or two later. Carefully review both your cover letter and CV to be sure the information in them is perfectly consistent. Often, a committee won't bother to try to resolve any discrepancies they find; they'll just move on to the next application.

Finally, Whitmire advises, "Be sure to have your cover letter reviewed by someone [who] can be trusted and who has experience. Often, getting a second opinion about how something sounds to the reader—i.e., what they got from reading the letter, not what you intended in writing it—can be very valuable."

E-Persona Non Grata: Strategizing Your Online Persona

From: dx.doi.org/10.1126/science.caredit.a0800112

By Peter Fiske— First published July 25, 2008

About three years ago, I was sitting at my desk at work, minding my own business, when I got an e-mail from a colleague inviting me to join LinkedIn. "What is this LinkedIn thing anyway," I asked myself, "some sort of pyramid scam?" I thought highly of the person who sent me the invitation, so I went to the LinkedIn website to see what it was about. At the time, I didn't see how it would help me, so I didn't join.

A few months later, a summer intern who was working with me sent an e-mail inviting me to join his LinkedIn network. When I failed to respond after a few days, he confronted me. I admitted that I was not using the service. "I have spent years developing a professional reputation and building a network of colleagues and friends," I told him. "Why would I want to show all that off to the rest of the world?"

More invitations came in. Eventually, one came from a very senior executive I regarded very highly. I could not refuse his invitation. I had no clue how a tool such as LinkedIn (or Facebook , or other social/business networking sites) would help me. I was now committed to finding out.

Connecting with people in different organizations and understanding who knows whom within your network are very powerful assets for professional advancement.

Your E-persona: It's More Than Just LinkedIn

Even if you refuse to sign up for any social-networking sites, there is information about you on the Internet. Are you familiar with the term "vanity Google"? If not, search online for it, then search for your name. It's interesting what comes up, isn't it? This is your e-persona: the record of yourself as preserved and presented on the web. Every employer considering hiring you will likely search online for your name. I do it with everyone who makes my shortlists.

Online social-networking sites can be a part of your e-persona, and unlike the Internet as a whole, you can control what is in your profile on these sites. For this reason alone, actively managing your e-persona through use of an online social network is a good idea. Like a well-composed resume or cover letter, a well-constructed e-persona reflects a measure of thoughtfulness, professionalism, and competence. Whether it's a personal website or your LinkedIn or Facebook profile, putting forward a consciously conceived professional image can't hurt.

The corollary is also true: Sophomoric, sarcastic, or inappropriate material can be a lasting liability. Many stories circulate about employers who checked out a prospective employee's Facebook page only to find embarrassing photos and comments.

Three Good Uses (and One Really Bad One) for Online Social-Networking Sites

Job searches: You can use online social-networking sites in a number of valuable ways for your job search. You can find contacts in companies or organizations that interest you through your network of friends and colleagues (and the people they know). You can research people in these companies and learn about their interests and backgrounds (a good way to prepare for interviews). You can also find people through your friends' networks who may be suitable for an informational interview; informational interviews can be a powerful means of investigating careers and employers that interest you--and signaling your interest in them.

Professional networking: Even when you are *not* looking for a job, you can use online social-networking sites to scan for opportunities. Connecting with people in different organizations and understanding who knows whom within your network are very powerful assets for professional advancement. I've found it interesting to observe how my network connects to those of my friends and have discovered several independent mutual acquaintances. In a few cases, this unexpected link has led to new opportunities. Many social-networking sites have an array of functions and features that allow you to search for people: past friends and colleagues, people who do interesting work at interesting companies, and so on. Some of these sites allow you to post and respond to questions, get recommendations, or get introduced to other experts.

Social networking: Online tools can help you find new and old friends and get connected to fun things that have nothing to do with work. From the formal (Match.com) to the informal (Craigslist.org), to Facebook, there are numerous ways to find others with bizarre and obscure interests similar to yours. Staying connected to your classmates and alums from your past schools could be especially valuable; there's no clear distinction, after all, between your personal and professional networks. For foreign national grad students and postdocs, this may be particularly important: Your expatriate community can be a powerful and highly motivated resource network for you. Facebook allows users to very easily set up affinity groups of people with similar interests.

Collecting Links and Friends for the Sake of High Numbers (Hint: A Bad Idea)

Even with a clear idea of what you hope to accomplish with these social-networking tools, it's easy to misuse or overuse them. I have come across profiles of folks on Facebook who claim to have more than 500 friends and folks on LinkedIn with 500-plus contacts; I suspect their definition of "friend" is more elastic than mine. If you linked to every single person who ever gave you a business card, you probably could, over time, accumulate 500-plus links. But how many of these people would remember you? And does this large but undifferentiated list of links do anything more for you than provide the world with a copy of your address book?

So, whom should you include on your list of links or of friends? If the person called you at work, would you take his or her call? If so, then he or she probably would be appropriate for your LinkedIn network. If this person called you on Friday evening, would you take his or her call? If so, accept their offer of Facebook friendship. Do you send out Christmas cards to 500 people every year?

It is okay to "delink" people from your network if you discover that the contact is not valuable or is never used; most sites make the "delinking" process invisible to the other party. Experts recommend that you periodically cull your list of contacts and throw out the ones who aren't active.

The Warm Contact Always Wins

The power and sheer multitude of web-based networking tools underscores a fundamental fact: Your real network, not a bunch of names in the Friends column of Facebook, is your most important professional and personal asset. Your network will be the source of your future employment, many of your future friends and colleagues, and, quite often, your spouse.

Online tools expand the ways you can connect to others, but they cannot substitute for face-to-face encounters. Whether in an informational interview, a professional mixer, or a social gathering, personal contact imparts momentum to your job search and professional life. If you have a choice between adding five more connections to your LinkedIn list or going out to lunch with a member of your network, choose lunch.

Additional Articles Online

Tooling Up: Defying Gravity
dx.doi.org/10.1126/science.caredit.a0800124

Tooling Up: On Headhunters
dx.doi.org/10.1126/science.caredit.a0800058

Tooling Up: Put Some Muscle Into Your Marketing Materials
dx.doi.org/10.1126/science.caredit.a0800026

Maximizing Productivity and Recognition, Part 2: Collaboration and Networking
dx.doi.org/10.1126/science.caredit.a0800016

Tooling Up: Negotiating Boot Camp
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The Dreaded Phone Interview
sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2006_03_17/tooling_up_the_dreaded_phone_interview

The Real Deal vs. Well-Oiled: Who Gets the Offer?
sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/3710/tooling_up_the_real_deal_vs_well_oiled_who_gets_the_offer

3. Skills for the Academic Scientist

Tips for Publishing in Scientific Journals

From: dx.doi.org/10.1126/science.caredit.a0700046

By Katrina Kelner— First published April 6, 2007

A string of impressive publications can propel a young scientist to the next academic stage, whereas an insufficient publication record can derail a career. Publications are the main way scientists publicize their work, and ultimately, it is by their papers that they will be judged.

So what makes a good paper? The most fundamental ingredient is excellent research. Work with the best scientists you can, in the best lab you can find. You will absorb the most about doing excellent science if you are surrounded by it during your training. Then make sure that the questions you investigate are important and of interest to others in the field. As an editor at *Science,* I see that the most successful papers are those that present innovative research. But the best papers also present their story in a clear and logical way. The thinking behind the paper is clear, so the writing is clear. Writing research papers with all these qualities can require a bit of strategic thinking, practice, and know-how.

In the eyes of your readers—editors and reviewers included—the quality of the paper you send in directly reflects the quality of the science behind it.

Choose a Good Environment for Publishing

One of the signs you should look at when choosing a lab for your thesis or postdoc is the group's publication record. Look for consistent output of good publications, because this will tell you that the lab is run well and that the lab head manages research projects successfully. Different members of the lab should also be listed as first authors, because this will show that projects and credit are distributed. Make sure that the papers are in journals in which you would want to publish. Then read the papers to find out about the writing skills of the lab's scientists. Are the papers clearly written? Did they convince you of the importance of doing the experiments? Can you easily tell what the important conclusions are?

The best way for you to learn to write first-class papers is by getting as much practice as possible. Before deciding what lab to join, as you examine the facilities and find out what it is like to be part of the team, also make sure to ask about the writing process. Do postdocs or graduate students get to write the first draft? Do they get valuable input from the head of the lab and other colleagues? Or does the head of the lab just write the paper and show it to the student or postdoc, which will not be so useful to them?

Think in Figures

Once you are working in your new lab and producing data at full speed, you have to judge when you have enough data to write a paper. Write too soon, and you may be wasting your time. Wait too long, and you risk getting scooped. Stop and write when the data are sufficient to tell a story that is complete and makes sense. The key is to constantly keep the paper in mind while you are performing the experiments. Think about the figures that can already go into the paper and the information they will contain. The reader must come to the same conclusions you have solely on the basis of your results. So ask yourself whether, after grasping the results presented in your figures, the reader will be led to the correct overall conclusion. What convincing experiment might be missing? Are there alternative explanations? If so, what data will you need to collect to eliminate that other possibility? Before performing a new experiment, always ask yourself how it will contribute to the logic of the publication.

As you are immersed in the details of your work, it may be difficult to remain objective and see the holes. Test your reasoning on colleagues by asking them whether you told a logical and convincing story after giving a talk from your assembled figures, for example.

Choose an Appropriate Journal

Aiming your paper at the most appropriate journal can save much effort and reveal your results to the world sooner. The so-called top journals value novelty and unexpected findings, but other journals may be more interested in careful, extensive analyses of critical (e.g., biological) processes. Survey the various journals and see where your work would fit best. Get advice from colleagues and others in the field who have experience as authors, reviewers, and journal editors. It may be tempting to send your paper to a top journal even if your results are not of the highest novelty or broadest interest. But you can save time and reduce your frustration if you send it to the appropriate journal first instead of waiting until it's rejected by a top journal.

Submit a High-quality Paper

In the eyes of your readers—editors and reviewers included—the quality of the paper you send in directly reflects the quality of the science behind it. A careless approach to writing can undermine the most meticulous experiment. It is thus critical that the paper be free of careless errors, especially in the data. Check and recheck that all information is consistent, that the images and graphs represent what you say they represent. Again, figures are your best ally to convey your story, so make them easy to understand. Each figure should make only one or a few related points, and together they should make all the paper's important points in an easy-to-grasp manner. Put as much information about the data and the conditions of the experiment directly on the figure as you can. The figure legend is important, but the less the reader has to refer back and forth to it, the better.

Do not neglect the form. It is critical that the paper is written clearly and that it contains no spelling or grammatical errors, and that the logic is crisp and clean. Show your paper to your most critical friends and colleagues and take their advice seriously. Also make sure that all authors have seen and approved the submission!

Help Ensure That the Review Process Goes Smoothly

Journals can be run by professional editorial staff (such as *Science*, which receives about 12,000 submissions per year) or by academics who take on the role of editor for a defined period of time. Both types of editors send papers out to peer reviewers—working scientists who evaluate your paper for accuracy, logic, and scientific interest. Some journals (such as *Science*) have an initial screening step in which papers unlikely to make it through the review process are rejected. *Science* editors make these initial screening decisions with advice from the Board of Reviewing Editors, a group of more than 100 working scientists.

Reviewers are chosen by the editor on the basis of their expertise in the field, often utilizing extensive databases assembled by the journal and the editor's knowledge of the area. Some scientists are better reviewers than others—they are more critical and thorough, a fact that quickly becomes known to editors. The review process can take anywhere from a few days to several weeks. After review, the editor makes a decision about publication, taking into account all of the feedback he or she has received. The editorial goals of the journal—sometimes journals decide that certain areas are of particular upcoming or lessening interest—factor into the decision, as does knowledge about the reviewers themselves and the background behind their opinions.

You can help the review process go smoothly by providing a cover letter that includes, in very clear language, a concise version of the whole logic of the paper that makes clear its importance and context. If there are any special

considerations that the editor and reviewers should take into account, include these in the cover letter. These might include information about your own availability, related work being reviewed at other journals (from your lab or other labs), or the names of other scientists who are working on the same problem and so would have a conflict of interest in reviewing your paper. Keep the list short; otherwise, the editor will be forced to ignore your list or get an uninformed review. If it is necessary to ask that a few individuals be excluded from review, explain why.

All of the related data not included in the main body of the paper should be clearly accessible to the reviewers, either as an appendix or through a publicly available database.

Respond to Reviewers' Comments Positively and Constructively

Good news: The journal wants to publish your paper. Still, only on rare occasions will reviewers recommend that your paper be accepted without revision. New experiments—usually ones that can be done within a few weeks—are often among their requests for revisions. *Science* editors also often give authors extensive advice on how to revise their papers.

Remember that the editor and reviewers are interested in your paper. They want to see it improved and published. You increase the chances of your paper being accepted if you make the assumption that the reviewers are offering their suggestions as constructive criticism. Make all possible attempts to comply with their requests, including performing extra experiments, even if you think they are unnecessary. Of course, sometimes the reviewers' requests are misguided or based on faulty reasoning. In these cases, especially if you have agreed to address the rest of the reviewers' comments, the editor may be willing to consider a reasonably worded argument that the request does not need to be fulfilled for acceptance of your paper.

When you send your revised paper back to the journal, you should include a detailed, point-by-point explanation of how you have addressed each of the reviewers' and editor's comments. Remember that the editor may send your responses to the reviewers, so if you are refusing to address one of the referees' comments, you should word your argument carefully to be clear but not offensive.

Always treat the reviewers' comments and motives with respect. It is never a good idea to engage in personal attacks or observations about reviewers or reviews. Also be polite to your editor. The editor will be most disposed to work with you when it is not unpleasant to do so.

How to Deal with Rejection

In spite of your best efforts, you have received a rejection letter from the journal of your choice. This does not mean that your paper is not good. At *Science*, we have to reject more than 90 percent of the papers submitted to us.

A rejection can be upsetting, and it is often sensible to let at least 24 hours pass before thinking about your next steps. It is not a good idea to fire off an angry e-mail to the editor explaining why the journal's process was unfair and biased. If, after careful consideration, you think there has been a misunderstanding or error, some journals will entertain a request for reconsideration, usually in the form of a clear letter or message explaining your point of view. Some editors might be willing to have a phone conversation.

In most cases, the best and most time-efficient course is to reassess quickly your choice of journal, fix any weaknesses that may have been pointed out in the review process, reformat the paper for your second-choice journal, and send it off. About 70 percent of papers rejected by *Science* are eventually published elsewhere. Even a submission that ends in rejection is an opportunity to hone your writing and editing skills.

Faculty Positions: Seeking the Skills for a Successful Career in Academia

From: dx.doi.org/10.1126/science.opms.r0800046

By Emma Hitt— First published January 25, 2008

Tenure-track faculty members must not only think well, but they must also write well, speak well, and interact with people well. They should have a keen business sense and be adept in managing budgets, projects, and people. Paradoxically, they must be fiercely independent, yet able to collaborate well with others. They must be confident enough to know when they've found a scientific truth, but humble enough to admit when they are wrong. They should be kind enough to mentor younger scientists, but stingy enough with their time to be able to manage it well. In addition, faculty members must have a driving passion toward their research and be willing to devote a Herculean effort over many years. Despite these stringent requirements, many can and do succeed in academia. The key, it seems, is making a conscientious effort to develop the necessary skills early on. In this article, people who have achieved high levels of success in academia provide specific, practical advice to others who would follow in their path.

Passion—Fuel That Fans Flames of Success

One resounding theme from successful faculty members is that one has to have passion. This is something that cannot be feigned, learned, or coerced—it either exists or it does not. "There has to be an inherent interest, whether it is derived from a crystallizing experience such as a parent dying of cancer, or from a value system that has developed within a person," says Mary Delong, director, Office of Postdoctoral Education at Emory University, which oversees career development for nearly 500 postdoctoral fellows. In addition to cultivating a passion for one's work, Delong also mentions that during the postdoc years, developing a track record of performance through

Managing a lab is really managing a small business and these are skills that, for the most part, are not taught in graduate school or during a postdoctoral position.

publishing papers and fully researching opportunities in the field are probably the most important steps. “But passion is what will carry a postdoc through the challenges,” she says.

Joseph Coyle, with Harvard Medical School, who has studied schizophrenia and other neurological disorders for more than 40 years, was drawn into his career path early on. “I'd say for most of my life I never saw myself as going to work, I saw myself as going to do something I totally enjoy,” he says. “If it's drudgery, you ought not do it. But if research isn't your passion, then a Ph.D. can afford many different opportunities, such as patent law and science writing. You don't have to feel trapped.”

Standing upon the Shoulders of Giants

A large proportion of Ph.D.s in the sciences go on to seek a postdoc position—about 77 percent of Ph.D.s in the biological sciences and 61 percent in the physical sciences, according to a 2006 National Science Foundation report. One of the first steps in graduate school and beyond is to seek out mentors who will provide guidance but who will also foster independence, says Nancy Schwartz, who conducts research on proteoglycan synthesis at the University of Chicago. Schwartz states that, for better or worse, she was forced into thinking independently early on during her career because of the intermittent absences of her thesis and postdoctoral advisers. She doesn't recommend that as a situation to seek out, “but really, it is each individual's responsibility to garner what they think they need from many other colleagues and mentors, throughout their career.”

Story Landis, director of the US National Institute of Neurological Disorders and Stroke (NINDS), who was in academic research for many years, also recommends being assertive about seeking out opportunities for oneself. “Early on in my career, senior people often gave me the opportunity to write reviews or to speak at meetings, and this really helped develop my skills.”

However, both Schwartz and Landis point out that one has to be careful about taking on too many administrative duties that would interfere with lab and teaching duties—this, they say, is especially important for women and minorities to remember, since they are frequently unrepresented on panels and often asked to participate in this way.

William Mobley at Stanford University suggests avoiding administrative responsibilities when possible, “except those you think would be fun to do and that would directly benefit your career and your science, such as participating in grant reviews—there will be more time to focus on these types of responsibilities later on,” he says.

No Man (or Woman) Is an Island

Another key component of a successful academic career is the ability to establish collaborations with other researchers and learning to depend on the help of others. This, of course, can be especially challenging for young scientists who, in the crucible that is graduate school, slowly come to achieve academic independence. Mobley, however, advises postdocs and junior faculty to seek out collaborations. “Science is too dangerous to do alone—too daunting, too lonely, and too huge,” he says.

“As you transition from being a postdoc to having your own lab, you start to rely on other people and their efforts more and more,” notes Richard Bucala, a researcher in rheumatology at Yale. “One should never be afraid about hiring or collaborating with somebody who is smarter. I think that’s the only way that one can really advance and grow.”

Dennis Liotta, whose lab at Emory identified the HIV drug emtricitabine, advises postdocs and junior faculty to find some colleagues that they respect, and make it their business to develop a genuine and collegial relationship with them. “These relationships should also extend out of the university and into other labs and institutions to provide a fresh perspective,” he says.

Winning at the Lab Business

An important transition period is moving from being a postdoc to starting one’s own lab, which presents a set of novel challenges. Mobley suggests that people signing up for an assistant professorship seek a position where the salary and necessary startup equipment costs are covered for at least a full three years. “If they can’t offer you that, then they don’t want you enough, and that’s not the place to go,” he notes.

Regarding salary, according to a 2006-07 survey by the American Association of University Professors, salaries for full-time faculty averaged $73,207. By rank, the average was $98,974 for professors, $69,911 for associate professors, $58,662 for assistant professors, $42,609 for instructors, and $48,289 for lecturers, although these figures are not specific for the sciences.

Managing a lab is really managing a small business and these are skills that, for the most part, are not taught in graduate school or during a postdoctoral position, Schwartz says. “You’re managing people and budgets, and you’re seeking funding, and then you’re responsible for how those funds are spent.” She recommends taking at least a few days to learn about budgeting, and mapping out a projected budget of what everything is going to cost. “Some of our junior faculty are totally astounded when they see how fast grant or startup money goes because they have not really considered the costs,” she says.

When it comes to managing people, lab tech and postdoc underlings are going to look to the leader of the lab, i.e., the new junior faculty member, to set the standard for that lab. “Whatever time in the lab that you set for yourself, that will tend to be the standard,” says Liotta. “So, if you want people to work evenings and weekends, then you will have to show up then also. Good students will often show up regardless, but that extra motivation of having their boss there is helpful.”

It’s also important to seek out the kind of staff, such as students and postdocs, that will meet expectations, Schwartz advises. “You have to be explicit about your expectations; if you plan on working 15 hours a day in the beginning, then you want a lab staff that will be willing to match that lifestyle.” You also have to learn to let go and let people make mistakes, “otherwise, you’re

not going to allow people to become independent thinkers and doers. They're going to develop more of a 'technician' mentality."

Creative Funding Strategies

A primary stressor that affects even seasoned faculty is funding. Coyle points out that when NIH funding is more difficult to obtain, as it is now, the most creative science, or science from younger faculty, may sometimes be passed over in favor of the less risky, or the tried and true.

However, Landis notes that the NIH has committed to fund as many first time R01 applicants in 2007 and again in 2008 as the average of the past five years. "NINDS funded R01s to the 25th percentile while experienced investigators were guaranteed funding if they got a 9th percentile, and overall we funded 15 percent of research project grants," she noted.

Coyle suggests seeking out alternate funding sources such as various foundations or nonprofits. "There is a lot more foundation money out there than there was when I started out," he says. "I think even basic science, even someone who's going to be doing basic biological research should think about the potential clinical applications and should look for opportunities to get support from relevant foundations that are interested in the clinical aspects of the research."

Bucala also advises young faculty to think outside the box when it comes to defining their research. "One has to be opportunistic. If one is really, for instance, captivated by the biochemistry of protein kinases, you don't necessarily have to work on kinases in oncogenesis. You can work on them as they relate to learning and memory or host defense mechanisms. You can't let yourself be constrained necessarily by a particular application," he says.

However, Liotta advises staying away from a "brute force approach" to getting funded. "The most important aspect for getting funding is putting together a well-thought-out proposal," he says. Liotta also suggests waiting to get results that are sufficiently compelling and provocative, and are likely to get the attention of the study section. "If they see a mediocre proposal from you several times, then they're going to associate you with mediocre science."

Teaching the Teacher

Teaching represents yet another obligation of a junior faculty member, and that teaching has to be balanced with research, lab management, and administrative duties. According to Mobley, it's important to understand from others what the best teaching styles are. "Try to convey your information as clearly and as simply as possible but engage your students—get students to help themselves learn, and give them opportunities to speak to you."

"Teaching and research are intimately intertwined," says Liotta. "If you're a good researcher and you don't know how to communicate those results, you're not going to be very effective." Liotta recommends using a camcorder to tape a few teaching sessions to identify and try to eliminate any idiosyncrasies. "Many people have habits that they don't realize and they're probably relatively easy to correct." He also points out that good notes and preparation can go a long way in producing a well-organized lecture in the beginning.

Playing Politics

The word "politics" carries many meanings, but in science, if politics means forming collaborations and generally getting along with people, then it plays a valuable role in advancing a career. But such politics cannot substitute for good science. "I certainly know some people who just spend their whole day on the telephone talking to everybody and finding out what everybody else is doing," Schwartz says. "It's far better to focus on doing, not just talking, science."

"In academic circles, good science, not politics, always wins," says Mobley. "Playing politics is potentially damaging. Focus on your scientific teaching, avoid politics in any way—only people who can't do science play that game," he adds.

Coyle agrees. "I've not been impressed that playing politics is the way to get ahead. I am impressed that if you really focus on your science, especially in the beginning of your career, and be very defensive about preserving your time to do your science, then that's probably the most important way of getting ahead academically," he says.

Tenure Track

According to the Howard Hughes Medical Institute, a tenure-track position is one that leads to a permanent professorial appointment and potentially full salary support if grant funding runs out. A faculty member can be fired only for limited reasons, such as gross misconduct. In general, a tenure-track faculty member will hold a position for about five years before a formal decision is made on whether tenure will be granted.

In 2003, among science and engineering doctoral degree holders who received their degrees within the past four to six years, approximately 20 percent were in tenure-track or tenured positions at four-year institutions of higher education, according to a National Science Foundation report. The percentage rates for individuals in various degree fields are as follows: Engineering 16.3; Life Sciences 18.0; Physical Sciences 16.7; Social Sciences 30.8.

Love of Learning

While there may seem to be an overwhelming array of skills to master for tenure-track doctors of philosophy, "philosophy" does in fact mean "love of wisdom." And if there's one single, defining characteristic among academ-

ics, it may be just that. Schwartz, therefore, advises approaching the mastery of these tasks as a lifelong learner, which makes it all more palatable.

"If you think about the job of a university faculty member, we're in a unique position," says Liotta. "We can do whatever kind of research we want to do and have the opportunity to work with bright young people year after year. We can go out and talk about our work with colleagues at meetings; we tend to have fairly flexible schedules so we can do a lot of interesting things, and you know—that's a fantastic job."

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4. Crafting an Industry Career

Tooling Up: Three Categories of Rules

From: dx.doi.org/10.1126/science.caredit.a0700184

By David G. Jensen— First published December 21, 2007

Many of my columns here describe difficulties people experience when they discover how different life is in industry than in academia. Each sector has its own rulebook; new graduates often feel they've been thrown into the fire when they make the change to a company employer. The conventions at work in industry aren't taught in college.

Michael Zigmond of the Department of Neuroscience at the University of Pittsburgh in Pennsylvania runs the highly regarded "Survival Skills and Ethics Program" seminars held each year in Aspen, Colorado. He told me recently that he believes there are three categories of rules that we come across in our work lives. The rules themselves may differ, but Zigmond's categories hold true no matter where you work.

"First off, there are rules that are true and which deserve that distinction. In academia, one example of this category would be the rule that 'Research equals experiments plus publications,'" Zigmond explained to his class in Aspen. "Another type of rule is one which is true, but which shouldn't be. Some examples are 'Always have preliminary data for proposals,' or 'Always do hypothesis-driven research.' Lastly, some rules are *not* true but *should* be. 'Good teaching is essential to promotion' is an example that I point to from

Those who learn networking early and practice it often are among the successful people in science. Years from now, you'll have new opportunities to thank the contacts you make today, assuming, of course, that you make those contacts.

the world of academia, where countless students have wondered how some people have moved up the ranks."

Sometimes a rule from the university clashes with a rule from industry. Consider Michael's first example: *Research = Experiments + Publications.* Would you land a job at a top-tier biotech company if you went to an interview espousing that as a guiding rule for your career? No way!

In industry it looks like this: *Research = Experiments + Products.*

The single most important evidence of productive research in industry is the development of research applications that can return value on shareholders' investments. Most of the time this means products. Although at some point in a well-run research organization you will be able to publish your work, it only ever happens after the company has protected its intellectual property.

Sometimes in this column I point out how a rule *really* works or make you aware of a rule that you may not have known about. That's my job here. Sometimes I try to help you learn to work within the rules. And sometimes my columns tell you how to work around the rules.

This time I provide some examples of rules from the biotechnology industry indexed into Dr. Zigmond's three categories. Studying rules from the three categories will help you come away with a better understanding of how company policy and politics impact life in a company and why, on occasion, it is better to circumvent rules than to follow them.

Rules That Are True and Which Should Be

Good communication skills are essential for success in any job. Read the job ads and you'll notice that good communication skills are mentioned in more than half. Insiders know this is more than standard HR-speak. Employers can't help but be impressed with good communicators, because anyone who runs a job ad knows these people are few and far between. If someone asked me what the No. 1 skill is that impacts hiring decisions, it would be this one. And communication skills are critical for moving up the ladder once you have that position.

Networking is a great way to find a job. Ads, job fairs, the Internet, headhunters, networking—don't miss any of these when you go looking for a new position. But stay particularly close to your networking contacts. Networking is a life skill and not just a job-search tool. Like communication skills, networking can help you get a job—and then help you perform well once you've got it. Those who learn it early and practice it often are among the successful people in science. Years from now, you'll have new opportunities to thank the contacts you make today, assuming, of course, that you make those contacts.

Industry success requires teamwork and interdependence. Independence rules in academia. Collaboration and teamwork get a lot of lip service, even in academia. And in fact, even there some value it and do it well. Yet a lab of your own, trainees assisting you, your own grants—all these aspects of independence are essential to success at a university. But that's not what industry employers want or need. The biologists and chemists who discover a new drug work closely with the engineers who scale it up and turn it into a product. Both those groups rely on teams of regulatory and clinical professionals to help take the next steps. "Teamwork" is more than a buzzword in industry; it's a way of life.

Rules That Are True But Should Not Be

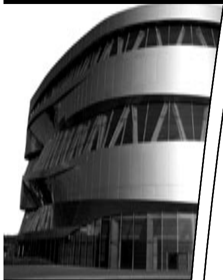
It takes a 60-hour work week to be a success in science. Is there *any* job in the biotech industry where successful people work a normal 40-hour week? I don't think so. "Normal" was replaced long ago by early-morning meetings, evening work, and Saturdays in the office or lab. Success in either track—academic or industry—starts at 50 hours a week and may average 60 to 65. Wouldn't it be nice for your family and outside interests if this rule were not true? A recent work-life balance feature in *Science* Careers featured an article on part-time scientists and another on corporate work/life policies that include part-time work. So this rule may not be universally true, but it almost is.

It's really hard to find a job once you are over age 45. Let's hope all your job searches occur while you're still young. Once you're past about 45, searching for a job becomes very difficult, assuming you're approaching it via the usual anonymous application. Although it rarely rises to the level of overt age discrimination, employers often note your years of experience and use words like "overqualified" to describe you. It's wise to have a large bank of networking contacts, an established reputation, and a head of steam when you face a sudden, unexpected, late-career job search.

You generally have to relocate to the coasts in order to find a biotech job. It would be great if there were biotechnology clusters equivalent to San Diego, San Francisco, or Boston in all regions. But despite the many states where policy makers promote biotechnology as a future economic development engine, there probably never will be more than 10 or 12 major biotechnology clusters in the United States. Very likely, in the future as in the present, the great majority of good biopharma jobs will be in biotech centers at the coasts. It's a tough reality for a person wanting to stay in the Midwest. Of course it's always possible that other biotech centers could develop, such as agritech in the Midwest, or nanobio in Texas.

Rules That Are Not True But Should Be

Promotion rewards strong leadership skills. Strong leadership skills are the first thing you'd think of when someone moves up the ladder into a management job. Unfortunately, it doesn't always work that way. Sometimes the person the most skilled in company politics gets promoted instead of the



Strong leadership skills are the first thing you'd think of when someone moves up the ladder into a management job. Unfortunately, it doesn't always work that way.

one with the best leadership skills. Then, there's that excellent communicator who just talks his or her way into the job, despite their lack of leadership ability.

Good science always sells itself. Many scientists were taught in academia not to worry about a job—to focus instead on doing good science. Unfortunately, for a lot of people this approach doesn't work. In industry, you have to be able to communicate your strengths, which can be really difficult. You need to stand up for who you are and what you are good at—a type of ethical self-promotion that is very difficult for many scientists to get their arms around. Moving past the ethical point—to self-promotion not grounded in ability—looks like playing politics. That kind of self-promotion is risky.

Bright scientists have excellent people skills. People skills and scientific skills don't necessarily go hand in hand. There's a lack of interpersonal-skills training and evaluation in academia, which leaves many technical people believing that decisions about their future will be based upon their scientific credentials and not those "soft skills" I talk so much about in Tooling Up. Of course, it's possible for really brilliant scientists to succeed without social skills—we've all known first-rate academic scientists who succeeded via sheer brilliance, never mind the fact that no one could stand working with them. But unless you're really cocky about your science—or totally lacking in social potential—your chances of success will be better if you bathe, communicate, and treat your colleagues with respect.

Different Rulebooks for Different Environments

At a recent AAAS seminar in San Francisco, our invited panel included two of our *Science* Careers Discussion Forum advisers and two senior executives from the local biotech industry. The goal that night was to discuss the lessons our speakers had learned along the way, what mistakes they had made, and to pass their wisdom along to the younger folks in the audience.

The common thread in all the speakers' remarks was that the "rulebook" is different in industry. All these professionals had succeeded, but for every one there was a time in their careers when they were poised between jumping over the wall between academia and industry and falling through the cracks. Only by learning all three types of rules—and how they differ from one job sector to the other—did they navigate the move from an academic lab to an industry job.

Transferable Skills and Portable Careers

From: dx.doi.org/10.1126/science.opms.r0700030

By Christie Aschwanden— First published April 20, 2007

Success in today's job market requires more than just solid lab skills and a stack of publications. Whether seeking tenure-track academic jobs, industry research positions, or nontraditional science careers, many job seekers are finding that a well-honed pipette thumb is not enough to land them an offer. "I don't know anyone who's gotten a job who spent their postdoc at the bench the whole time," says Crystal Icenhour, who was recently hired as vice president and director of research at IDX Labs, a startup in Charlottesville, Virginia.

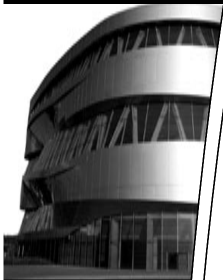
Postdocs must develop skills beyond the laboratory if they're to be competitive in the tightening job market, says Icenhour. Where nonacademic jobs once required skills that did not carry over to academia, that's not necessarily the case these days, says Gregory Kopf, who spent more than two decades at the University of Pennsylvania before moving to Wyeth Research. He has since returned to Penn as an adjunct professor. "When I first started in academia, the training skill sets were very different for industry and academia, but the lines are starting to become a lot more blurred," says Kopf. "Leadership, project management skills, the ability to develop goals and manage budgets and your lab—these are skills that are just as important for academia as for industry."

The ability to work well in a team is the No. 1 skill that industry employers look for, says Neil Stahl, senior vice president of research and development sciences at Regeneron Pharmaceuticals in Tarrytown, New York. "You have to be able to sort through issues and communicate effectively in a nonthreatening way."

Academic scientists also need team skills so they can work effectively on committees and form successful collaborations. Running a lab or working on a research team both demand strong interpersonal skills and diplomacy. "You have to be able to say the right things without antagonizing your colleagues, and that's a skill that many postdocs don't have," says Chee-Keng Ng, a principal research scientist at Wyeth Biopharma in Andover, Massachusetts. "We need people who can fit into the teamwork culture."

Whether the goal is to secure NIH funding or to sell the corporation on a novel idea, success hinges on the ability to communicate. "How you package and present your data matters, especially in a large company," says Ng. "You need to be able to communicate well, especially to people who aren't as expert as you. You have to be able to explain the science to the managing director on the project," says Stahl.

Project management is another skill in high demand. "In academia, you have to manage your research so you're competitive for the next funding round. In industry, you have very tight timelines, and you have to manage your project so you can meet those deadlines," says Kopf. Meeting project goals requires effective management of people and time, yet many postdocs don't recognize the importance of honing management skills until they start



sending out their resumes, says Philip Clifford, associate dean for postdoctoral education at the Medical College of Wisconsin in Milwaukee.

"When you get to a postdoc, there are virtually no rules," Clifford says. Many postdocs lock themselves in the lab and hope that their toil will pay off in publications that lead to the job they want. "People feel that they need to do project after project and publish, publish, publish," Clifford says, but he suggested that they need to develop skills beyond the bench too, even if it means getting out of the lab.

Charting a Path

From the start, postdocs should identify the skills they need to make themselves marketable in their chosen career path so they can maximize their training, and the sooner the better, says Clifford. "We propose that people go through a self-assessment process to identify their own values, skills, and interests and then look at the potential universe of jobs that fit those," he says. ScienceCareers.org website offered by AAAS (American Association for the Advancement of Science) and books like Cynthia Robbins-Roth's *Alternative Careers in Science: Leaving the Ivory Tower* are good places to start. "Do some informational interviews with people in the career path you're interested in and find out what skills they use, then figure out what you need to do to get them," says Clifford. Some institutions employ career counselors that specialize in science. For instance, the Medical College of Wisconsin has hired a career adviser specifically to work with postdoctoral fellows and medical students.

Robert Tillman, postdoctoral program coordinator at New York University School of Medicine, advises budding scientists to create an individual development plan (IDP), through a process like the one developed by the FASEB Training and Careers Committee. Creating an IDP involves a four-step process to identify a well-suited career path and formulate a plan to achieve it. Tillman's institute has adopted IDPs as part of its postdoctoral handbook. "It's a way to focus my strengths and weaknesses in relation to my goals," Tillman says. "If I'm a postdoc and in four years I want to become faculty, what do I need to do to achieve that? How do I get there?" An IDP provides the roadmap for getting from a postdoc to a dream job.

Some postdocs expect that they will try for a tenure track research position and, if that doesn't work out, then they'll think about a plan B. But this type of approach sets postdocs up for failure, says Clifford. "Keeping your options open is exactly the wrong approach. You're not really doing the things that will direct you toward a specific career." There simply aren't enough tenure-track positions to go around, so postdocs should have an alternate plan in place from the start, Clifford says.

Many postdocs tell themselves that if they don't land a job at a top research institution, then they'll just apply for a teaching position. But that's a mistake, too, says Clifford, because teaching-oriented universities want people with proven teaching skills. "If your goal is to work at a teaching institution, you need to figure out how to get that experience," he says. Regardless of what career path you hope to follow, "you need to identify the skill sets that are necessary for that career option, and figure out how you're going to get those," says Clifford. Someone seeking a job in biotech, for instance, might consider a business course or even an M.B.A., he concludes.

Managing to Learn

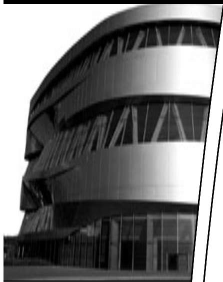
Bench skills are just one component of a successful science career, yet they've long been the focus of graduate and postdoctoral training programs. "Whether you run your own academic lab or take a position at a company, learning how to manage people, projects, and budgets are necessary skills, but traditional graduate and postdoctoral training do not offer formalized courses in these topics," says Garth Fowler, outreach program manager for ScienceCareers.org. But that's changing as AAAS, ScienceCareers.org, and other organizations step in to fill the void with courses and workshops devoted to these topics.

In 2002 and 2005, the Burroughs Wellcome Fund and the Howard Hughes Medical Institute partnered on a course to teach laboratory management skills to postdocs and beginning faculty members. Though the course's focus stood squarely on the needs of the academic scientist, many of the skills taught, such as time management, project management, collaborations, and mentoring, carry over to nonacademic jobs as well. Organizers have turned the course into a book, *Making The Right Moves: A Practical Guide To Scientific Management For Postdocs And New Faculty* available for free from the HHMI website (www.hhmi.org/resources/labmanagement).

In 2005 organizers of the BWF/HHMI program put on a "train the trainers" course in an effort to encourage similar programs at institutions across the country. "They wanted to spread the wealth," says Lisa Kozlowski, assistant dean for postdoctoral affairs and recruitment at Thomas Jefferson University in Philadelphia. Kozlowski attended the course and then, with support from AAAS and ScienceCareers.org, collaborated with three other Philadelphia-area institutions to develop a lab management course for postdocs from all four institutions.

A total of 55 postdocs enrolled in the Philadelphia Scientific Management Course, which is ongoing and split into four sessions spread over five months (www.tju.edu/JCGS/postdoc). Topics include leadership skills, time management, project management, funding, mentoring, and landing a faculty position. Vera Hintz, a postdoc in TJU's department of dermatology, is attending the course and says it prodded her to look for opportunities to gain skills that will enhance her resume. When she looked at job ads, she saw that many wanted experience planning meetings, so she volunteered to help plan the TJU's postdoctoral research symposiums. Hintz says the course has taught her to view her career as a project that she needs to manage, rather than just something that simply unfolds on its own.

Laboratory management courses like TJU's are becoming more common. Last November, the New York University School of Medicine, also with support from AAAS and ScienceCareers.org , put on a two-day workshop,



Management Skills for Scientists, open to 25 people. "We wanted it small so it would be interactive," says Tillman of NYU. Postdoc Marie-Hélène Delmotte attended the course and says it helped her recognize that her lab skills alone might not be enough to land her the position she wants. "My resume is good but I realized that I need more to find a job. I need to know myself and know how to sell myself." Delmotte says the program helped her understand the importance of developing short-term and long-term goals for her career. Instead of focusing solely on her research, she is putting energy into mentoring, an effort that will pay off in a skill she can add to her resume.

The management course is just one way Tillman's institute is promoting career development. The school's office of learning and development offers courses on topics ranging from how to give an effective presentation to managing conflict and running meetings. Tillman says that NYU also helps about a half dozen of its postdocs enroll in a 16-week Fundamentals of the Biotech Industry course at the Center for Biotechnology, a state-funded center created to support the region's growing biotech industry.

Acting the Part

Of all the laboratory management courses that have sprung up, perhaps the most innovative is the Laboratory Management Institute at the University of California, Davis. The institute holds a three-week intensive program divided into five courses: leadership, management, best practices, mentoring, and innovation. Participants come from a wide range of disciplines and receive a certificate and 14 credit hours through the UC-Davis extension.

The program's hallmark, Lab Act, employs professional actors to play out the concepts explored in the course. Instructors discuss strategies for handling management issues, then actors play out scenarios that workshop attendees anonymously submit. Participants discuss what happened and work on new solutions that the actors then try out. "We're all about practicing," says LMI director John Galland. "We use Lab Act to allow students to try out different solutions without putting anyone on the spot."

In addition to the summer program, LMI offers a year-long program for postdocs. "I'm impressed at how effective it has been to watch the actors role play," says participant Tamara Holst, a postdoc at the Public Intellectual Property Resource for Agriculture. "It's almost uncanny how well the scenarios translate across different labs, and the way to defuse a situation is usually similar across the board."

Taking the Initiative

Formal programs like LMI's are not yet the norm, but even without them, motivated postdocs can find ways to develop useful and necessary additional job skills. Icenhour of IDX Labs made her resume stand out from the rest by getting involved in the postdoctoral associations at the Mayo Clinic in Rochester, Minnesota, and at Duke University where she did a second postdoc. She also joined the board of National Postdoctoral Association and credits this experience with teaching her the skills she needed to land her current job as vice president and director of research.

"My NPA experience really emboldened me," says Icenhour. "As a board member of NPA you're reviewing the employee handbook, revising budgets, and running committee meetings. The experience introduced me to a lot of the things I do in my daily work life now." Not every postdoc has the luxury of enrolling in an institute-sponsored program like LMI, but as Icenhour's experience illustrates, motivated postdocs can create their own opportunities to learn skills beyond the bench if only they would step out of the lab.

Opportunities: More School?

From: dx.doi.org/10.1126/science.caredit.a0700068

By Peter Fiske—First published May 11, 2007

In this column, and in every career workshop I lead, I emphasize how Ph.D. training can prepare you to be an adaptable problem solver, capable of taking on a wide range of demanding assignments with little assistance. Developing your own research, tackling a range of technical challenges, figuring things out on your own, and pulling it all together into an original piece of scholarly research is, I argue, very similar to the real-world challenges entrepreneurs and other business leaders face when they build companies. Like the Ph.D., building a business is about doing, not learning. So, in some respects, a science Ph.D. is excellent training for people interested in starting—or leading—a business.

Yet, there's no doubt that entrepreneurship and business management require skills—accounting, law, finance, and a million other topics—that no Ph.D. program I know about teaches routinely. So, if you think you might like to start your own company, or take on a high-level role at an existing early-stage company, you're bound to consider adding an M.B.A. to your degree collection. A Ph.D. is great on fundamentals—it teaches you how to make something completely on your own—but it falls short on the practical stuff every entrepreneur has to master. Those practical skills are the specialty of the M.B.A.

So should you get one? And if you decide to get one, how can you do it as cheaply and conveniently as possible? These are the subjects of this month's "Opportunities."

M.B.A. Versus Ph.D.

Each degree has its merits for entrepreneurship, and each gives you skills and experience totally missing from the other.

Most full-time M.B.A. programs take two years, and part-time programs usually take three years or more. Most of the work is coursework, with an emphasis on practical skills and "case studies": select vignettes used to illustrate specific issues in business. Full-time M.B.A. training usually involves

The principal downside of the M.B.A., of course, is that it takes two more years of expensive school—and it's not only the tuition and fees that make it expensive.

some practical work experience—a paid internship, you might say, usually between the first and second years—which gives you some extra experience and helps pay some bills.

The Ph.D., as most of you know, is very different. Unlike any other professional degree, the Ph.D. is about *doing* rather than just *learning*. Some argue that a Ph.D. isn't a professional degree at all—not a preparation for professional practice—but, rather, an opportunity to acquire knowledge for its own sake. I think this is disingenuous and one of the problems with the Ph.D. degree—but let's save that for another column. Although there is a lot of coursework at the beginning of many Ph.D. programs, the textbooks tend to disappear after two years, if not sooner. After that, you drill into a single subject and work for years to produce an original piece of scholarship largely by yourself. I have described this as being marched to the edge of human knowledge and being told to take the next step on your own.

To M.B.A. or Not to M.B.A. ...

If you are getting or already have a Ph.D. and you think you would like to steer your career away from the bench and toward business—especially entrepreneurship—you have two choices: Go back to school for the M.B.A., or make the transition to a startup directly. There are advantages to both approaches.

One of the principal advantages of an M.B.A. is that the job opportunities at early-stage companies are excellent for M.B.A. grads. Not only will you have all the knowledge and experience of a Ph.D.; you'll also have the practical knowledge an M.B.A. provides. Add to this the fabulous network you'll acquire in business school—faculty members, fellow students, alumni—and the M.B.A. can be a compelling path. Many of the people you'll be learning from, and alongside, have direct experience in the technology startup arena, so you'll have a lot of experience to tap into.

The principal downside of the M.B.A., of course, is that it takes two more years of expensive school—and it's not only the tuition and fees that make it expensive. The opportunity cost of those two years—the salary and experience you forgo to attend more school—are even higher than the tuition. It's a good thing these masters of business earn a lot right out of school: There would be no way to pay the cost otherwise!

Depending on your ambitions, an M.B.A. may be completely unnecessary. In some industries, such as biotech, the path to a leading business role is well established for Ph.D. scientists, even those without M.B.A.s. Because the work in biotech involves a high technical component—and because many biotech companies are started by Ph.D. scientists—you'll find Ph.D.s throughout management. Software engineering startups may also recruit Ph.D.s without any business exposure. And it might be possible to join an early-stage startup as a technical expert; if you can manage, you will have plenty of opportunity to grow into a business role.

When to get an M.B.A. is as important a question as whether to do so. Going straight from a Ph.D. to an M.B.A. is not advisable. For starters, you'll be more attractive to prospective M.B.A. programs if you have a few years of work under your belt. Second, getting multiple degrees without accumulating real-world work experience might turn off certain—although certainly not all—hiring managers. So if it's possible, work for a couple of years before going back to your M.B.A. Your training might end up being cheaper this way. Best of all, if you go to work first, you may find you don't need an M.B.A. after all to do what you want.

Having Your Job and Eating It Too

It is possible to maintain a professional career *and* get an M.B.A. by enrolling in a part-time program that meets evenings, weekends, or both. Part-time programs often are populated by people like you: older, often technical, steering their careers in new directions. I got my M.B.A. at the University of California, Berkeley, in the evening program, where two-thirds of my classmates were engineers who worked full-time. There are *lots* of part-time M.B.A. programs, including a number that teach entirely online. Just like full-time programs, the reputations of part-time programs vary widely. If you are interested in working at a startup or an early-stage company, look for M.B.A. programs that have a strong entrepreneurship focus. Not only will the curriculum be better suited for your ambitions, but the network and alumni contacts will be more fruitful as well.

If you are already employed, ask whether your employer will pay for some of your M.B.A. training. Many, especially larger, employers have programs to subsidize the cost of higher education for their employees. In my evening M.B.A. program, two-thirds of my classmates had some of their tuition paid by their employers. Nearly 20 percent had all their tuition paid for.

Here are some factors that might favor a decision to go back for an M.B.A. to support your entrepreneurial urges.

- You want to make a career transition soon.
- You want to obtain a breadth of skill that would support an entrepreneurial career.
- You have one or more excellent, and appropriate, part-time or full-time M.B.A. programs in your region—assuming you have geographical constraints.
- Your employer may subsidize your M.B.A. education.

Here are some factors that might steer you away from an M.B.A.

- You're not in a hurry.
- You're in a field in which technical people often move into management and business roles without additional training.
- There are no good entrepreneurship programs at any of the business schools that are, realistically, available to you.

- The opportunity cost of stepping out of your career path would be too high—although you can still consider a part-time M.B.A. in this case.

Whether an M.B.A. is right for you is, of course, a function of where you want to go professionally. Neither degree is a hedging strategy for professional indecision! As with the Ph.D., the best way to ensure that your investment in an M.B.A. pays off is to know what you want out of it. That requires some vision for yourself and your professional future. That's something you need to sort out *before* applying.

Additional Articles Online

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5. Nontraditional Careers

A Matter of Policy

From: dx.doi.org/10.1126/science.caredit.a0800057

By Brian Vastag— First published April 18, 2008

In early 2005, Joseph Helble, a chemical engineer, entered the legislative fast lane. A few weeks earlier, the most powerful tsunami in decades had swept across Southeast Asia. Senator Joseph Lieberman (ID-CT) wanted to know why that region lacked a tsunami warning system. So the senator turned to Helble, who was serving in Lieberman's office as a Roger Revelle Global Stewardship Fellow. Each year, that fellowship sends one mid-career scientist or engineer to a government office or nonprofit organization to work on global environmental policy.

"I walked out of [Lieberman's] office figuring, OK, now I need to figure out how to do this," Helble says. The next few weeks were "incredibly hectic." Helble quickly studied tsunami warning systems. He spoke with "everyone and anyone" who worked on tsunami warning technology and consolidated his findings into a memo and presented it to Lieberman, who decided on the spot to sponsor a bill that would fund a $30 million system. Soon after, Helble found himself answering questions at a press conference called by Lieberman to announce the legislation.

"It's not the sort of thing you're prepared to do in academic work," Helble says, "but it was very illuminating how quickly things can get done when [a legislator] is committed to it."

Each year, several hundred scientists and engineers flood Capitol Hill and executive branch agencies in Washington, D.C., to get a taste of policy work. From 10-week get-your-feet-wet programs for graduate students to multiyear stints for tenured faculty members, scientists and engineers enjoy plenty of opportunities to explore science policy as a career path or as a means to broaden their knowledge and skills.

After their stints in Washington, D.C., scientists and engineers head in one of three directions, says Cynthia Robinson, director of Science and Technology Policy Fellowships at the American Association for the Advancement of Science (AAAS, the publisher of *Science* and *Science* Careers) in Washington, D.C.: They go back to academia, they stay in the policy world, or they decide to do something completely different.

Helble decided to return to academic life, becoming dean of the Thayer School of Engineering at Dartmouth College . As an administrator, he constantly draws on his Washington, D.C., experience. “The skills I learned are directly transferable,” he says.

Policy Jobs for Former Fellows

Almost half of scientists who do the AAAS Science and Technology Policy Fellowships decide to stay in policy. Below are some job titles of former fellows:

- Associate Director, White House Office of Science and Technology Policy
- President, National Center for Policy Research for Women and Families
- Associate Director, Nicholas Institute of Environmental Policy Solutions, Duke University
- Senior Science Adviser, Office of Science Policy and Planning, National Institutes of Health
- Water Resource Specialist in Agriculture and Rural Development for South Asia, World Bank
- Senior Adviser, Regional Conflict, Democracy, and Governance, US Agency for International Development (Kenya)
- Regulatory Analyst, Biotechnology Regulatory Services, US Department of Agriculture, Animal and Plant Health Inspection Service
- Special Policy Adviser to the Executive Director of the World Food Programme, Rome
- Program Officer, Science and Technology, Global Development, Bill & Melinda Gates Foundation
- Global Director, Fleet/Forces Department and Head, International Liaison Office, Office of Naval Research, US Navy

Savvy Scientists

"Our goal is to have more policy-savvy scientists out there in the world," said Robinson. "We believe that's of value whether they stay in government, go back to academia, or go on to the private sector or to a nonprofit organization." Policy fellowships are also "a two-way street," she says, where legislators and government agencies benefit from the fellows' scientific and technical expertise.

Like Helble, about a quarter of all AAAS fellows return to universities or take other nonpolicy jobs. But almost half get "Potomac fever" and decide to stay in the policy world, either as a return fellow or as a full-time employee at their fellowship agency, at a different government office, or at an outside organization.

Saharah Moon Chapotin is one such fellow. She earned a Ph.D. in plant physiology from Harvard University but "kind of knew" she'd never become a professor. She first tried the 10-week Christine Mirzayan Science and Technology Policy Fellowship program offered by the US National Academies. Chapotin enjoyed working in Washington, D.C., so she applied for and won a AAAS policy fellowship, which lasts one year with a second often available. Chapotin is in her second year at USAID, where she enjoys the "big picture" view that working on biotechnology safety issues provides—a view she never had in the lab. Chapotin is hoping to stay at USAID permanently to shepherd the projects she's been working on, such as a technology-exchange program with West African cotton breeders.

While Chapotin is working on policies related to her degree, many fellows find themselves treading unfamiliar ground. Katherine Seley-Radtke, an associate professor of chemistry and biochemistry at the University of Maryland, Baltimore County (UMBC), spent a year at the US State Department as a Jefferson Science Fellow, a program for tenured faculty members. Jefferson fellows typically spend a year full-time at the State Department and then serve as informal advisers for five more years. Seley-Radtke was sent to Moscow as a scientist-diplomat to keep tabs on turmoil in the Russian Academy of Sciences. She soon found herself tasked with briefing top US embassy officials on Russia's new nanotechnology initiative. As an organic chemist, Seley-Radtke wasn't an expert on nanotechnology. "But I certainly am now," she says.

As scientists, the Jefferson fellows "know how to go find the right information," Seley-Radtke says. And then they have to turn around and communicate that information to career diplomats and other nonscientists. As information "goes up the ladder, you certainly don't want the wrong information getting to the people who make policy decisions," she says. "You don't want the secretary saying the wrong thing. So you need to understand the technical details of a particular problem, even if it's not in your area, and then relate key points in a nontechnical way."

Taking It Home

Over and over, former and current fellows emphasized written and oral communication skills as keys to success in the policy world. "The kind of writing you do, the quick memos, it's so different than writing grant proposals and

"The idea of serving as a science diplomat is only now getting on the radar screen of the average engineer and scientist."

papers," said Seley-Radtke, who returned to her lab at UMBC but continues to advise the State Department on bioweapon threats.

Helble added that learning how to negotiate on Capitol Hill with "people with a broad range of dearly held opinions" has served him well as a university administrator. Also, he says, "The time scale in academic life is very different. When an issue comes up [on Capitol Hill], you need to digest it, understand the science and the ramifications of the science, and put it together in a coherent one-page memo—and do that all within an hour." At a university, a similar project might drag on for months.

In her keynote address at the AAAS Annual Meeting in Boston, Massachusetts, in February, Nina Fedoroff, the State Department's top science adviser, emphasized the growing importance of policy-savvy scientists. She highlighted Alex Dehgan, a former AAAS science policy fellow at the State Department who persuaded former Iraqi weapons scientists to help rebuild their country. Dehgan, a behavioral ecologist and conservation biologist, also persuaded journal publishers to offer discount subscriptions to Iraqi scientists.

Fedoroff would like to see more scientists and engineers get involved in international relations. "The idea of serving as a science diplomat is only now getting on the radar screen of the average engineer and scientist," said Fedoroff. "But now is the time for scientists to stop going back to business as usual."

After his time in Washington, Helble, too, would like to see more of his colleagues take a similar path. "Look at all the issues—climate change, stem cell research, general environmental issues, health care, energy—that have a fundamental scientific or engineering basis. And we complain that these decisions are being made in a vacuum without significant scientific or engineering input. Well, the way to fix that is for scientists and engineers to get involved in the policy process."

Working as a Medical Writer

From: dx.doi.org/10.1126/science.caredit.a0700088

By Sarah Webb—First published June 22, 2007

When Kara Nyberg was about halfway through her Ph.D. in molecular and cellular biology at the University of Arizona, she had a revelation. "As much as I love thinking about science," she realized, "I don't actually like doing it." So she set out to find a way to use her science Ph.D. outside research. As she inventoried her skills, she realized that she really enjoyed writing.

As she finished her degree, she made contact with professional organizations like the National Association of Science Writers

(NASW) and the American Medical Writers Association (AMWA). She took a science-writing course at the University of Arizona and attended the Santa Fe Science-Writing Workshop. To gain writing experience, she wrote press releases for the University of Arizona's news office. She defended her Ph.D. in 2003, moved to Boulder, Colorado, and began working as a freelance medical writer.

Writing about Medicine

The term "medical writing" encompasses different kinds of work for clients in media, government, and industry. Pharmaceutical companies, medical-device manufacturers, and clinical research organizations (CROs) all employ writers to prepare regulatory documents used to seek US Food and Drug Administration (FDA) approval for drugs and devices. Medical writers help doctors write research articles, monographs, and reviews on medical topics. Continuing medical education (CME) companies employ medical writers to produce educational materials and slide kits that doctors and nurses use to prepare for license renewals. Medical writers produce sales training materials, press releases for industry, and fact sheets or website materials for government organizations. Medical writers also write about research discoveries for medical journals, websites, newsletters, magazines, newspapers, and any other medium that includes coverage of health and medical issues.

Solid Writing Skills and Clear Understanding

Scientists interested in a medical-writing career should seek projects outside the circles they normally move in. Academic papers and conference proceedings make lousy writing samples because they are dense and jargon-laden, whereas the emphasis in medical writing is on clarity. Employers (and potential clients of freelancers) seek writers who can translate medical studies into accurate but approachable language and tailor the information to audiences that include regulators, health professionals, investors, or the general public—but usually not all at once. Medical writers need solid writing skills, attention to factual detail and accuracy, and the ability to see relationships between ideas and to organize complex information.

"You need to get your writing to where you're confident in your abilities," says Emma Hitt, an Atlanta-based freelance medical writer. For some people, this might mean taking a degree in journalism or technical writing, but a "couple of writing courses can show people that you're serious about writing," she says. "And you can learn a lot on the job." AMWA provides several certificate programs that educate medical writers about the fundamentals of editing and writing, freelance writing, and writing for specific markets.

Two Ways In

Because she wanted to be near her future husband, Nyberg launched her career from Colorado. She spent the first few post-Ph.D. months networking and applying for jobs. "It was initially extremely difficult getting that first job because I didn't really have clips, and I didn't have any contacts," she says. "But once I had some samples that I could show people, things gradually started to snowball from there."

Now a medical writer in Longmont, Colorado, Maggie Merchant was applying her Ph.D. in biochemistry and molecular and cellular biology at a small

biotech when the company decided to build up its marketing department. She wrote the company's customer newsletter and compiled the first consumer manual for its product, exercising her editing and writing skills to explain the technology and the product's use. That experience allowed her to cross over to a full-time writing career.

Working on a Team

Deanna Heier, a managing director for Clinical Care Options, a CME company based in Reston, Virginia, went straight into freelancing after receiving her Ph.D in biochemistry from Emory University in Atlanta, Georgia. After a year and a half of freelancing, she joined one of her client companies, working with doctors and writers to develop a package of medical education materials. "I enjoy the fact that it's a team effort," Heier says. "I felt like that was missing for me in my freelance career."

Heier now works in management, hiring writers and editors and managing projects, staff, and workflow. "Critical-thinking skills, project-management skills, independence, and the ability to clearly communicate complex topics are key assets for succeeding in this type of position as well as in research," she says. And all those skills are nurtured, if not always systematically and intentionally, by graduate science training. Companies often look for writers with an expertise in a particular medical area. So although an advanced degree in a relevant field isn't required for work as a medical writer, it's a distinct advantage.

Getting Drugs and Devices to Market

Medical writers produce the documents that help companies push a drug or device from clinical trials through FDA approval, including literature summaries, applications to FDA to investigate a new device or drug, and documents intended for review by institutional review boards (IRBs).

The trick, says Andrea Friedman, a writer who works on a contract for Symbion Research International, a CRO in Agoura Hills, California, is "being able to very concisely summarize large bodies of information in as short a way as possible."

The responsibilities of regulatory medical writers vary depending on the structure of the company they work for. As a frequent consultant to small startup companies, Friedman works alongside clinical researchers to develop the research protocols in clinical studies. At a larger company, she says, she would most likely focus more on the writing end of things, using information provided by clinical researchers.

All medical writers have to know something about medical science and be able to write. In addition, regulatory writers in clinical settings need to understand the regulatory process and its required documentation. Friedman recommends learning about good clinical practice, which encompasses the scientific and ethical standards that researchers and companies follow in any study involving human subjects. These skills can be gained on the job, but formal training programs are also available. "There are certification programs in regulatory affairs and certification programs in clinical research," Friedman says. Some master's degree programs have a regulatory component, and medical organizations, such as the Drug Information Association, offer medical-writing sessions at meetings. One of the certificate programs offered by AMWA covers writing specifically for pharmaceutical companies.

Good Salaries and Flexible Opportunities

Some medical writers have journalism degrees, whereas others have M.D.s and Ph.D.s. in science fields. Thirty percent of the respondents in AMWA's 2004 salary survey had advanced degrees, up from 21 percent in 1989.

> About a third of all medical writers freelance, the rest work on staff for pharmaceutical companies, medical communications companies, and other organizations.

Medical writers get paid more than many other writers because their skills are more specialized and much of the work is supported by the pharmaceutical industry. The average annual salary for medical writers exceeded $74,000 per year in 2004, according to the survey. Medical writers with advanced degrees averaged between $83,000 (for women) and $94,000 (for men).

"I would say that there's definitely enough work to go around," says Hitt, who runs a free e-mail jobs list on her website. On-site staff jobs are plentiful in areas like New Jersey with a high concentration of pharmaceutical companies. Freelancers, of course, can work anywhere once they are established.

Intangible Rewards

Some medical writers find a particular reward in the fact that their work might have a direct impact on the public's medical literacy. "I believe in the power of communication, and I believe medical writers can make a difference," says Amy Stone, a subcontractor for the CDC who writes fact sheets, congressional testimony, and other documents about HIV.

Other medical writers enjoy talking with scientists and learning about a wide variety of topics as they work on projects and assignments. "I don't have the need to be an expert in science," Hitt says, "but I do love to learn." Friedman, too, enjoys learning details about diseases and new indications for drugs or medical devices. "I'm constantly learning new things," she says. "For me, that's really fun."

Mastering Your Ph.D.: A Career in Management Consulting

From:dx.doi.org/10.1126/science.caredit.a0800077

By Bart Noordam, Patricia Gosling— First published May 23, 2008

Assisting corporate executives with their toughest decisions may not seem the most obvious career move for someone who has just finished or is in the process of finishing a science Ph.D. But many consultancies hire Ph.D.s to join multidisciplinary teams to do exactly that, and new Ph.D.s are often thrilled to work in such a novel and exciting environment, in which facts and analysis play an important role.

If solving problems, using your analytical skills, exploring unknown territory, and learning while you are working appeals to you more than the science itself, management consultancy might be a good choice for you. Here, we address a number of questions you might have to help you decide whether you would like to become a management consultant.

What Do Management Consultants Do?

Management consultants help company managers deal with issues and problems that arise within their businesses.

Of course, companies have internal resources to address their problems. But corporate executives may decide that a certain issue calls for a team of external, independent problem solvers working full-time. (See “Your First Assignment” for an example.) Typically, consultancies send in a small team of consultants to address the issue, supported by partners and expertise from the company. Usually, the team includes a leader responsible for running the daily operation, senior team members with several years of experience, and some younger team members, such as freshly minted Ph.D.s, who are learning on the job.

Solving a corporate problem is not much different from solving a scientific problem. It requires data, a thorough analysis of the data, and a synthesis leading to the best possible solution. Finally, the solution has to be reported in such a way that the audience accepts the message and is willing and able to implement it. Those challenges are familiar to most scientists fresh from Ph.D. programs.

There is one big difference: time. Time is money in the corporate world, particularly for the types of problems that management consultants are usually asked to solve. So it is essential to find the best possible solution within a given time frame, rather than a completely correct “scientific” answer.

Solving a corporate problem is not much different from solving a scientific problem. It requires data, a thorough analysis of the data, and a synthesis leading to the best possible solution.

Do Consultancies Hire Many Ph.D.s?

Having a Ph.D. is not a prerequisite to joining a consultancy, but quite a few management consultants do have a Ph.D. track. For example, the Boston Consulting Group and McKinsey and Co. both have special entry levels for Ph.D.s. Martin Danoesastro of the Boston Consulting Group reports that 12 percent of its worldwide staff have Ph.D.s. McKinsey and Co. has similar numbers: According to Teun Hermsen, director of personnel at McKinsey, the company's Amsterdam office hires three to five Ph.D.s every year.

Why Hire You?

Because your Ph.D. research topic is probably of little value to a consultancy, you might wonder why they are willing to hire you or another science Ph.D. with similarly irrelevant graduate experience. "Problem solving is a key asset that Ph.D.s have. Not just the analytical skills but also the ability to structure a problem top-down make Ph.D.s well-suited for a consultancy career," says Hermsen. Danoesastro adds, "To have the ability to work independently and come to the heart of the problem is truly helpful to do a good job as a consultant."

Your First Assignment

Because management consultants deal with a variety of problems, there are no "typical" assignments. But here's an example of the type of assignment you might get as a new hire at a consultancy:

The company HighTech is losing market share on its main product because last year a competitor introduced a superior product. To survive, your client needs to regain its market share by improving the performance of its main product—its primary moneymaker. This means expanding the company's research and development (R&D) effort.

In addition to that, HighTech has a breakthrough technology in the works, but it has to be launched in time for the holiday sales season. But the new product has big technology uncertainties, and these, too, require a lot of R&D effort.

It is up to you and your team to analyze HighTech's current position, evaluate the major technology challenges, consider the options, and decide whether and how to pull additional money from the market (loans or stock issuance, for example) to finance these options. You'd better hurry, because HighTech is losing money every day and will be bankrupt by next spring if the recovery plan doesn't succeed.

What Skills Do You Need to Develop?

Your analytical and quantitative skills are probably adequate. But if like most science Ph.D.s you lack an economic or business background, you may have to catch up on those skills. “They have to acquire a business sense and learn to focus on the most important issues,” says Hermsen.

In addition, providing the best possible answer in a limited time frame is new to many Ph.D.s, Danoesastro says, so Ph.D. scientists may “have to learn to be somewhat pragmatic.”

Is the “Up or Out” System a Threat to Your Career?

Top-tier consultancies generally have a fast career track; you are expected to move up to the next role within two to three years. What if you can’t, or don’t want to, make the next step up? In that case, most consultancies would advise you to look for opportunities outside the company.

Is this something to worry about? Probably not. Most former consultants say they learned a lot while on the fast track and received good advice on how to move on in their careers and on what to do next. “In the long run, you are better off learning fast and moving on” when your progress slows, says one seasoned pro.

How Can You Learn More About Management Consultancy?

Most consultancies organize business courses or master classes for potential hires. In a program, typically lasting a few days, you get to work on a real problem, supervised by consultants. It is an excellent way to gain an appreciation of the thrill of the job or to realize that it’s just not your cup of tea.

How Do Consultancies Select a New Generation?

Applying for a job at a management consultancy is not much different from applying for a job anywhere else. Try approaching someone in the company you know or someone one of your colleagues or friends knows. Follow up with an application letter that states your interest and willingness to work for the company. The initial interviews, which usually are with recruiters, are likely to be conventional interviews in which you talk about your skills, your career history, and your ambitions and ask questions about the company.

Your next round of interviews may include working on a case study with one of the company’s consultants. You receive information about a particular problem and, with the help of the interviewer, plan a problem-solving approach and try to crack the problem on the spot. Interviewers are aware that you aren’t an expert, so they’ll focus instead on general skills and the progress you make on the case. Because this is quite different from a normal interview, consider doing a practice case. Company websites often provide examples of case studies. But "the best piece of advice I can give candidates is to get a good night's sleep and be fresh," suggested one recruiter.

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Short-Term Science
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6. Diversity Issues in Science

Family Trailblazers

From: dx.doi.org/10.1126/science.caredit.a0800075

By Susan Gaidos— First published May 23, 2008

Rebecca Conry, who grew up on an Indian reservation, was the first member of her family to go to college and also the first to become a college professor.

Professors like Conry are more numerous than you might think, although their representation has declined as college attendance has risen. Data from the 2006 Survey of Earned Doctorates, an annual census of research doctorate recipients conducted by the National Opinion Research Center at the University of Chicago, show that in 1976, 44 percent of doctorate recipients reported that neither of their parents had an education beyond a high school diploma. By 2006, that number was halved to a still-substantial 22 percent. No one knows how many research doctorate recipients go on to become members of college faculties, but Ohio State University reports that it has 450 or so on a faculty of approximately 3,500 on its campuses.

Now a tenured professor at Colby College in Waterville, Maine, Conry has much in common with other professors who, like her, are family trailblazers on college campuses. Such faculty members often report feeling like outsiders, alienated from the culture and not knowing the rules. And when they could really use help, they tend to go it alone instead. "Looking back, I never really got the fact that I needed to find a mentor. I just decided I needed to figure it out, and I figured it out on the fly," Conry says.

Finding the Trailhead

Conry is not Native American, but she grew up on the Yakama Indian reservation in central Washington. She says she always knew she wanted to go to college; she just didn't know how to make it happen. With no family experience or advice to fall back on, she set out to negotiate the maze of applications and scholarships on her own.

Once she got there, it took her a while to settle on a major. "I went in thinking I would be a doctor, but I didn't have the confidence that I would get into medical school. So I chose the nursing track." A defining moment came, she says, when she took her first chemistry course and found herself at the top of the class. "My professor encouraged me to major in chemistry. The rest of the class hated me because I ruined the curve."

Some "serious soul-searching" was required, but Conry took her professor's advice and set her sights on a tenure-track academic career. With what she calls "no real understanding of what graduate school was," she applied to a single institution, the University of Washington, and was accepted.

Under the Microscope

After making it through graduate school, Conry was surprised to find that the maze of requirements and expectations permeating the academic culture didn't end. On the tenure track, Conry says, she began to feel pressure to "fit in" to the academic environment. She found herself navigating a culture with an unfamiliar set of rules.

"In academics, the big prize is tenure. But if you ask people in any department what it takes to get tenure, they probably can't tell you. The problem is, it's a moving target," she says.

Although teaching and scholarship are generally recognized as "the big two" requirements for tenure, the ability to get along and fit into the academic department is equally important. The hidden, often imperceptible, expectations can catch some first-generation graduates off-guard, Conry says. "You have to be savvy to all the nuances, the position, the place, and the institution's policies. This can be difficult if you come from a very different culture."

By the time she got to Colby, Conry had grown more savvy. But she was late, she says, in picking up on some of these messages during her first tenure-track position, at the University of Nevada, Reno. After seven years as an assistant professor, she was denied tenure. "It was a split decision. I was close. I just wasn't enough above the bar, and, being different, you get looked at under more of a microscope," she says.

Social Challenges

Although being a first-generation student may present some unique challenges, it need not stand in the way of success. John T. Groves, Hugh Stott Taylor Professor of Chemistry at Princeton University, says he was the first in his family to attend college. Unfamiliar with the school's orientation process, when it came time to register for classes his father pulled up to 77 Massachusetts Avenue in Cambridge—the front door of the Massachusetts Institute of

Technology—and dropped him off. Groves found his way to the registration office and on, eventually, to a named chair at Princeton.

In hindsight, Groves says, he recognizes that his sons, who are both Ph.D. chemists, "enjoyed an abundance of opportunities and experiences" that he never had. "They used to visit me at the laboratory, and one of them did a high school project using a mass spectrometer."

Because many first-generation graduates come from less affluent families, such socioeconomic differences are common, says Rebecca Lamb, assistant professor of plant cellular and molecular biology at Ohio State University in Columbus and a first-generation college grad. "Many of my peers in graduate school had parents who were college professors or professionals. They often talked about places they had been or research opportunities that they had been able to pursue on a volunteer basis."

The routine socializing and networking in an academic community may also cause feelings of insecurity. "The wine, the beer, the fancier foods—when I got out of undergraduate school, I simply wasn't familiar with all that. I don't think anyone went out of their way to make me feel bad. Still, I felt awkward at times and sometimes still do," Lamb says.

Because many of the social cues are subtle—people discussing art films or books with intellectual vigor, for instance—Lamb says finding a way to fit into a culture that comes with its own set of rules can sometimes be confusing. "I go to artsy movies, too, but sometimes you don't want to admit that you saw the latest shoot-'em-up escapist film."

Struggles to fit in at the new workplace are often matched by struggles to fit in back home, as some first-generation scholars find themselves losing the support of their families. Sheila Smith, assistant professor of chemistry at the University of Michigan, Dearborn, says her family encouraged her to go to college and become a high school teacher "because that was a good career for women."

She entered North Carolina State University on a fellowship that required her to teach in the state's public schools after graduation. But during her sophomore year, Smith got involved in research and discovered that she loved solving problems that people didn't have answers for. When it came time to do her student teaching, she was told she would have to give up her research to fulfill the requirement. "I had a manuscript in preparation and wouldn't have been able to continue with my project. From then on, I wasn't getting an education degree, I was going to graduate school."

Because her new career path required years of additional study and obligated her to repay the state loan, Smith says, her decision didn't go over well with her family. "My parents didn't go to college, so they expected me to go and instantly get a job making twice as much as my father ever made. Instead, I chose to go to school again. It was a source of great friction between me and my family for a while."

Struggles to fit in at the new workplace are often matched by struggles to fit in back home, as some first-generation scholars find themselves losing the support of their families.

Financial Challenges

Even with the emotional support of family and peers, first-generation students who come from a background in which money is tight may continue to grapple with the financial aspects of college long after they are awarded a degree.

Although his parents saved to send him and his sister to college, Marcus Chacon, assistant professor of neurology at the University of Wisconsin, Madison, School of Medicine and Public Health, borrowed nearly $200,000 to complete medical training. “I’m certainly at the higher end of debt of anyone that I know,” Chacon says, “and to a certain degree it affects what I can do.” He has considered getting some additional training, either through a master’s or Ph.D. program, but financially, he says, it’s just not feasible.

Chacon comes from a large, extended Hispanic-American family and says concerns about money might also include “background issues” that can bring additional stress while attending school or embarking on a new career. “I’ve often wondered if there are some of us who worry about how our parents are doing financially. I’ve seen people in even more extreme situations than myself, who are actually sending money to their parents.”

Chacon, who juggles a medical practice and a faculty position, says the medical school administration has been very supportive. The dean and others, he says, have helped him navigate the system and plan for his career. “It was one of the reasons I chose this medical school, and it has been a very valuable resource.”

Nurturing Women Scientists

From: dx.doi.org/10.1126/science.opms.r0800047

By Jill U. Adams— First published February 8, 2008

When the US National Institutes of Health (NIH) surveyed its postdoctoral fellows in 2003, more than 1,300 of them answered questions ranging from marital and family status to their views on the value of a good salary, flexible hours, and other workplace issues. One result was particularly worrying. While women and men both felt equally well trained for a career in academic science, women were less confident about their chances to land a position, much less achieve tenure.

Elisabeth Martinez, who was a postdoc at the time and helped design the above survey, expected preparedness and career outlook to be in alignment. With her task force colleagues, Martinez, now an instructor at the University of Texas Southwestern Medical Center, predicted that women might feel less ready—but they didn’t. “By and large women felt equally well prepared, and yet there was still a bit of a confidence issue,” she said.

This finding bodes poorly for efforts to close the gender gap in representation at higher levels of the academic ladder. And yet, those involved in such efforts—in academia, government, and industry—continue to move forward, casting a wider net for hiring, pushing family-friendly initiatives, and increasing the emphasis on mentoring.

"It is reasonable to assume that those women who have assessed the situation carefully recognize that they're going to have more problems than men," says Phoebe Leboy, the president-elect of the Association of Women in Science (AWIS). "So you can call it lack of confidence or you can call it an accurate perception of the situation."

One reason women might have grounds for less confidence in their careers than men has to do with the pressures of raising a family, says Leboy. But even putting family issues aside, she says, "Women are going to have a harder time than men succeeding" at every stage of the tenure-track academic career.

Leboy points to data made available by the NIH that showed women lagging behind men in terms of grants per investigator, dollars per grant, success in getting grants renewed, and responsibility for big budget center grants. And because success is so closely tied to funding, particularly in academic health centers, says Leboy, all of these things mean that women are having a harder time achieving tenure than men.

Add all this to what Leboy calls "the escalating rat race in academia" and it paints a bleak picture.

Looking Past the Numbers

It's no longer a pipeline issue, says Nancy Nielsen, president-elect of the American Medical Association. She cites the National Academy of Sciences (NAS) report from last year which showed that although women have earned more than half of the Bachelor's degrees awarded in science and engineering since the year 2000, their representation on university faculties remains woefully low. Indeed, for those with Ph.D.s in engineering and science, four times more men than women hold full-time faculty positions. And minority women with doctorates are less likely than white women, or men of any racial or ethnic group, to be in tenure positions.

It's a problem of numbers, but as is so often the case, numbers do not tell the whole story. A survey of faculty at Princeton five years ago looked at promotion, compensation, and retention by gender. "The major finding was that we have made progress in attracting and retaining women faculty," said Joan Girgus, a psychology professor who serves as a special assistant to the dean of faculty, a post that was created as a direct recommendation of the survey's task force. "But, we still found that women were under-represented."

When the Princeton survey team looked beyond the quantitative data, one thing they found was that women were less likely to request extensions of tenure for childbirth than were men. "Now this is really odd, right?" Girgus said. "When we asked people to comment, they said things like: we don't know if it's okay to ask for it, we're afraid we'll be seen as less serious, we're afraid we'll be penalized in the tenure consideration."

Princeton's response? Make the extension of the tenure clock automatic. When a tenure-track faculty member, male or female,

When the Princeton survey team looked beyond the quantitative data, one thing they found was that women were less likely to request extensions of tenure for childbirth than were men.

brings a new child home, the dean of faculty sends a letter with a new tenure date and a book for the baby, said Girgus.

In addition to the postdoc study run by Martinez, the NIH conducted an extensive survey of its tenure-track and tenured scientists (as well as other staffers) to examine gender issues. In general, "women do not perceive the NIH as a female-friendly environment," said Joan Schwartz, an Assistant Director in the Office of Intramural Research. "But to tell you the truth we don't know how exactly to define that because we didn't ask them what they meant by it."

Schwartz is presently conducting followup focus groups on the same populations to try to get at specifics. "We need to understand what the issues are so we can work on coming up with solutions," she said. "That's the ultimate goal—to develop practical solutions."

Beyond Education and Training

Obviously, progress has been made. One success story found in the NAS report is the number of women getting Ph.D.s in science and engineering. In biomedical science, some 45 percent of postdoctoral fellows are women. As the problem—women leaving science or their careers stalling—moves to a later juncture on the career path, the solutions must be tailored to a different set of circumstances.

Put a different way, the problem of equal representation of women has moved from the education and training realm to the employment realm. Academic science might look no further than corporate America to find expertise in the practices of hiring, career development, and family-friendly policies.

"Attention to career development and advancement is more part of the culture of industry than it is in academia," says Gail Cassell, who is vice president of scientific affairs at Eli Lilly and Company and was previously a department chair in microbiology at University of Alabama Schools of Medicine and Dentistry at Birmingham. "Lilly certainly invests a lot of time and resources in nurturing the careers of females in both technical and management positions."

Employees at Eli Lilly undergo evaluations twice a year and, in addition to being evaluated by their bosses, those in supervisory positions receive performance reviews from peers and the people they manage. With multiple inputs going into an employee's review, the process is more objective than the opinion of a single person, like one's boss. This continual feedback "improves the individual, improves the system, and builds a better relationship between employee and employer," says Cassell.

From an employer's perspective, evaluations help identify talent and hold onto it. "So you don't turn around and they're being courted by one of your competitors. Succession planning is a very important part of human resources here. I'm not so sure that's the case at universities, particularly with administrative positions."

Kourtney Davis, senior director of worldwide epidemiology at GlaxoSmithKline, can speak to her company's helping her meet her objectives. Earlier this year, she co-chaired a women in science program that pulled together women across the whole R&D organization to offer networking and mentoring. Davis says it was a great chance to promote opportunities for women. "It was also on my development plan, because I want to work on leadership outside of my

department." She credits the company's human resources team for trying to find opportunities for women scientists to increase their leadership skills.

With regard to family-friendly policies, both GlaxoSmithKline and Eli Lilly were recognized by *Working Mother* magazine as two of the top 100 companies in America, based on measures of work force, compensation, child care, leave policies, and the like.

Davis jokes that she's a poster child for the company's family-friendly programs. With each of her two children, Davis took advantage of extended leave—time beyond paid maternity leave—and then came back at reduced hours for another three to six months. "I also telecommute one day a week," she says. "My supervisor has been incredibly supportive."

The biotech firm Genencor has gone so far as to provide a lactation room and the services of a lactation consultant, says Lisa Zanetto, director of human resources for R&D. Employees at the company also take advantage of flextime schedules, backup day care, and using sick days to take care of sick children.

Zanetto notes that men use family-friendly policies too, like the single dad who works a reduced-hour schedule. The philosophy behind these programs is based on the belief that employees are the company's greatest asset. "We put programs into place, not just to have a program, but so it will actually benefit employees," she says. "We do these things because we believe it's right."

Eli Lilly's commitment to diversity has led the company to create a new position, a vice president of diversity. The company also helped fund the NAS report on academic science and has encouraged the academy to do a followup study on women scientists and engineers in industry.

"With our scientific talent pool being what it is today around the globe, you want that diversity to ensure success," Cassell says. "You have to have it."

Changing Culture

Industry differs from academia in how achievement is measured. "In industry, as in much of corporate America, rewards are considered for the team, for how the team does," says Nielsen, which affects not only how science is done, but how scientists are judged.

By contrast, the emphasis in academia is on individual achievement. That works against women, says Nielsen, who adds that for all the talk about partners sharing home and family duties, "the reality is women still do the brunt of that."

Nielsen, who is senior associate dean for medical education at the University at Buffalo School of Medicine and Biomedical Sciences, illustrates the contrast with a change she's witnessed in clinical medicine. Thirty years ago obstetrics and gynecology was dominated by men, but now the majority of residents in any OB/GYN program are women, she says. "I think it was because the life of an OB/GYN being on call all the time was very difficult. In the old days solo practice was the model." Now group practice is more common and allows doctors in a large group to have a very reasonable call schedule. "They can have a life," says Nielsen. "And those are issues for my medical students, male and female. They want a reasonable life balance."

Several universities have launched initiatives to change the culture of academic science and to increase the representation of women on the faculty at the highest ranks. The National Science Foundation has been funding many of these efforts through its ADVANCE program.

One of the first awardees in NSF's ADVANCE program was the University of Wisconsin at Madison. "The unique thing about these awards is they're really working on the institution level," says Jennifer Sheridan, who directs UW-Madison's Women in Science and Engineering Leadership Institute. "This kind of money has never been put at the top, at a system level before. It's always been a 'fix-the-women' approach."

One of UW-Madison's approaches is to educate faculty—those who serve on hiring and tenure committees—about research-based evidence on unconscious bias. Studies have shown that identical resumes are perceived differently depending on the gender of the name at the top. "We use the research as a way in," says Sheridan, to persuade science faculty that if they're not paying attention, these biases can emerge. "It takes the blame off men," she says, "because women do it, too."

The hiring workshops have been effective at Wisconsin, says Sheridan, who has measured a positive correlation between departmental participation in hiring workshops and more women hired. In addition, responses on climate surveys showed that new hires were more satisfied with the hiring process. "The workshops talk a lot about the interview process and treating candidates respectfully," she says.

Another NSF grantee is Rensselaer Polytechnic Institute, which has created a program called RAMP-UP (Reforming Advancement Processes through University Professions). Rensselaer President Shirley Ann Jackson said the program is focused on two things: "We are working to improve career progression for women from the junior faculty ranks to the senior ranks, and to expand recruitment of accomplished women at the senior level."

Startup packages and access to resources will be looked at more carefully. In addition, the institute is expanding its mentoring and coaching services to better guide women faculty through the advancement process.

"It starts at the departmental level, because that is where hiring starts and where the promotion and tenure process occurs," Jackson said. In addition, the "tone at the top" is important, she says. "It is essential to set clear expectations. I am very focused on the need to ensure that the processes affecting the progression of women faculty—and of all people in their careers here at Rensselaer—are fair and consistent."

To fill looming gaps in the science, technology, engineering and mathematics (STEM) work force, Jackson says the United States must engage more women and minorities. "Demographics are changing. Women and minorities now constitute one-half to two-thirds of the population, yet they have traditionally been underrepresented in the STEM fields. If we are to sustain our capacity for innovation, it must be an all-in proposition. You cannot presume to have tapped the best talent if you do not tap the complete talent pool."

Opening Doors for Scientists with Disabilities

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By Laura Bonetta— First published November 16, 2007

Chad Cheetham is pursuing a Ph.D. in neuroscience at the University of Alabama in Birmingham. He is one of six students at his institute to have received a coveted Howard Hughes Medical Institute scholarship for his graduate work. Megan Nix, an electrical engineering graduate of the University of California, Riverside is looking for a full-time position, probably at the Jet Propulsion Laboratory (JPL) where she interned in the spring of 2005. She received first place in a competition from the Institute for Electrical and Electronics Engineers for her project at JPL.

These are typical success stories of students pursuing careers in scientific fields, except that the students happen to have a disability. Cheetham has no left visual cortex, which means he lacks the right visual field and depth perception, while Nix has fibromyalgia, a chronic condition that causes widespread pain in the body and exhaustion.

In many cases, disabilities are not barriers in science and technology fields, where mental capacity and creativity are keys to success. Nonetheless, individuals with disabilities face unique challenges as they transition from high school to college and from college to employment.

In many cases, disabilities are not barriers in science and technology fields, where mental capacity and creativity are keys to success.

They might need software or other technologies to help them follow along in classes, face problems finding adequate living arrangements close to their university, or come up against faculty or employers who are fearful of dealing with a person with a disability. A number of programs and resources are helping to alleviate such challenges.

The Voice of Experience

Ted Conway did not divulge to prospective employers that he had cerebral palsy. When invited for an in-person interview, he would explain he had a loss of muscle action caused by a lack of oxygen during birth to the part of the brain that controls muscle movement. "I always describe what the disability does rather than calling it by its name," says Conway. "If people hear cerebral palsy, or muscular dystrophy, or cancer, they always think the worst."

A professor and associate dean at Virginia Commonwealth University, Conway has, for the past 21 years, been going up the academic ladder in the fields of mechanical, aerospace, and, more recently, biomedical engineering. He has held jobs in industry, government, academia, and as a consultant. "The only challenges that I have faced have been overcoming other people's predetermined ideas about what a person with a disability could do," he says.

An effective way for attitudes to change is for more people to see individuals with disabilities in established positions. "Role models serve as examples, but also act as mentors for people who want to acquire that position," says Conway. "Someone has to blaze that trail and then the next person who comes along can ask 'What do I have to do to get there?'"

Increasing Numbers

A handful of programs are trying to increase the numbers of individuals with disabilities in science, technology, engineering and math (STEM) fields. Eleven years ago, the American Association for the Advancement of Science (AAAS), publisher of the journal *Science* and *Science* Careers, established EntryPoint! The program provides internship opportunities to students with disabilities at IBM, Merck & Co., the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Technology (NIST), Lockheed Martin, CVS, NAVAIR, and NASA.

"A persistent student can get an undergraduate degree. There are barriers, but if you want to do it, you can do it. It may be harder at the graduate level. But it is harder still to get employment in your field," says EntryPoint! Director Virginia Stern. "The internship is critical. The employer gets to know you and what you can do. And you find out what you want to do."

To participate in EntryPoint! a student with a disability not only has to be interested in STEM careers but also have a 3.0 or above grade point average. "The organizations we work with want the diversity, but they need competitive students," says Stern. "We do the talent search."

Cheetham spent a summer at Merck & Co. where he was in charge of developing an assay to screen compounds related to obesity. "EntryPoint! does not lower expectations. They only take the best," says Cheetham. "They are advocates for people with disabilities, but they want really qualified students. It's not 'Poor me give me an internship because you feel sorry for me.' It's 'Give me an internship because I am really good!'"

Successful work experiences are not only critical to opening career doors; they also change the attitudes of employers who may be wary of hiring individuals with disabilities. "We make sure that the employer has a positive experience," says Sheryl Burgstahler, director of the Disabilities, Opportunities, Internetworking and Technology (DO-IT) program at the University of

Washington. “If there is a problem we intervene, and most of the time it is not a disability-related issue. That is what we help the employer see.”

DO-IT, a multifaceted program to help people with disabilities succeed in college and the work force, includes an online mentoring network and an internship program that are part of the program entitled Access to Science Technology, Engineering and Mathematics (AccessSTEM). It provides about 50 internship placements a year in the states of Oregon, Washington, Alaska, and Idaho.

Enabling Technologies

Established in 1992, AccessSTEM makes extensive use of computers, assistive technologies, and the Internet to help students with disabilities become more independent in their academic and career activities. “An employer might say ‘How can you have a blind person do programming?’ But it is not hard. You need a standard computer with a refreshable braille display and a braille printer,” explains Burgstahler. “We want to show that with the right technology people with disabilities can succeed.”

Help obtaining those technologies can be a boon to students. “Most assistive technology is overpriced and yet may be a student’s sole means of communication or may give someone the ability to use a computer,” says Chris Schlechty, a senior at the University of Washington studying computer science.

Schlechty has limb girdle muscular dystrophy and uses a power wheelchair to get around. “I need an accessible workstation, which consists of a certain keyboard and mouse set, a height adjustable desk, and an alternate headset or handset for the phone as I cannot lift up the receiver,” he explains.

Schlechty interned at Microsoft through the DO-IT program. After graduating in June 2008, he hoped to obtain employment at Microsoft or one of the other major software companies in the area. “A student should not prematurely label classes or careers as inaccessible. By working with the professors and using a bit of creativity, we were always able to make accommodations that worked, and I have been able to successfully complete all of my courses, including those that seemed to require a fair amount of physical activity,” says Schlechty.

The National Science Foundation has supported DO-IT’s AccessSTEM and other similar programs through its Research in Disabilities Education (RDE) program. Other RDE awards include projects that develop new assistive technologies for people with disabilities. One example, developed by a team at Pennsylvania State University, University Park, is a hand-held submersible audible light sensor that fits in a test tube and converts the light intensity to an audible signal to help blind scientists conduct chemistry experiments.

STEM Careers Make Sense

Individuals with disabilities are generally underrepresented in science and engineering professions. Nevertheless the employment rate for scientists and engineers with disabilities is 83 percent, much better than the estimated 26 percent for the overall US population with disabilities. These statistics suggest that the engineering and science fields provide careers in which individuals with disabilities can find success.

"I actually think those fields are good ones for students with disabilities to get into, because there are just so many opportunities available to help get women, minorities, and now people with disabilities involved, since they are so underrepresented," says Alison Ecker, a junior at the University of Oregon majoring in comparative literature.

Ecker, who is hard of hearing, completed a DO-IT internship in viticulture, an area outside her field of study. Because of the internship, she would now consider a career in scientific research. "I would highly recommend having an internship, possibly even before deciding a major, as it allows you to get real-life experience, to see if it's a career that you might actually be interested in," she says.

Why are STEM careers a good match for individuals with disabilities who have an interest in these fields? "It is a combination of things. There tends to be an increased use of technology in those fields which makes it easier to integrate assistive technologies," says Burgstahler. "STEM jobs are often not physically demanding jobs. You are using your head, not your muscle."

The Employers' Perspective

And if STEM careers make sense for people with disabilities, it also makes sense for employers to hire them. "We are competing with countries that have plenty of individuals with technical expertise. We cannot afford to leave any talented people out of the work force," says Ted Childs, former vice president of global diversity at IBM.

Like IBM, the Center on Polymer Interfaces and Macromolecular Assemblies, an NSF-sponsored center and a joint effort between Stanford University and IBM Almaden Research Center, has had students with disabilities as summer interns for the past six years.

These internships required making some changes in the buildings, such as adding touch plates to doors, and making other accommodations, including hiring sign language interpreters during meetings and seminars as well as purchasing some special software. "It is a combination of changes in the buildings and working with the students to find out what they need," says center director Curtis Frank, who had two students with disabilities in his own lab.

But Frank sees many advantages to these internships. "For the other group members, it gives them an example of what can be accomplished. My group already has a good collegial working relationship. But having someone with special needs helps bring the group even closer together," says Frank. "It requires more folks to pay attention to what is happening in the lab."

Julie Peddy, program manager at NOAA's Northwest Fisheries Science Center and EntryPoint! coordinator for NOAA, has also had good experiences

hosting students with disabilities as summer interns. "Some employers are worried about what the cost will be, but for the most part it is not costly to provide some accommodations for a person with a disability," she says. "The response has been very favorable. A number of interns have been repeat interns and a couple will be picked up as permanent employees."

Changing Attitudes

Many scientists with a disability, particularly one that is apparent, say it is important to discuss the disability with teachers and prospective employers and advocate for whatever accommodations are needed to succeed. "As a student you have to make sure that you are not excluded from obtaining the same skills, or equivalent skills, as everyone else in the class," says Imke Durre, a physical scientist at NOAA. "Part of that responsibility falls on the teacher, but it is also up to the student to say, 'This is how I could do it.'"

After completing her Ph.D. in atmospheric science from the University of Washington, Durre applied for a fellowship from the National Research Council. Durre, who is blind from birth, added a "personal statement" in her application explaining what accommodations she uses. "I wrote 'This is how I handle graphics. This is how I read print documents,' and so on," she explains. "The approach worked for me."

She landed a postdoctoral position at NOAA's National Climatic Data Center, which later converted to a staff position in the Climate Analysis Branch. Durre got hooked on climate science as a child, when her mother would read her the newspaper's weather page. It never occurred to her that this was something she could not do. "I did encounter a teacher in junior high school who did not think I could do higher-level math, but I did not pay much attention," she says. "I figured she did not know me."

Incight, a not-for-profit organization based in Portland, Oregon, works with high school and college students with disabilities to help them overcome their own fears and become better advocates for themselves. "When we hear 'I would like to do this but I don't think I can do it,' that is when we get really motivated," says Incight's Aubrie Abbott. "We work with them and say 'Well, actually, we think you can. Let's figure out the steps you need to get there.'"

Incight works closely with a set of college students from all over the country, providing them with scholarships, mentors, and assistance in finding internships. This year the scholarship program, which started only four years ago, received 800 applications for 70 spots. In addition, Incight helps prepare Oregon high school students for life after graduation, through training and mentoring. "By the time they get to college they are better at being their own advocates," says Abbott.

Programs like EntryPoint!, DO-IT, Incight, and many others are working to change the face of research by providing tools and advice to talented students who have disabilities. They are also creating networks of students and professionals with disabilities who can serve as role models for others to follow. “Eventually we would like to put ourselves out of business,” laughs Abbott. “In a perfect world you would not need us. We are trying to develop leaders who can remove barriers and pave the way.”

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7. Leadership and Lab Management

Making the Leap to Independence

From: dx.doi.org/10.1126/science.caredit.a0700029

By Irene S. Levine— First published March 2, 2007

Independence is a lofty goal. It's what every parent wants for their child and every citizen wants for their nation. It is also what most scientists aspire to after years of training and working for other people.

But the practical challenges of achieving independence in a scientific research setting are formidable. First, you have to secure a position, lab space, and sufficient funds to buy equipment and hire people, during a time of constricted budgets and increased competition. And once the first round of resources is in hand, you have to be skillfully employed in a coherent scientific effort even as you seek another round of resources. The effort requires a mix of scientific, technical, project management, and interpersonal skills. More intangibly, the path to independence requires flexibility, persistence, and self-confidence. Not everyone has what it takes. Then again, not everyone aspires to scientific independence.

"Those who succeed are well-grounded people who have seen success and believe they can do it too. They are not the type of people who worry too much or are easily intimidated," says Michael Hochella, Jr., a professor of mineralogy and geochemistry at Virginia Polytechnic Institute and State University in Blacksburg, Virginia.

Earning Your Wings

One prerequisite to independence is an academic position that provides the space, freedom, and employment stability necessary to engage in independent research and to build a research team. But this is only the beginning. Although academic positions generally come with startup packages, setting up a lab from scratch is expensive and it's soon necessary to go hunting for more funding.

The scientific community has long considered single-investigator research grants, such as the R01 offered by the US National Institutes of Health (NIH), the Holy Grail of science funding—but that goal often remains elusive, particularly for young investigators. The success rate for R01 grants, for example, remains disappointingly low. Of 22,148 applications reviewed in 2006, only 3,610 (or 16.3 percent) were funded. Over the 25-year period between 1978 and 2002, the median age of doctoral biom edical researchers receiving their first independent research grants from the NIH rose from 37 to 42.

Recognizing this as a threat to the development of the next generation of researchers, NIH decided to turn the problem on its head. Last year, it announced the K99/R00 Pathway to Independence award, a new mechanism designed to increase the share of federally funded awards received by younger investigators and to create institutional incentives to help postdocs become independent investigators. After two years of funding at $90,000 per year, grantees can apply for an additional three years of funding for up to $250,000 per year. And since the grants cover full overhead costs, they provide a strong incentive for universities to create positions for these grantees.

In Europe, the governments of the UK and Ireland have made similar efforts to expand the number of transitional awards for early-career scientists. Back in the United States, NIH has just announced a "new" award—dubbed the New Innovator Award—that is intended for newly independent biomedical scientists. The number of New Innovator awards is likely to be tiny, however.

More Than Science

But money isn't everything. Becoming a successful scientist requires getting the work done. What differentiates those trainees who go on to become independent investigators from those who continue to work for others? Although there is little hard data, the common assumption is that only the best and the brightest go on to independence.

But there is more to it than intellect and scientific skill. To become successful as independent investigators, young scientists must possess—or acquire—a battery of nonscientific skills. Traditionally, individuals were left to pick these up on their own, but they may now take advantage of many excellent programs that focus on teaching them the skills of successful grant applications and scientific management. One of the most ambitious and comprehensive of these efforts is a program in lab management supported by the Howard Hughes Medical Institute (HHMI) and the Burroughs Wellcome Fund in the USA. (Howard Hughes Medical Institute, *Making the Right Moves: A*

At the top of the list of traits required for independent research are persistence, self-confidence, and flexibility.

Practical Guide for Scientific Management for Postdocs and New Faculty, Second Edition, with a free download)

A successful principal investigator (PI) must know how to bring a team together and nurture each individual, says Peter J. Bruns, vice president for grants and special programs at the HHMI, who was on the faculty of Cornell University in Ithaca, New York, for more than 30 years. His advice to budding lab managers: "When you look at successful mentors, you'll find that they recognize the human needs of their people. They listen to their problems, work-related or not. They help them succeed as people," Bruns says.

Many scientists believe that personality plays a crucial role in achieving independence as well. "The scientific abilities of independent investigators versus the nonindependent ones are essentially the same," says Hochella. "In my experience, the difference may lie in both the level of ambition and basic personality," says Hochella, whose career mentoring doctoral and postdoctoral trainees has spanned more than two decades.

Do You Have What It Takes?

The foundations of personality are part nature and part nurture. With effort, people can make some changes around the edges but most core character traits endure. How we are hard-wired may make us more or less likely to become independent researchers. According to some of the experienced lab managers interviewed for this article, at the top of the list of traits required for independent research are persistence, self-confidence, and flexibility.

Persistence. Independent research isn't the path for the scientist who is motivated by quick rewards, Hochella says. Research independence requires tenacity, drive, and the willingness to hang in for the long haul. "Young scientists who wish to become independent need to be able to see the rewards down the line, set their minds on it, and go for it," says Hochella. "They remain calm, take things one step at a time, and know that if they pass all the individual hurdles, they will have a good chance of making it."

Michael Thoennessen, a professor and associate director of the National Superconducting Cyclotron Laboratory (NCSL) at Michigan State University in East Lansing believes that mentors can help young scientists by modeling the costs and rewards of persistence. "He can convey to the mentee that he loves his job, although it involves intense work, long hours, and is sometimes loaded with administrative tasks," he says.

Experience in the PI's basic tasks can also give aspiring scientists a leg up while they're still in training. Steve K. Lower, an assistant professor of earth and environmental sciences at Ohio State University in Columbus is one of Hochella's protégés who has gone on to secure his own grants from the National Science

Foundation (NSF) and the Department of Energy. "As a graduate student, my adviser allowed me to play a big role in the writing of NSF grants. He also allowed me to review the panel reviews" of the grant proposals he helped write, says Lower. Aside from learning the nuts and bolts, those experiences helped him recognize the importance of persistence and humility, he says.

Confidence. "Those who succeed are well-grounded people who have seen success and believe they can do it too. They are not the type of people who worry too much or are easily intimidated," says Hochella.

Adam Rich, an assistant professor of biological sciences at the State University of New York, Brockport, believes that "confidence" doesn't quite describe the essential quality—more like fearlessness, he suggests. "I was willing to develop new or novel protocols to get an experimental question answered. I was basically willing to try anything, and therefore, wasn't afraid to push techniques beyond where they were supposed to work," says Rich.

Mentors can help trainees become more self-confident by engaging them in meaningful discussions and treating them as peers rather than "down-the-pecking-order" students and postdocs, says Thoennessen. "Trainees gain confidence when they realize the people they respect in the field don't have all the answers," he says.

Flexibility. "The ability to handle ambiguity and uncertainty with some equanimity, even to embrace it, is really critical," says Thoennessen. This requires a willingness to learn new roles, even or especially when it means moving beyond one's comfort level or skill set, he says.

"I enjoy the process of science and can be happy working on a variety of different projects," says Rich. He took his prior work and expertise in the area of gastrointestinal motility and applied it to a new animal model, the zebrafish, to show that he could do what he proposed to do and then added a new hook to get it funded. "When considering projects, I always keep two things in mind: what work will be fun to do and what work is fundable," says Rich.

Working smart. One of the most universal keys to adapting to an independent position is learning to get more done in less time. Between teaching, research, grant writing, mentoring, and committee work, new faculty members have a lot more to do than they did when they were grad students and postdocs, so they can't afford to waste time—and that means working smart as well as hard.

"I recall professor Hochella saying, 'You can make discoveries by spending a month in the lab or a day in the library,'" Lower says. He first put that lesson into practice when he spent a good part of his first summer of grad school in the library. "At the end of the summer, I had figured out what was missing from my area of research. I knew where I could carve a niche," he says. He's been applying the lesson ever since.

Different strokes. Not everyone is interested in pursuing independent research. "There are many young scientists who don't have a burning ambition or an inherent need to lead. They are content with following, knowing that they are just as capable," says Hochella. "They just don't want the hassle."

"Today, many students don't want to be clones of their professors," says Bruns. He hopes that the graduate school community will recognize the need to prepare some equally talented graduate students for jobs other than doing "big research in big groups."

Indeed, in a time of increasingly collaborative science, perhaps it's the concept of independence itself that needs revising. A seminal report from the National Research Council (NRC) published in 2005, called *Bridges to Independence: Fostering the Independence of New Investigators in Biomedical Research*, suggests that the traditional definition of an independent researcher—as an individual, usually in a tenure-track position, who has received his or her first RO1 research project grant (or equivalent) as a principal investigator—is too narrow. Rather, it says an independent researcher is "one who enjoys independence of thought—the freedom to define the problem of interest or to choose or develop the best strategies to address the problem." Encompassed in the broader term is the notion that researchers need not be in tenure or even self-sustaining to be independent. They can achieve independence by making distinct contributions to the research enterprise even if they're not in charge of the lab.

The problem is that there aren't many alternatives to PI-ship for established academic scientists. Although some non-PI jobs may be found within universities—running core facilities, for example—these kinds of jobs are relatively few. Far more common are older scientists stuck in postdocs with little job security, even a decade or more past their Ph.D.s. But these are not jobs that anyone aspires to. So early-career scientists who aren't eager to head up their own research enterprise should consider opportunities to teach or to find work outside academia—at government labs or in private industry—where they can do good work without having to build and support a laboratory and a team. The kind of teamwork described in that NRC report is far more common in industry than it is in academia.

In one of the all-time most popular career advice books, *What Color Is Your Parachute?* (first published in 1970 and updated many times since), author Richard Nelson Bolles says, "The key to a happy and fulfilling future is knowing yourself. This self-knowledge is the most important component of finding the right career." If your pursuit of independence feels like a slippery slope and you're not enjoying it, sometimes it helps to reassess your career goals and talk them through with a trusted mentor, a career counselor, or a mental health professional.

Managing Scientists

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By Karyn Hede— First published November 9, 2007

Christina Hull chuckles when asked where scientists acquire their interpersonal skills. She acquired hers the same way most scientists do: They were thrust upon her when she started her laboratory at the University of Wisconsin, Madison. Suddenly she was the boss, faced with the daily challenges of motivating students, negotiating with peers in committee meetings, resolving conflicts in the lab, and a dozen other tasks that require what are broadly called "people skills."

Hull acknowledges that possessing good management ability is essential to productive scientists, but she received no formal management training prior to taking the reins. Her experience is not unusual. Fully half of US postdoctoral scientists responding to a 2003 Sigma Xi survey said that they had received no training in lab or group management, and nearly all the rest had received only ad hoc or "on-the-job" training. Most wanted formal training in lab management, but only 4 percent had attended a workshop or done formal coursework.

Even established senior scientists recognize the disconnect. "Science is odd in some ways," says Robert Doms, chair of the Department of Microbiology at the University of Pennsylvania School of Medicine. "You spend all your time as a student and postdoctoral fellow learning how to be a good experimentalist. Then you become an independent scientist, and if you are successful, before long you are no longer doing experiments because you don't have any time, and personnel management becomes a major issue."

Like many scientists, Doms modeled his management style on that of his scientific mentor, Ari Helenius, a virologist at Yale University School of Medicine, whose style Doms admired. The ad hoc method can work sometimes, but it's hit-or-miss.

"There are some horrible pathologies in some labs in the relationships," says Edward O'Neil, director of the Center for the Health Professions at the University of California, San Francisco (UCSF), who offers laboratory management workshops throughout the United States. "People stay because they are inspired by the science, but they leave the training in some of these labs really wounded people. Then they will use that as a model for leadership."

In his workshops, O'Neil tries to get scientists to change their behavior by asking them to frame a hypothesis. For example, "If I stop yelling at my technician when he makes a mistake and work together to correct the problem, he will finish experiments more quickly and completely." Then, O'Neil asks them to collect and analyze data to see if the data fit the hypothesis.

Becoming an Effective Leader

Success in science is often measured by number of publications, citations, and similar metrics. But when Alice Sapienza, a chemist with a Ph.D. in organizational behavior who is now at Simmons College in Boston, Massachusetts, asked experienced scientists what qualities they most admire in a scientific leader, she got a very different answer.

Sapienza says her research suggests that the best leaders are those with the best people skills.

Sapienza says her research suggests that the best leaders are those with the best people skills. She surveyed more than 200 scientists and engineers from the United States, Europe, and Asia, asking them to describe the most effective scientific leader they knew. Leading the list were people of "caring and compassion," followed by those who "possess managerial skills" such as effective communication and conflict resolution. Technical skill was a distant third.

Another common misperception among scientists, she says, is that managing people in a laboratory environment is somehow different from managing people in other types of workplaces. "People are people," Sapienza says. "There's a very short list of things that go wrong when people work together."

So how do you make sure those things don't go wrong? "There is no easy fix," she says. "It should not be surprising that it will take time to become an expert in the discipline of interpersonal behavior."

Carl Cohen, co-author of the book *Lab Dynamics: Management Skills for Scientists* (and a former *Science* Careers contributor), recommends taking short courses in management and reading books such as William Ury's *Getting Past No*, which he found invaluable in developing negotiation skills. There's a whole literature out there, he says, that can be very helpful.

O'Neil recommends yearly performance evaluations for everyone in the lab, including the lead investigator, using what's known as a 360-degree evaluation in which people give and get constructive feedback from supervisors and those they supervise. This kind of assessment taught Sapienza that she needed to be more explicit with her students and postdocs in setting goals and expectations.

Formalizing Training

Not long after her trial by fire at Wisconsin, Hull, a former Burroughs Wellcome Fund (BWF) Career Award recipient, got a taste of formal training when she participated in a five-day lab management "boot camp" sponsored by BWF and the Howard Hughes Medical Institute (HHMI) in Chevy Chase, Maryland, in 2005.

"I decided to go to [the course] grudgingly," she acknowledges. "I wasn't sure it was worth a week of my time." She feared the course would be a bunch of "business-speak" that didn't apply to the issues she faced in the lab. But by the end of the course, she was glad she had gone. She says she valued hearing the collective expertise of experienced scientists who had been through the same issues she faced, and she learned enough about her own personality and management style to make changes she says have improved her skills as mentor and manager.

"I realized there were some things I was doing that my lab expected me to do differently," she says. "My students pointed out that I don't manage interruptions well—that I allow them to interrupt me too much. I thought that was interesting because I was very much into my open-door policy. When I became more protective of my time, they respected my time more."

Peter Bruns, vice president for grants and special programs at HHMI, says that HHMI is unlikely to offer the lab leadership course again. Instead, the institute is trying to disseminate its model by "training the trainers": teaching the nuts and bolts of how to run such courses to a core group of 17 interested professional societies and universities that want to offer them.

HHMI gave small seed grants to each partner and asked for evaluation data from the workshops. In aggregate, more than 90 percent of respondents who participated in the courses said that they would recommend them to a colleague, according to Maryrose Franko, senior program officer at HHMI.

Michelle Hermiston, a new assistant professor of pediatric hematology at UCSF, took a laboratory leadership course offered by UCSF's office of postdoctoral education this past spring. "I'm a huge cheerleader for the leadership course. I found it extremely useful, as did all of my friends who also took it," she says. She particularly appreciated the tips on how to assess work styles and how to ask difficult questions about potential weaknesses during the hiring process. "For many of us who have been trained in science, learning how to do those things can be challenging."

Hermiston says that the course has already had an effect in her lab. Her technician told her recently that she has become much more open to feedback and said how nice it has been not to have to guess what she is thinking. "I've become much more cognizant of what level of hands-on management people need at different stages of their training," she says. "It's probably changed some of my behaviors for the better in that I give and ask for feedback more often."

The United Kingdom has decided that such training should come long before a scientist finds herself running her own lab: A fundamental change is under way that aims to make "soft skills" a part of doctoral education in science. In 2002, a government-commissioned panel recommended that all science graduates receive such training. In answer to those recommendations, Research Councils UK, the nation's primary research-funding body, now disburses £21 million (about US$42 million) per year to universities for professional development for graduate students and postdocs in areas such as project management, supervising others, and communicating with the public. The goal isn't to improve laboratory management per se; it is, rather, to give graduates skills that make them more attractive to potential employers in all sectors.

There is still some skepticism on the part of supervisors, and some people believe that the money would be better spent elsewhere. But the program seems to be having an effect. "We're probably about halfway there in terms of getting transferable skills into Ph.D. programs," says Iain Cameron, head of the Research Careers and Diversity Unit within Research Councils UK. "We've made a huge amount of progress since 2003, but we've still got some way to go."

Such skepticism is not confined to the United Kingdom. When Elizabeth Ellis, director of Graduate Training in Biomedical Sciences at the University

of Strathclyde, UK, gave a talk on the UK's integrated-training model at an Association of American Medical Colleges meeting last year, she encountered skepticism there as well. "There seemed to be some resistance to mov[ing] towards skills-based training in the United States, and there was little understanding of why transferable skills were needed," she writes in an e-mail.

Brian Schwartz, a physicist and vice president for research and sponsored programs at the Graduate Center of the City University of New York, has been co-teaching courses on business skills for scientists for 10 years. Schwartz says students and postdocs are often savvier than their supervisors about the need for such skills in the job market. He advises students to take such courses throughout their graduate careers. "Even while getting a Ph.D., take some other courses," he says. "A lot of students say, 'But my thesis adviser won't allow me.' I say, 'Don't tell 'em.'"

"Scientists have to learn that it's not the science they're managing, it's the people who are doing the science that they're managing," says Sapienza. "Sometimes that's a quantum leap for people to understand."

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