Career Basics

Advice and Resources for Scientists from *Science* Careers

Science Careers

From the journal *Science* AAAS

Contents

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.

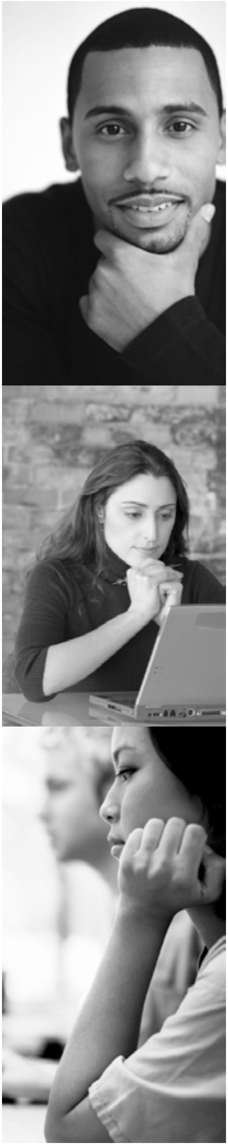
Science, one of the most prestigious and highly cited scientific journals in the world, and AAAS, the world's largest multidisciplinary society for science-related professionals, are dedicated to helping guide qualified scientists to meaningful careers at all stages. *Science* publishes special international 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 (incorporating Next Wave – the editorial voice of 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*

Your Career Is Our Cause



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Here's how ScienceCareers.org can help.

1. **Visit our website and register as a user.** Registration is free and allows you to apply for jobs in our system and enables you to receive our monthly newsletter that highlights jobs and career advice.

2. **Once registered, sign up to receive customized job alert e-mails.** These automated e-mails will keep you up-to-date on the job market whether you're actively looking or just want to stay informed.

3. **Post your resume/CV in our database.** Help employers find you as they need to search for scientists with unique skills.

4. **Join our Career Forum** and get advice from career experts in industry, academia, and government. Start a dialogue with career advisers and peers to help you answer the difficult questions.

5. **Search the Career Development content for advice you need.** Whether it's help with interviewing skills, negotiating salaries, or finding alternative career options to bench research, we cover hundreds of topics.

It's all here for the taking. Let us help you take your next career step today.

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www.sciencecareers.org

1. CV Writing and Interview Skills—The Essentials!

CVs THAT OPEN INDUSTRY DOORS

by Dave Jensen

As a professional recruiter, I look at over 300 resumes a week. And although I'm not anxious to spend my nights and weekends writing about them as well—my Tooling Up columns tend to focus more on career search strategies than on the minutiae of the job hunt—it is a really good idea to revisit this particular topic regularly. Many people have found that a style and content review of a CV is a good thing. It can help tighten and focus the document in ways that may make it a better fit for the chosen market.

Resume and CV writing is a huge subject, and thousands of books have been written about it. My goal in this column is to give you a brief refresher on some of the most common concerns that you may have regarding the preparation of your own personal "marketing materials." And please don't be put off by that description. Despite the low regard you may

Despite the low regard you may have for sales and marketing, it is exactly this job that a resume or CV needs to do when it arrives at its destination.

have for sales and marketing, it is exactly this job that a resume or CV needs to do when it arrives at its destination. Its content will either appeal or it won't. Your job is to take the excellent work you've done and feature it in a way that opens the doors you want opened. I'm not suggesting style over content; we both know that your abilities as a scientist will be very carefully screened when your letter arrives at a company. But given that a lot of "good science" does show up at the doors of industry firms nowadays, don't you think that you ought to improve the way that *YOUR* science is presented?

Resume Real Estate

Little details like the length of a CV can cause some grad students and postdocs sleepless nights. For the CEO and the undergrad with no experience, the old "one page at most" rule certainly applies. But everyone in between should focus on making the document as readable as possible and not worry about the length.

> After many years of reviewing CVs and resumes, I can tell you that problems don't occur when the writer went over or under a certain number of pages.

It is when the writer can't keep things concise and to the point, or when they fail to put the important stuff "up front" that they lose out on reader interest. (The HR executives at the Director and VP level I consulted when writing this article all told me that any important information should be on the front page because they only have time to read the first page before moving into "scan" mode.)

Delete the Following from Your Resume. Writing succinctly is an art, and nowhere does it make more of an impact than on a cover letter and resume. Here are some areas that often need to be exorcised:

Hobbies and Interests sections: I would suggest removing this area from a resume altogether, although many people would disagree with me. They believe that there is some value to showing a side of you outside of work. Perhaps it is the workaholic in me, but I don't really care if you enjoy hiking and travel. What I am looking for when I scan a resume is how well qualified you are for a specific job. Does it really matter that you enjoy bowling, biking, or brewing beer?

Academic CV relics: You should also get rid of all those oddities from the old-style academic CV. I mean, who really needs to know the names of your spouse and children, their birth dates, and your social security number? These things have just got to go if you are applying for jobs in industry.

Keyword lists: Some CVs come into our office with a special section on the document geared to the modern database search. Although it is true that companies do employ software that searches through your documents, I think that it's better to incorporate those "keywords" into the text of the document in a more natural fashion. But if you want to use a brief keyword list, try titling it "Skills and Techniques" and make it a separate section of the document.

So, don't shoot for a certain page length—but do (please!) keep it succinct. Once you've finished your final rewrite, go back and take another look to see if you can tighten it up just a little bit more. You don't need to drop whole sentences or sections just for the sake of brevity. But you should read each sentence or bulleted item to make certain that it is important and that it supports the entire application. The bottom line is that everything you include in a resume should reinforce the objective you've set for yourself or should support your application for a particular position.

The Style and Format of Your Marketing Materials

Any book about resume preparation can tell you about the different styles and in what situation they might be used. People who read a lot of resumes don't react in the way that you'd hope when they come across a CV printed on mauve paper—or when the dates and positions are hidden behind a couple of pages of "skill areas." Instead, they'll lose interest. Look closely at the CV's that others of your level and experience are circulating. Make certain that you have something that stands out because it is powerfully written—and not because of your choice of font.

> But as a general—and perhaps counterintuitive—rule of thumb, it is better *not* to be creative and unique with your personal marketing materials when you are applying for positions in industry, where prospective employers actually prefer some uniformity.

CV vs. resume. Regardless of your technical strengths and how many publications you have, your material should always reflect your ability to accomplish goals. Certainly, hiring managers will need to know about your technical proficiencies, but they are even more interested in reading about your accomplishments on the job. The traditional academic CV won't cut the mustard in this regard. But neither will the one-page resume.

It is the intermediate document that will best suit your needs in the long run. A modified CV that lists experience and accomplishments beneath each historically arranged job title. This material should then be combined with the usual credentials and publications—generally with the education listed at the top of the first page and the publications trailing at the end of the document. I'll be referring to this type of document from now on as the "CV."

Accomplishments. When you list each of your accomplishments in a CV, you need to do so succinctly, which means you'll have to focus on just the right information. Try this: use the acronym CAR (for Challenge-Approach-Results) to help clarify your thinking. Consider the problems you have faced (the Challenges), your unique contribution (the Approach), and the benefits that you have imparted (the Results).

Proper Contact Information. Your CV must have proper contact information at the top of page one. A lab phone number is fine, but many HR departments will not make telephone contact with a candidate at a work number. So make certain that your home information is present, and an e-mail address as well. More than half of today's job-related correspondence from companies arrives via e-mail.

CV Distribution

How will you distribute your marketing materials? Hard copy? Fax? Or e-mail? What's best will be determined by the company you are writing to, and is usually mentioned in their ad.

Hard Copies. I wish that I could show you what most recruiting and HR offices look like as a result of their neglect of hard-copy CVs. Because we have become spoiled by e-mail, traditional resumes now sit in large stacks waiting for someone to take the time to scan and/or file them away. Hard copies are OK when they are sent out to a specific hiring manager who doesn't have to deal with the deluge of the daily mail. Even then, however, hiring managers, who are just as busy as the rest of us, will tend to treat those hard copy CVs with less urgency than electronic versions that can be processed with a couple of mouse clicks.

If you must send a hard copy of your CV, then be sure to make it scanner friendly: use only white or beige paper and plain fonts (which scan best), and avoid font treatments like underlining and italicizing. Once again, let me remind you that this is the wrong place to be creative—unique resumes don't scan well.

E-mail Copies. What great impact! Instantly your contact has that CV sitting in front of her, ready to read. And although there are still some problems with certain file translations and computers, I believe that the great majority of e-mailed documents reach their destinations in readable condition. About 15% of the time I have to fiddle with the document to fix a formatting irregularity or some weird font substitution. But I'm willing to do this, because the alternative (hard copies) requires me to get up off my chair and start searching through file cabinets. When given a choice between having your resume sitting in the file cabinets or in the company's database where it can be scanned for keywords, you'll definitely want the latter.

Word or RTF documents, e-mailed without compression (no ZIP files, please!), seem to be becoming the de facto standard. In addition, many people clip and paste the text of the CV into the body of the e-mail message "just in case." While I don't like plain text, it is better than a vintage 1985 Wordstar document that no one can open. And it is better than PDF documents. Of all the electronic documents that get e-mailed, PDFs look the best—you can preserve all the formatting and font selections and make your material print out beautifully. But the unfortunate thing about PDF files is that they cannot be stored in a corporate database and cannot be keyword searched. Therefore, if you send a PDF file, make sure you enclose either pasted ASCII text or a Word version as well. At least the keywords can be entered into the database, and searches will be able to pick up your name for a phone call.

Fax Copies. Use the fax machine only when specifically requested by a hiring manager or advertisement. Fax machines produce copies that most often cannot be scanned, and they are losing the value that they once had for urgency. Faxes at our office often sit with the day's mail which, as I mentioned above, loses out in priority to electronic correspondence.

In Closing

The biggest mistake that people make when in the throes of a job search is to believe that their resume or CV is the beginning and end of the process. That isn't the case. The resume is simply a door opener, much like an enlarged business card. There's no way that this document will actually land you a job. Therefore, don't fixate on the CV as the source of your job-search difficulties (or consider it the magic bullet that will solve them). It is certainly true that a poorly written document will hold you back in the job market. But I would far rather proffer to one of my clients a candidate with a marginal resume and the ability to sell herself than someone who has crafted a work of art but who can't communicate those strengths in person.

This article first appeared on ScienceCareers.org (Next Wave) at:
http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0490/cvs_that_open_industry_doors/

INTERVIEW TECHNIQUES: You've Worked Hard to Get This Far

by Jim Austin

Don't blow your job interview!

Only one-third of the postdocs who responded to recent queries on PostdocNet and elsewhere had received any interview coaching from mentors and advisers. "Nobody coached me," wrote one young scientist via e-mail. "I think people don't like to talk about that." Said another young scientist, "I received no coaching from my mentors, or even tips for that matter." There were some glowing exceptions, but in general the art of mentoring seems to have fallen on hard times.

This is bad news, right? Not necessarily. Yesterday's world of science was less diverse than today's science, and more personal. Although it helped to be a really good scientist, in the good old days it also helped to be white, male, and buddies with someone famous. The people with the best mentoring were, very often, the people who needed it the least.

In contrast to excellent mentoring, which is often unavailable to all but the well-connected, the Career Development Center for Postdocs and Junior Faculty (the CDC) is available to anyone with an Internet connection, from Amherst to Yeshiva U. We can't get you a job interview, but we can help you perform well once you've earned one. One of the key goals of the CDC is to level the playing field by disseminating as widely as possible information that once was available only to the privileged. It is in that spirit that we introduce (drum roll, please) the Career Development Center Guide to Faculty Interviews.

"Remember that we will be judging how you might teach students by how well you teach us."

What should you expect? While the pattern of campus-based interviews varies widely from campus to campus, the basic structure consists of interviews with faculty, postdocs, students, staff, and academic and human resource administrators, as well as giving one or two talks. Given all these components, most (but not all) campus-based interviews now last the better part of two days.

At some institutions the teaching talk will be with a real class during which you may be asked to fill in for the regular professor. If this is the case, be sure to ask for sufficient background information about the course so that you can prepare well. Elsewhere the teaching talk will be a mock teaching lecture, in which you may be asked to prepare certain material, or may be allowed to make that choice yourself.

At still other institutions both talks will be research talks, the second often a "chalk talk," less formal and more interactive than the research talk with "more opportunity to explore ideas, direction of work, and some perspective of the field," as one senior faculty member put it.

Do your best to remember everyone's name, but if you can't, don't worry about it too much.

Don't Expect to Eat Much. You'll probably have lunch with students and dinner with faculty. Although more relaxed than the rest of the interview, these are not social events. Stay sharp.

During meals you'll be talking too much to chew your food, and if you're the nervous type you won't be hungry anyway. So bring along a couple of protein bars, a bag of trail mix, or some other snack, so that you can squeeze in a few calories during those too-infrequent 5-minute breaks. Finally—and this is very important—make sure you have access to plenty of fresh, clean, cool water.

Keep Talks General and Short. The biggest problem with most research talks? It was unanimous: "Much too technical," said one faculty member/administrator. "This is not a talk to the 10 people in the world who actually care about mini-details. Remember that we will be judging how you might teach students by how well you teach us. It is not clever to pitch the talk above the heads of the faculty."

"[Candidates] usually do not have the big picture," wrote another respondent, "and present talks which do not place the work in the context of the field." Another wrote, "The most important flaws are the candidates' inability to present information or respond to questions relevant to a broad audience." Still another: "Make the talk focused, punchy, clear."

Your audience is seeking evidence that you can see the big picture. While they are likely to be smart and well trained, few audience members will be specialists in your field.

Keep talks short because you want to leave plenty of time for interaction at the end. And don't abandon detail completely. You don't want to talk about the details, but you do need to demonstrate that you're aware of them.

But Be Prepared to Answer Specific Questions, and Let People Know You're Prepared. Don't use your talks to answer complicated questions that nobody has asked; you'll only confuse the audience. Lay out your research plan and its significance in a general way, and leave time for discussion. End your talk with a brief discussion of specific preliminary plans, just to let people know that you've thought about it, and invite them to squeeze more information from you during Q&A. Your detailed explanations will be far more comprehensible—and far more appealing—when they come in response to a particular question from an obviously brilliant professor.

What Kind of Questions Should You Prepare to Answer? You should be prepared to present a detailed, step-by-step plan for attacking your research problem, and you should anticipate and be able to answer any technical and scientific objections your interrogators might raise.

You should be prepared to present an alternative approach in case the primary one should fail, to satisfy those audience members who are certain that your first plan won't work. Even if the skeptic is skeptical of the second plan, too, you'll be showing them that you aren't a one-trick pony.

You should be ready to present a funding strategy. To whom will you apply for research grants, and when? What evidence can you present that your work is fundable? That *you*, personally, are fundable? Have you written grant applications? Did they do well?

Modesty Is the Best Policy. Although having research funding already in hand is a great advantage, if you play it wrong it can work against you. "Sometimes, the candidates with big extramural funding seem to think that funding alone is sufficient to carry them. It isn't. Ironically, these same candidates want to know how many more dollars in start-up will be invested in their programs. They can come off as uninterested or, worse, selfish and arrogant. It is interesting to note that these are typically experienced scientists in nontenure-track research slots, and it is easy to understand why they have not landed more permanent positions."

> Keep your claims modest, because understatement comes over well, and even nonspecialists can smell exaggeration.

The best way to impress someone during a one-on-one interview is to show interest in their work.

Think Hard about What You Need to Succeed. And make sure they have it. Ask to see critical core facilities.

Do Some Thinking about Management Issues. Fourteen percent of Ph.D. graduates intend to do work that involves management, but nearly 50% find that their jobs require management skills. Management is part of the job and would be in the job description if there was one. You'll spend far more time than you anticipate filling out forms and dealing with compliance and personnel issues. So give management some thought. I don't mean that you should read Drucker or any of those business-management tomes (although it probably wouldn't hurt). Stick to the nuts and bolts: Kathy Barker's *At the Helm* covers the most important management issues.

Give some thought to recruiting. How do you intend to get good students? How will you attract postdocs? How many of each do you intend to have in your lab in the first years? Would you prefer a lab weighted toward older personnel (postdocs and senior technicians) or younger personnel (graduate and undergraduate students)? (Here's a hint: Unless you're older or have a forceful personality, it's best to start out with a young lab; *you* want to be the one to determine the lab's direction.) Another important question: How much time do you intend to spend in the lab? Most (but not all) are likely to agree that the more time you spend in the lab during your first years, the better.

Take time to map out your answers to these questions. Your interrogators will want to know that not only have you thought through these issues but also you have a sound approach that will minimize their need to cover your lack of management experience.

Make It Personal. Scientists are human, and the best scientists are often driven by personal, even idiosyncratic, passions. Don't hide yours. The committee will not be hiring your publications or your research accomplishments; they will—hopefully—be hiring you. So while narcissism is to be avoided, it is entirely appropriate to display a personal connection, a passion for the work. Keep it on a low boil (no *When Harry Met Sally* performances at the lectern) but don't keep your love of your work a secret. Your future employers want to know what drives you. Show them.

Do Your Homework. It sounds cynical, but it's a fact: The best way to impress someone during a one-on-one interview is to show interest in their work. This is perhaps the most important factor in succeeding in the endless series of faculty interviews. A sure sign of a good interview is that the interviewer does most of the talking—and obviously enjoys herself. You might be able to get away with smiling, nodding, and exclaiming ("how fascinating!"), but it would be much better if you could insert the occasional insightful comment. "They should ask for a list of everyone they will meet," wrote one experienced scholar. "Then cruise the Web site of the department, even read the latest papers—or at least abstracts—of people they will meet."

Your interrogators are seeking a new colleague, a potential collaborator. "We value our candidates' interactions with us," wrote one senior faculty member, "and their potential for making us more than the sum of our parts." And don't stop at the department: "They must tell us if they have colleagues elsewhere on campus with whom they hope to collaborate—or we won't know until it is too late."

Don't Confess. So now we move on to the more generic interviewing tips. One young woman I know felt so out of her depth at a job interview that she was moved to confession. She had applied on a whim and expected her application to be culled in the early stages. After a self-effacing research talk, she found herself speaking to the department's only female (a young, personable woman), and confessed that she felt like a fraud.

For the record: She got the job anyway, but that says more about the peculiar chemistry of hiring committees (the young woman voted against her, but the department's other members—all senior men—were oblivious) than it does about the wisdom of that particular move.

Everyone Matters. Treat everyone with respect, including administrative assistants, technicians, and undergraduate students, plumbers. First, because they deserve your respect, and second, because one or more of those low-level functionaries might hold the key to your future.

When giving your talk, look all around the room. Walk to the back of the room from time to time and address some remarks to the slouching students. Their opinions matter.

Be Confident. 'Nuff said.

But Not Too Assertive. Some people can get away with cockiness and others can't. Sadly, this tends to break down by gender. Especially if you are a woman, you need to strike a careful balance. Work hard to appear confident and competent, but avoid being perceived as aggressive or overbearing. Some (especially older, accomplished) men don't deal well with competitive—even confident—women. It's a sad fact, but it's a fact.

Still, if you are naturally assertive and feel the need to choose between being cautious and being you, that's a very easy choice: Be yourself and deal with the consequences.

Be Redundant. Trying to decide between overhead transparencies, slides, and a projected PowerPoint presentation? Bring all three. That way if they can't figure out how to work the fancy projector, or if someone put all the slides in backwards, you're covered. No need to take any chances.

Another sort of redundancy is also advantageous: Ask the same questions of a variety of people at different levels. Triangulate responses and test perspectives. After all, this is a two-way audition.

Don't Get Your Back Up over Personal Questions. Okay, so many questions about your personal life are illegal, technically. Some interviewers don't know that. Most mean well, even if their lack of social grace and cultural

awareness is sometimes appalling.

Anyway, when you think about it the prohibition *is* a little strange. Sure, it's well intended, and it has some positive effects, but the division between professional and personal is a little artificial. You're all going to be working together, so it's natural for them to want to get to know what kind of person you are. You will, of course, have to make your own decisions about how to deal with these, but I recommend that you go easy. If an interviewer asks you if you're married, assume the best, not the worst. Answer honestly with a smile, and with conviction: you don't want to appear to be apologizing for something—or someone—you care deeply about.

There are limits of course. Anything sexual is off limits. If an interviewer tries to seduce you or starts telling demeaning sexual or racist jokes, don't let the door hit you in the rear. Use your own judgment, but queries about future reproductive plans are clearly inappropriate and deserve a similar response. Still, be polite.

Dress Appropriately, Take a Shower, and Brush Your Teeth. "Scruffy, unkempt hair, dirty nails," wrote one prof in biomedical science at a large state school. "Inappropriate dress—e.g., a high slit skirt on a woman, or a holey T-shirt on a male. Academics are tolerant but there is a limit to what will be seen as disrespect."

Be Polite—Make Eye Contact—Use a Firm Handshake (But Don't Break Any Hands)—And Sell Yourself, with Integrity. The goal of an interview is to make a good match. For that to happen, you have to give an honest account of yourself. Salespeople have a lousy reputation. Happily (since you are now in that line of work) sales can be an honorable profession; the trick is to sell well-made, useful products, to present their virtues honestly, and to stand behind them. In this case you are the product, so you can feel good about selling it.

The sales analogy works another way, too. The wiser members of the hiring committee realize that this isn't the last sales job you'll be doing. Just as your new job will involve more management than you anticipate, it will also involve more sales. Even as the committee is evaluating the product, they're also evaluating your skill in selling it.

This article first appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2030/you_ve_worked_hard_to_get_this_far

FROM AN EMPLOYER'S WISHLIST TO YOUR CV

by Sara Shinton

Dear CareerDoctor,
I would like some advice on CV writing, specifically for people who, like me, are planning to go into the biomedical industry. Rajeev

Dear Rajeev,
In this column I'll give you my strategy for preparing a CV and point you towards useful resources, but first of all let me assume that you are planning to start your career within the U.K. job market. CV styles vary across the world, and if you are interested in applying for jobs in the U.S., for example, you will find a lot of advice on the American version of CV writing elsewhere on the Next Wave site.

The first thing you will need is a blank page—don't be tempted to update an existing CV. However, you should avoid the temptation to start filling that page with details of degrees, previous jobs, or interests. Successful CVs need to match the employers' needs as closely as possible, so your first task will be to identify those needs.

I am going to use a recent advert from a large pharmaceutical company to illustrate what I mean, but bear in mind that not all recruiters make life this easy, so you may need to trawl through the employers' Web site, call them up, or talk to people in similar jobs. You may also check out the list of skills specific to different jobs in the Report from RCI Working Group1 on Training[1] (look for Appendix 1) on the Universities UK Web site.[2]

The advert reads: *"A position is available for a graduate immunologist to join our Drug Discovery team on the discovery of novel medicines for the treatment of cardiovascular diseases. Ideally you will have recently graduated with an upper-second class or first class honours degree in pharmacology, immunology or a related biomedical science and have an interest in learning more about the physiological processes which occur in CVS diseases and about the drug discovery process in the pharmaceutical industry. You should enjoy practical laboratory-based work and have an appreciation of the importance of both in vitro and in vivo studies in drug discovery. The position will involve setting up and running medium- to low-throughput in vitro assays, pharmacological profiling, and mechanism of action studies, using tissues, cells in culture, and expressed recombinant human proteins. It could also include animal model efficacy and therapeutic index studies. Along with a strong background knowledge of pharmacology or immunology, you should be a good team worker with excellent communication and organisational skills and the ability to work to defined objectives and timelines."*

These few paragraphs tell you exactly what information you should convey, and more importantly, represent the checklist against which your application will be compared—and either short-listed or rejected.

So, how do you translate an employer's wishlist into a CV? On the left hand side of your blank piece of paper write down the skills, experiences, and qualities the job description explicitly asks for. Then on the right hand side write down evidence that shows how well you fit with the employer's criteria. To start with, you might get something that looks very similar to your old CV—things such as an honours degree in a relevant subject and general skills are at the centre of every CV. But looking more closely at the employer's list, you'll realise that more subtle qualities also need to come across—knowledge of specific techniques, interest in physiological processes, enjoyment of laboratory-based work, evidence of successful teamwork, and strong communication skills. Here are some tips to get these across in your CV.

Be up front about the level of expertise you have in the specific techniques the employer mentions in the ad (or elsewhere). Don't be tempted to overrate your technical capabilities or you will be asking for trouble. By default, list those skills you have actually developed and include a comment about your ready ability to acquire new ones. This may be something that your referees can back up in their statement, so make a note to discuss this when you ask them for feedback. Also bear in mind what is realistic for the employer to expect from you at your level. The language used in this particular ad suggests to me that they don't expect direct experience but rather an understanding of the techniques.

To illustrate your interest use the choices you have made during your undergraduate studies such as your degree modules or the topic of your final-year project. Some highly tailored courses don't offer this flexibility—but then if you opted for one of these courses, then you must have been guided by a particular interest of yours in the first place! If your choices don't match the specifics required by the employer, then you can always refer to them in your covering letter and emphasise your ability to follow your drive.

Enjoyment may seem rather difficult to convey but enthusiasm for the job should shine through on your CV. Having said that, if a smiling face is a must at an interview, until the day dawns when "txtng" is adopted by human resources, emoticons are not acceptable on a CV. So you need to liven up your CV with well-chosen words that are compatible with the profile given by the employer. Don't emphasise the value of intellectual freedom or the thrill of pushing the frontiers of pure knowledge when industrial research is all about product development. If you are stuck for inspiration click on a few careers sites such as ChemSoc[3] or Prospects.[4]

Other skills, those related to teamwork, communication, and project management, are also important and must be given the same consideration. At the graduate level your examples are more likely to be based on your involvement with societies or work experience. See my column on vacation work for links to sites that can help you identify the skills you may have developed through this type of activity. Don't feel that casual work develops "casual skills"—you may have experienced difficult situations, dealt with management issues, or shown real initiative whilst working in a bar or doing voluntary work.

Although my comments in this column are focused on graduates, if you are an applicant with a Ph.D. or postdoctoral experience, the process is exactly the same. Of course you will have more to prove for higher profile jobs, but you will also have far more experience upon which to draw. The UK GRAD Web site[5] and Swansea University's Career Development Planner[6] for academic researchers will help you recognise your skills.

Once you have been through this process you should have gathered sufficient evidence that you possess most of the desired characteristics. If there are serious gaps then you need to think carefully about whether to apply for this particular post. Alternatively, you may find that your achievements are much greater than those demanded. Don't fool yourself into believing that it will make you a more attractive candidate; in fact it is just as likely your application will be rejected. The first stage of short-listing is pretty ruthless and HR departments are unlikely to redirect CVs to better suited jobs, so you are better off simply contacting the employer to ask about more senior positions.

If it looks as though your list of skills and the job description are a good match, then you now have enough ammunition to start writing up your CV ... but that is another story, which I'll cover in Part 2! Meanwhile you can spend some time thinking about additional qualities that the ad does not explicitly require but that you think will give you an edge.

All the best in your career,
The CareerDoctor

This article first appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2310/from_an_employer_s_wish_list_to_your_cv_part_1/

1. Report from RCI Working Group on Training: http://www.universitiesuk.ac.uk/activities/RCIdownloads/RCItraining.pdf
2. Universities UK Web site: http://www.universitiesuk.ac.uk
3. ChemSoc: http://www.chemsoc.org/careers/careerswords.htm
4. Prospects: http://www.prospects.ac.uk
5. UK GRAD Web site: http://www.grad.ac.uk
6. Career Development Planner: http://www.swan.ac.uk/crs/career.htm

NOTE: Part 2 of this article can be found at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2310/from_an_employer_s_wish_list_to_your_cv_part_2

2. Funding and Grant Writing

HOW NOT TO KILL A GRANT APPLICATION

by Vid Mohan-Ram

"Facts, Hercule, facts! Nothing matters but the facts. Without them the science of criminal investigation is nothing more than a guessing game."

Inspector Clouseau's words ring true as much for *scientific* investigation as they do for legal proceedings—especially because research grants can prove to be as slippery to nail down as the Pink Panther.

Let's just recap the facts of grant writing thus far: We've established how to set the overall tone of your application; we've discussed how to design a good title, work out the structure of your abstract, and come up with logical aims and hypotheses; and we've learned the importance of careful editing. But before we move on to the next stage of the game—how best to put together methods, results, and your game-winning conclusions and discussions—let's review the suggestions, advice, and facts about grant writing that have been mentioned in this series:

Part One: Murder Most Foul[1]

20/20 Hindsight without Time Travel. Only a quarter to a third of applicants who submit applications to the main federal funding agencies—the National Institutes of Health and the National Science Foundation—get funded. That's some 17,000 to 23,000 grants and renewals out of the 70,000 or so applications sent to the federal agencies every year!

» Know the chances of grant-funding success.
» Be aware that there is a good possibility that you will have to resubmit your proposals.

Young Dogs, New Tricks, Old Mistakes. Be aware of mistakes, errors, and oversights that continue to crop up.

» Failing to support hypotheses.
» Failing to explain how data will be analyzed or how results will be interpreted.
» Failing to cite pertinent research findings.
» Including jargon.
» Being overly technical.
» Making sweeping generalities.

Project Titles: The Sweet Smell of Success. The project title needs to be:

» The total summary of the proposal.
» Clever (but not cutesy).
» Informative.

Part Two: Abstract Killers[2]

What's in an Abstract? Your grant application abstract should address the four following points.

» What do you intend to do?
» Why is the work important?
» What has already been done?
» How are you going to do the work?

Half-Baked Abstracts. To be complete, your abstract should.

» Summarize the full proposal.
» Include some indication of the costs of your proposal.
» Be hypothesis-driven.
» Never assume your hypotheses are true.

Dog Walker or Cocktail Talker? Be sure to set aside enough time to "walk the dog" (i.e., write the proposal), and remember that "an idea without a plan is simply cocktail talk."

» Sit down and write every day.
» Write a four-page summary of your research.
» Boil down the summary to create the abstract.
» Make sure this summary fits with and reflects the entire research project.

Drive home your message by repeating words or concepts in the title throughout the application.

Om1t J@R/g0n. Everyone involved in evaluating grants—from program officers to reviewers to funding committees—stresses that jargon should be avoided at all costs.
» Make the specific aims and ultimate goals very clear.
» Do not assume reviewers know that you know how to overcome and solve problems.
» Do not write for audiences that are intimately familiar with your field of research.

Keywords Perhaps Not Key. Referral offices—such as those at the NIH—use more than just the title or description to make assignments or pick reviewers.
» There is no point in trying to direct assignments by judicious word choices.

Rate Your Abstract. Not all reviewers on a panel will be formally assigned to read your entire proposal: Decisions—and the reviews—can be based largely upon this summary. That is why your abstract has to be perfectly constructed and why it is so important to carefully rate your abstract.
» Does it address the funding agency's criteria?
» Is it concise?
» What does it lack?

Part Three: So What?[3]

Psychological Tailoring. Before dashing off to write a full-length proposal, first step back and ask yourself how you want to sell your research.
» Decide where and how to pitch your proposal.
» Ensure your application matches the ideals of the organization.
» Check out funding agency home pages for submission criteria.
» Make sure your proposal is honest and realistic.

Uninformed, But Infinitely Intelligent. The research plan should begin with a basic but thorough introduction to the subject.
» Be explicit and state the obvious.
» Do not skip over basic information that can help clarify your research project.
» Be aware of how diverse your audience is.
» Educate the reviewers.
» Don't let your reviewer's mind wander or jump.

Biting Off More Than You Can Chew. Some application forms ask for the aims of your research proposal explicitly, others ask for it implicitly.
» Keep the number of aims to a minimum: two to four aims. Do not be over ambitious.
» Each aim should consist of only one sentence.

» The specific aims must be logical and stand alone.
» Keep aims related but independent of the successful outcomes of the previous aim.

So What?!? We've Heard It All Before. After reading the title, abstract, aims, and hypotheses, the reviewer should have a pretty clear idea of what you hope to achieve and how you plan to go about doing it. In your introduction or "significance" section, you have to now describe *why* you want to accomplish these aims.
» Do not be subtle—deliver your message fast.
» Describe the significance of your research at the top of your introduction. Go for the jugular right away.
» Make a compelling case for your proposed research project.

Part Four: Lost at Sea[4]

"Say It Again, Sam." Reviewers become frustrated at having to read, reread, and decipher a research plan before understanding a project. To write well:
» Read aloud what you write.
» Avoid using "this," "that," and dangling participles.
» Use bold and italicized text.
» Use clear headings and subheadings.
» Leave spaces between paragraphs.
» Drive home your message by repeating words or concepts in the title throughout the application.

Funnels, Paper, and Brainstorms. How can you organize your thoughts?
» Buy a sheet of paper, pin it up on a wall, and write headers on it.
» Brainstorm and write down every idea that comes to mind.
» Connect the ideas and words by arrows and develop a visual flow.
» Convert the pathways and arrows into typed sentences.
» Work in increments: When you write, write in paragraphs.

Review Thermodynamics. Give your reviewers an application that is easy and enjoyable to read.

Treat your reviewers fairly.

» The more energy and time a reviewer must devote to figuring out your application, the less energy a reviewer has to actually review your application!

Positive and Negative Feedback. Whatever writing assignment you undertake—editing is crucial to polishing the final work. For grant applications:
» Circulate your research plan among colleagues.
» Find out about professional editing services.
» Approach grant reviewers for editorial advice.
» Realize that editing is only the halfway mark of grant writing— *not* the end stage.

Don’t Sweat the Small Stuff—Just Do It! Applicants can bolster their applications with data from relatively easy but purposeful experiments.

» If possible, write the proposal one full grant cycle before the intended deadline.
» Use the extra time to perform the obvious experiments that reviewers will ask to see.
» Amend the text of your earlier application draft with the new results.
» Write with confidence, and don't list all methodological details such as buffer concentrations, unless necessary.
» A reviewer will read your application only once, so you really need that Wow! factor.

This article first appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0490/how_not_to_kill_a_grant_application_part_five_the_facts_of_the_case_thus_far

1. Part One: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0280/murder_most_foul_how_not_to_kill_a_grant_application
2. Part Two: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0280/abstract_killers_how_not_to_kill_a_grant_application_part_two
3. Part Three: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0350/so_what_how_not_to_kill_a_grant_application_part_three
4. Part Four: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0350/lost_at_sea_how_not_to_kill_a_grant_application_part_four/

FUNDING OUTSIDE THE BOX

by Jim Kling

Your new discovery has implications for breast cancer therapy. Who funds you, the National Cancer Institute (NCI)? Nope: The U.S. Army. You’ve just developed a swift-growing tree that drinks up metals in the soil as if they were lemonade in July, and it could be the next killer app for cleaning up Superfund sites. Who cut the R&D checks, the Environmental Protection Agency (EPA)? Uh-uh: The U.S. Air Force. A new airborne chemical sensor: EPA? The Department of Energy? Homeland Security? No: It owes its existence to the Small Business Administration (SBA).

Securing funding is difficult, time-consuming, and unpredictable, especially in an election year. Who knows how next year’s president's policies will impact the budgets of the National Institutes of Health (NIH), the National Science Foundation (NSF), and other stalwarts of scientific funding? The outlook right now isn't good. When a well dries up, it's time to drill a new one. It behooves anyone to look for money wherever it can be found.

By all means, go to the obvious sources. If you're a medical researcher, hit up NIH. If you're an engineer, knock on DOE's door or NSF's. But when you've exhausted your primary sources, consider this: Pots of gold are available throughout the federal government and the private sector, often where you'd least expect to find them. For example, the U.S. Army—through its Congressionally Directed Medical Research Programs—trails only NCI as the leading funder of breast cancer research in the U.S. government. Who knew?

Finding Money Plenty

So how do you go about finding these hidden sources? Start with networking. See all those related research articles piling up on your desk? Check the acknowledgment section to see who is funding those projects, says Janet Rasey, director of research funding services at the University of Washington.

> Put the OSP to work for you.

Then it's time to get out of the office. Your institution's Office of Sponsored Programs (OSP) is an excellent place to start, says Jerry Boss, professor of microbiology and immunology at the Emory University School of Medicine in Atlanta, Georgia, and a regular contributor to Next Wave. They may have a list of funding sources other researchers at your institution have used; colleagues whose work resembles yours might clue you in to potential sources you hadn't thought of. OSP should also have a list of private foundations that support scientific research; if your research has even a tenuous connection to a foundation's interests, add the foundation to your list.

OSPs exist to help you secure funding, so use them. Make an appointment and see what services they're able to offer. "It always works out better if you aren't trying to do things all on your own," says Susan Eckert, associate dean for finance in Emory University's Nell Hodgson Woodruff School of Nursing and another Next Wave contributor.

Ask around. Talk to your PI, your old adviser, your collaborators. Pigeonhole researchers at conferences. Don't ask them straight out; chat them up about what they're working on these days—and, oh by the way, where do you get your funding? "I think it's amazing how many different kinds of grants PIs have that we don't know about," says Maryrose Franko, senior program officer at the Howard Hughes Medical Institute, sponsor of GrantsNet.[1]

And while you're at it, consider making contact even at the obvious funding agencies, if you haven't already. NIH, for example, is a wildly diverse place, so try to find a friendly guide. NIH program officers are there to help, says Dennis Glanzman, chief of theoretical and computational neuroscience at the National Institute for Mental Health. "Tell us what you're interested in or send a one- to two-page white paper. We can usually find the

right person for you [to talk to]. So many people seem to be afraid of NIH as a black box, so they don't even try" to inquire, he says.

Your Lab Is a Small Business

Of all the odd places you've looked for funding, I bet SBA is one you hadn't thought of. SBA does not directly fund research, but a 1982 SBA mandate has made available hundreds of millions of dollars through participating government agencies (in 2001, total grants exceeded $78 million). Every government agency with an external R&D budget of at least $100 million is required to participate in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. With 11 participating agencies (not including the National Security Agency and the Central Intelligence Agency, which participate under a different set of rules), this adds up to quite a bit of money.

And before you object that you're not in business, keep in mind a nice little caveat in the SBIR mechanism: You do not need to be in business to apply. Though SBIR grants require you to be employed by a small business at the time the award is made, with STTR grants you can keep your day job, as long as you are *collaborating* with a small business. STTR rules require that 40% of the research work has to be done by the business. If you have an idea with true potential, finding a young technology company that's willing to take some government money shouldn't be that hard.

Here's how it works. A participating agency with a specific need issues an SBIR or STTR solicitation describing it. If you find something you think you can develop, you apply.

Phase I typically nets you fewer than $100,000 for a short-term proof-of-concept study. If you get invited to apply for phase II, you're eligible for $450,000 to $750,000 over a two-year period, at which point you are expected to develop the technology for commercialization. Phase III "is nirvana," says Morgan Allyn, director of strategic initiatives for Springboard Enterprises in Washington, D.C., which helps women entrepreneurs secure equity financing. That's because the true boon of SBIR is that once you've developed the technology, you are the government's exclusive provider for as long as you remain in control of it. That sensor you develop for the Air Force might just be bought by the other armed forces as well.

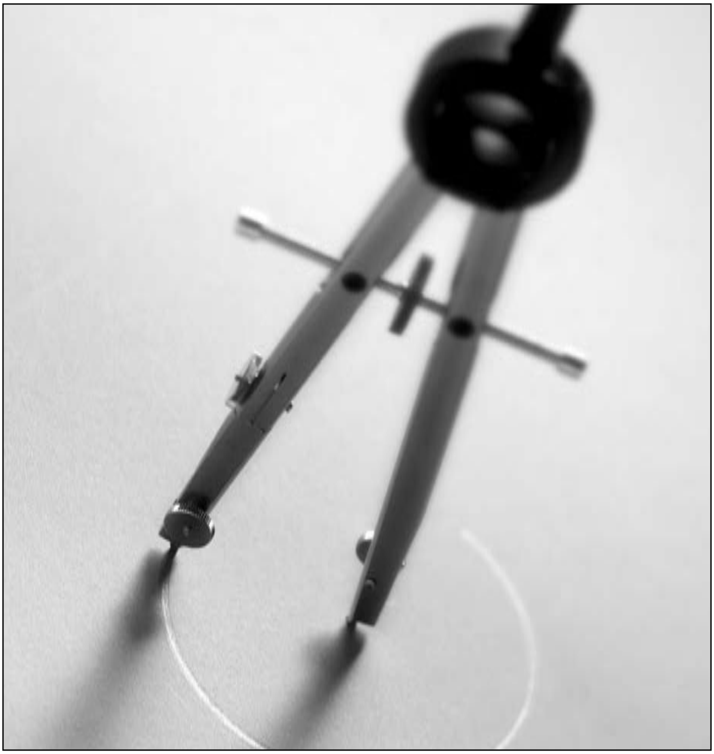
Several million- and billion-dollar companies owe their starts to SBIR grants, according to Allyn. "It gave them the edge. It put a stamp of approval that they knew how to do R&D, and you get easier access to other federal contracts. And the piece that trumps it all is, the moment you win a phase I SBIR contract you are immediately eligible to be the sole source provider."

The first step Allyn recommends is heading to SBIR World,[2] which provides a searchable database of SBIR announcements both past and present. Plugging in a variety of keywords related to your work may produce some surprises. Even if you have no intention of applying for an SBIR grant, it might be a useful exercise. All of these agencies have external R&D of at least $100 million, so there is money to go after even through more traditional avenues.

So go crazy, there and elsewhere. Surf the NSF Web site, NIH's CRISP database, GrantsNet, the DOE Office of Science, and any other potential sponsors you can think of. Finally, visit Next Wave's extensive list[3] of federal research-funding agencies. Surf using keywords only tangentially related to your own subject, and see what comes up. It may or may not yield an unexpected windfall, but such explorations are an interesting exercise. Even better: Reading about others' research can always inspire new ideas for your own.

This article first appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/3150/funding_outside_the_box/

1. GrantsNet: http://www.grantsnet.org
2. SBIR World: http://sbirworld.com
3. Next Wave's extensive list of federal research funding agencies: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/1470/the_federal_trough



3. Expanding Choices

UNIVERSITY CHALLENGE: Administering Research

by Carol Clugston

As someone who has successfully made the transition from a career in research to one away from the bench, I am often asked what specific steps I took to develop my chosen career in university management. The truth is that my career was not particularly well planned—at least initially—but I have learned a lot of valuable lessons along the way and I now have a career that I greatly enjoy and that challenges me every day.

Best and Worst Mixed Together

I developed a keen interest in science at an early age—I have always been curious to know why things happen and how things work in the natural world around us—and I eagerly began my B.Sc. Honours undergraduate degree without giving much thought to how my career would develop thereafter. Throughout my degree the infectious enthusiasm of several of my lecturers for their subject areas drew me to a career in research, and I embarked on a Ph.D. in molecular genetics.

The time spent earning my Ph.D. was, as I believe it is for many research students, one of extremes—the best and worst times of your life mixed together! Weeks of struggle during which experiments did not go as planned were rewarded by days of elation when positive results made all the effort worthwhile; many unforeseen problems had to be dealt with (equipment breakdowns, vital materials not arriving at crucial times); a myriad of relationships had to be managed with all their attendant challenges, from supervisor troubles to seeking help from colleagues, but at the same time developing friendships that have sustained and grown stronger over the years. There were the agony and ecstasy of presenting research findings at meetings, of writing and submitting papers for publication, and of finally having a completed thesis to submit.

I didn't realise at the time that, throughout the rollercoaster ride of my research project, I was developing a wide range of valuable life skills, including oral and written communication, problem solving, strategic and analytical thinking, project management, time management, and team working. And despite my lack of recognition of them, I continued to develop them over the years and I still use them every day in my current role.

Following my Ph.D., I quickly found employment as a postdoctoral researcher. I spent two years in plant molecular biology followed by six years in cancer research. Although these were different subject areas from those of both my undergraduate degree and my Ph.D., I found it relatively easy to apply my research skills and experience in different subject areas and, on paper at least, my research career was progressing well.

However, I became increasingly disillusioned with research as a long-term career. There appeared to be very few permanent posts and I experienced the practical difficulties and insecurities of life on short-term contracts, among them the issue of securing a mortgage. I felt under pressure to regularly move location to develop my career and I gradually realised that, as a woman, it would be very difficult to pursue a successful career in research unless I was prepared to make sacrifices in my family life.

I did not have children at the time, and I knew of very few successful female researchers who did. What's more, opportunities for part-time working or job-sharing were unheard of. In addition, while I still loved science, I was beginning to find life at the bench very repetitive and my desire to have more variety in my day-to-day activities grew.

Listing Transferable Skills

My decision to leave research was a difficult and daunting one. I had known no other career and initially thought that I had few skills to offer elsewhere. I seriously considered studying for an M.B.A. in order to gain a business-related qualification, but the high cost ruled out this option. Instead I

I had convinced myself that I had a range of useful skills to offer the world outside science, but could I convince an employer?

made lists of the transferable skills I had and of the nonresearch activities that I had been involved in that would demonstrate competencies and commitment outside my functional discipline; for example, I had organised my department's external seminar programme for several years and I had acted as secretary to my local Community Council for a similar period.

When I reviewed the lists, they were more impressive than I had thought they would be. This process helped me to identify my existing skills and, significantly, gave me the confidence to pursue a different career path with a positive attitude, rather than viewing it as faltering in my original plan.

I had convinced myself that I had a range of useful skills to offer the world outside science, but could I convince an employer? It was not an easy task. I applied for a variety of positions that interested me, from jobs in health promotion and health education, to various administrative posts within the higher education sector, and found myself competing with people who had directly relevant experience. Although employers could see that I had enthusiasm, commitment, and potential, it took six months of perseverance to secure my first nonresearch role as a university administrator.

The job that I was offered wasn't immediately the most appealing to me—in fact I considered turning it down—but I developed an instant rapport with the enthusiastic professor who would become my line manager, and I could also see that by accepting the post I would have the opportunity to gain a lot of administrative experience to add to my CV. I believe that I found it easier to get a position within a university, rather than a nonuniversity role, because the university recognised the value of my Ph.D. as a multilevel achievement rather than simply as a specialist in academic publication.

I moved to a subject area that was completely new to me—nanoelectronics—on a reduced remuneration, but from day one I didn't look back. The job was challenging, stimulating, and full of variety. I was immediately responsible for all the administrative aspects of the department, from managing the multimillion pound research budget and coordinating European networks, to organising a major international conference for 300 delegates. I was also responsible for promoting the research of the department and quickly had to learn to deal with regular press enquiries.

The requirement to quickly learn and understand new subject areas and technologies in order to be effective tested the limits of my capabilities. I realised that I had been working within a relatively narrow subject area and I was now exposed to areas of research whose existence I had not previously been aware of. But I also realised that I wasn't wasting any of my previous research experience—every day I was applying the generic and transferable skills that I had developed over the years of being a research student and a postdoctoral researcher. Each day brought different challenges, whether they be solving problems, managing resources, analysing complex data, or presenting technical material in a variety of formats to a range of audiences. I didn't miss life at the bench for a minute!

I stayed in my university administrator role for two years, building on my existing skills and developing a range of new skills and experience. I was then able to move to a more senior post, as administrative assistant to the university's vice-principal for research. This was an even broader role as it encompassed all the subject areas of the university, and it enabled me once again to use my biomedical research experience as well as my generic skills. It also enabled me to develop a much greater understanding of university management and to see research from other perspectives, e.g., the importance of research income to the university, what "overheads" are, the high costs of accepting charity funding (which covers no indirect costs), how research is balanced with teaching, and how interdisciplinary research can be fostered.

Over the past five years my role has developed considerably and my responsibilities now include many areas of strategy and policy, from helping to develop the university's research strategy and submission to the research assessment exercise, to drafting policies relating to research ethics and misconduct. Most recently I have assumed responsibility for developing the university's postgraduate research strategy and I am working closely with the University Careers Service to ensure that all our postgraduate research students and postdocs have access to generic skills training and personal development planning.

Fortunately, most postgraduate research students today are aware that the majority of them will not have long-term careers in academic research and they are much more aware of their generic and transferable skills through personal development plans and structured career planning. Funding bodies now also offer a wider range of career development schemes that allow for career breaks and part-time working. However, if you are considering a career outside research, my advice would be first of all to be confident of your motivation, and then to go for it! Your Ph.D. is a passport to many exciting career opportunities outside the confines of the laboratory!

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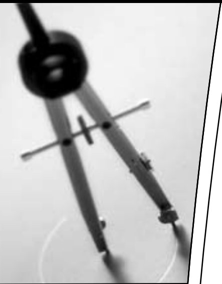
PATIENT TO RETRAIN IN PATENT LAW

by Anne Forde

Describe a game of hockey to a Martian." That was the task that neuroscientist-turned-patent-agent Sarah Thompson was asked to do when she was interviewing for a job as a patent agent trainee a few years ago. Thompson must have provided a decent impromptu description since she got the job; four years later, she is almost fully qualified as a patent agent.



"You have a lot to learn, but when you can argue the case of your patent application successfully to a patent examiner, it's great," says Sarah Thompson.

So were those interviewers being facetious? Not really. One of the fundamental skills required to work as a patent agent, says Thompson, "is putting difficult concepts into what a layperson—your clients—would understand." True, those clients are not extraterrestrials, but there is a wide gulf between the worlds of law and science, and Thompson's new job is to span it.

Seeking Her Niche

After finishing her undergraduate degree in pharmacology at Bristol University, Thompson wanted to continue her studies and felt that "doing a Ph.D. was a natural progression." She was keen to do a neuroscience research project, so in 1997 she started her Ph.D. at the University of Manchester in neuroimmunology. Thompson investigated the role of anti-inflammatory mediators in context of stroke and the resulting cell death. She soon decided that research was "very frustrating"—and unappealing for the long haul.

While still doing her doctoral work, Thompson found her interests growing broader. She became the editor of a newsletter in her university focused on public awareness of science. She also participated in the Biotechnology YES[1] (Young Entrepreneurs Scheme) competition, an activity that presaged her professional future. In Biotechnology YES, teams of undergraduate or postgraduate science students form a business plan for a virtual company and present the plan to a panel of judges, competing against other teams. The competitors live on-site and the competition runs over three days. During this time, the teams are visited by expert advisers who help them mold their business plans.

One of the competition advisers was a patent agent, and Thompson had the opportunity to talk to him about his job. He agreed to let her shadow him at his office—a private practice in Glasgow—for a day. Through her personal networks, she later gained another week's experience at another private practice in London.

After those brief work stints, Thompson decided to pursue a career as a patent agent. She felt that working in private practice would give her the best and broadest training, exposing her to a wider patent portfolio. As a starting point, she set about investigating what the firms were looking for. "Some places were looking for someone with a specific background, others not," she says. "Some did not even require you to have a Ph.D." In December 2000, she interviewed at the firm Mewburn Ellis L.L.P.[2] Being able to communicate difficult concepts in general terms—like explaining a game of hockey to a Martian—was probably the key to her getting that position, she feels. The following September, she started her new job.

A New Beginning

Although a scientific background is essential for her job, Thompson had to fully retrain to make the transition. For the first two years or so, Thompson worked under the supervision of various partners—senior patent agents—rotating every six months. “For example, I had to read examination reports from the European Patent Office (E.P.O.),” says Thompson. The key question a patent agent has to be expert in asking and answering, explains Thompson, is, “What is the invention? You need to be able to sumarize a lot of complex data to do this. There was lots to grasp.”

Patent Agents, Examiners, and Attorneys: What’s in the Name?
Patent agents have several employment options, Thompson explains. The first is working in private practice—like a law or accounting firm—where you act as the interface between your client and patent offices. The second is to work “in-house,” for example, at a pharmaceutical company. In both scenarios, the patent agent is drafting, prosecuting, and defending the patent.

Patent examiners, on the other hand, review—and then reject or accept—the patent applications submitted by patent agents on behalf of their clients. They are employed by a government or intergovernmental agency, such as the U.K. Patent Office,[3] in Newport, Wales, or the European Patent Office[4] (E.P.O.), in Munich, Germany. Patent examiners may move to work as patent agents, says Thompson, “but not normally the other way around.”

In the U.K., registered patent agents can use the title “Patent Attorney” although this title is also used by solicitors who may have no formal qualification in intellectual property.

A year into her training, Thompson spent four months at Manchester University doing a foundation course—a certificate course in intellectual property—in preparation for the first of the two sets of examinations that are necessary to qualify as a patent agent in the U.K. During this period, Thompson studied U.K. and overseas patent law, trademark law, and design and copyright law. “It’s an intensive course,” says Thompson, “with a lot of subjects to cover.” While on the course, Thompson was still on salary at Mewburn Ellis, and the firm paid her course fees. “It was good to do it full-time; not all firms allow that.” On completing the course, participants can take an examination that is equivalent to the first of the patent-law qualifying exams. Back at the office, on her return, “I was allowed to be a little more independent,” she says.

But her studying was far from over. She still needed to do part 2. The qualifying examinations—especially the second—are notoriously rigorous. Candidates are examined in all aspects of U.K. patent law. Passing the exams, says Thompson, “means studying most evenings and weekends”

"Here you have to make sure you're getting things done and meeting your objectives. It's almost a completely different experience."

beginning many months prior to the exams. The failure rate is high; many have to resit individual papers. Last month, Thompson resat part 2 papers for the second time and is awaiting the results. Last March, she also took the European Qualifying exams—exams the vast majority of U.K. patent agents in private practice and industry take—so she will be authorized to work with the E.P.O. She needs to resit one of these next year.

Gaining Experience and Responsibility

Now that she is working at a more senior level, Thompson says, she really enjoys being able to argue why an invention is worthy of its name—or not. "You are kept up-to-date; intellectually you are on the go the whole time," she says. Agents at her current level manage a portfolio of applications, which means swift decisions and many deadlines. But it's fun.

Last year, Thompson moved from Mewburn Ellis to the biotechnology firm, Cambridge Antibody Technology[5] (CAT), in Cambridge, U.K. Thompson appreciates the broad training she received in private practice, but she now finds specializing "in one particular technology area and working closely with the company's scientists" just as stimulating.

For Those Considering Patent Law

Passing those exams, says Thompson, required tenacity and years of study. Tenacity—and an argumentative streak—have helped her make it as a patent agent. What else? Communication and time-management skills are key, she says. Knowing a foreign language is also useful. Research training is important, but don't expect to work on patents that match your research area. When she was working at Mewburn Ellis, Thompson's "specialty" was all of biotechnology. "I had only one neuroscience-related patent in those three years," she says.

Was it worth it? "It was hard, you have a lot to learn, but when you can argue the case of your patent application successfully to a patent examiner, it's great."

This article first apeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2005_12_02/patient_to_retrain_in_patent_law

1. Biotechnology YES: http://www.biotechnologyyes.co.uk
2. Mewburn Ellis L.L.P.: http://www.mewburn.com
3. U.K. Patent Office: http://www.patent.gov.uk
4. European Patent Office: http://www.european-patent-office.org
5. Cambridge Antibody Technology (CAT): http://www.cambridgeantibody.com

LIFE IN BIOTECH

by Jim Kling

Life in the biotech industry is a far cry from academia. It isn't pure science. If you make the leap, expect to be indoctrinated into the world of business, because in industry business goals drive research. And even if you join a company as a scientist, you may find yourself moving out of the lab altogether. "There are lots of scientists who get tapped to do things in project management, business development, or marketing. As scientists, they don't have the background to handle those duties," says Rebecca Rone, who is director of the M.S. program in drug discovery and development at the Massachusetts College of Pharmacy and Health Sciences. The program offers classes in business and financing as well as various biotechnology-related sciences.

A biotech company is a tightly focused environment, where freedom of academic inquiry is often curbed in the interest of completing a project as quickly as possible, whether it's a new drug, a diagnostic technique, or some other science-related product. "In industry you gain knowledge along the way, but your focus is to do whatever you need to do to [to finish a project]. If something doesn't work, you have to realign your focus," says Joshua Seno, who is an associate in corporate development for the technology evaluation group at Amylin Pharmaceuticals in San Diego, California.

Like many graduates, Seno spent a couple of years working in an academic lab after he graduated from Purdue University with a degree in cell biology in 1998. He spent the time working at the Indiana University Medical Center in Indianapolis, Indiana, studying DNA repair proteins and how they respond to heat, a possible adjuvant to radiation in cancer therapy.

"I guess we were working toward some sort of goal [in academic research], but it was not a [well-defined] goal. There weren't any pressing deadlines except to get grants in," he recalls. But the academic life wasn't quite what he wanted. He didn't want to do a Ph.D., and he wasn't sure a master's degree would be any more valuable than the practical experience he was already getting. But when he read an article in *Science* about a new kind of hybrid master's program that combined biological science with business training, he was intrigued.

He settled on the master's of bioscience offered by the Keck Graduate Institute, a program in Claremont, California, that offers classes in biology, bioinformatics, and bioengineering side by side with courses in management, ethics, and business policy. After two years there, during which he did a summer internship at Amylin, Seno hired on at the company. Initially he worked half time in the lab because he wasn't completely comfortable moving into the business side of things, but after about six months he went to his current position full time. He soon found out that things had changed. "[At the Indiana University Medical Center], I felt a little more free to do anything I wanted, whereas here you have to make sure you're getting things done and meeting your objectives. It's almost a completely different experience," he says.

Seno's primary focus is researching therapeutic or technology areas

that Amylin is considering investing or participating in. For example, he was assigned to look into proteomics—to survey the field, identify the key players and potential collaborators, and survey the technology providers. He also performs financial analyses for specific projects. Once he identifies an opportunity, his role is to pursue relationships with companies, make contacts, and begin to set up potential deals. "My job as ... the rookie in this group is really to handle some of the smaller scale projects, whereas people with more business development experience would handle bigger projects," he says.

Cross-disciplinary programs like Keck were created because of a lack of business training for scientists that join the biotech industry, but Rone also sees a need for cross-disciplinary education. "Several people have mentioned to me that they think the pipelines have dried up because we've taken advantage of the easy hits—the [targets] that Mother Nature has informed us about. There is a real feeling that we have to totally reinvent things in order to come up with [new classes of compounds], and the best way to handle that is to have understanding between the disciplines," she says. That means that molecular biologists, cell biologists, chemists, pharmacologists, and bioinformatics specialists must be able to communicate with one another in order to combine their efforts.

You need that kind of communication just to get anything done in a small biotech company, says Douglas Gjerde, CEO of San Jose, California-based PhyNexus. "Today's small company has to produce. I firmly believe in the ability of the individual to have an impact, but the individual needs help. The only way that's going to happen is if they ask for help in a very specific way. You have to know enough [about another discipline] to know how to ask a question."

But don't get too caught up in trying to know a little bit of everything. Specialization is still very important. To succeed in industry, "you have to know at least one [discipline] extremely well, and you have to know the jargon of others," Gjerde says.

So be an expert, but be a generalist, too.

No one ever said the life in the biotech industry was easy.

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MAKING THE LEAP: When, How, and Why a Career in Drug Discovery May Be Right for You

by Matthew Bell

As a young scientist considering a career in drug discovery, you may have many questions that need answers. How does the pharmaceutical industry work? How would my career progress? What skills are companies looking for? Would I do high-quality science? Is it a better option than academia? The answers to some of these questions depend, of course, on the individual scientist. But the good news is that the pharmaceutical industry has many opportunities for scientists seeking a career in drug discovery, both in the laboratory and out.

First Things First—Is There an Opportunity for Me?

Creating new drugs is a risky, expensive, and time-consuming business. A top-10 pharmaceutical company will employ over 1,500 scientists, and spend over $1 million every day, on discovering new biological targets and creating new therapeutics (chemicals, proteins, or vaccines) to move forward into clinical testing. In total it can take more than 10 years to get a new drug to market, and the effort will involve thousands of people from many scientific disciplines.

In such a large and complex organization, there are many different career options for young scientists. If there is a life sciences discipline being pursued in academia, there will be a pharmaceutical industry opportunity in a similar field. No longer limited to biology and chemistry, the pharmaceutical industry offers long-term careers in various disciplines and subdisciplines (see Tabulation 1). Furthermore, cross-functional scientists are becoming an increasingly valuable commodity. As systems biology begins to take hold and bear fruit, there will be an increasing opportunity for scientists with multiple degrees: information technology with biology, statistics or mathematics with bioinformatics, pharmacology with genomics, and so forth. The opportunities are many.

Where Do I Start, and How Does a Career Progress in Industry?

You can make the leap into industry at any point in your science career. A promising young life scientist can secure an entry-level drug discovery position, usually termed “associate scientist” or “scientist,” with a bachelor’s degree in science. At this level you are responsible for completing basic experiments and will be a member of one or more cross-functional project teams that focus on discovering and progressing new medicines. These teams will have representatives from many scientific disciplines: chemistry, biology, and others. With a Ph.D. or postdoctoral experience, you can expect greater seniority and control over your own activities, and you also can expect to be leading these project teams soon. Being team leader of a discovery project is akin to being the senior postdoc in an academic lab, controlling the key staff and activities associated with a given line of research.

The good news is that drug discovery is unique in offering multiple career options that let you stay close to science without the daily grind of laboratory life.

The most successful team leaders can, in time, move into broader management positions, gaining progressively greater responsibility in terms of staff size, budget, and ability to impact strategy and direction. These people focus on managing other scientists (usually of the same discipline) and eventually attain the title of director in most companies; job titles are remarkably consistent between big companies. For many, this is the pinnacle of a successful career in drug discovery, but the most successful and ambitious directors will usually get promoted to head up entire departments, often with upwards of 100 people. Department heads can expect a title of vice president; they are akin to the very high-profile, large group, successful principal investigators (PIs) in academia. In the organization I work for there are about 15 vice presidents (senior leaders), and about 60 directors (middle managers) in a discovery organization of 1,300 staff.

Tabulation 1. Common Drug Discovery Disciplines

Biology
Assay development
Cellular biology
Electrophysiology
Genomics and molecular biology
Medicine
(Behavioral) pharmacology
Physiology
Protein biochemistry, expression, and synthesis
Protein engineering and biopharmaceuticals
Proteomics
Structural biology and crystallography
Veterinarian services

Chemistry
Analytical chemistry
Medicinal and synthetic chemistry
Rational design
Computational chemistry
In silico and de novo design
High throughput screening

Related Sciences
Engineering
Mathematics
Statistics
Bio- and chemi-informatics
IT, hardware, and software design

Many scientists don't like the daily grind of grant writing and administration that comes with a successful career as a PI in academia. Similarly, many scientists in industry have no interest in a progression into management. These scientists prefer to stay close to the science and away from the details of management, politics, and company bureaucracy. Thankfully most pharmaceutical companies recognize this and work especially hard to retain their best scientists, usually by offering an attractive nonmanagement career ladder. In many organizations these bright, dynamic, and innovative scientists can expect to become distinguished research fellows, on par with the most senior leaders of the organization but without day-to-day management duties and with the time and authority to focus on developing innovative new ideas, new technologies, and new science. It would be like being a visiting professor every day.

Tabulation 2. The Five Myths of Working for Industry

1. You don't get to publish
Not true. Most pharmaceutical companies strongly encourage publication of scientific work and often link bonus payments to high publication levels.

2. You don't get to go to conferences
Not true. Pharmaceutical companies generally encourage scientists from all levels to attend key conferences as both delegates and presenters.

3. You just screen or make compounds all day
Not true. A drug discovery operation is made of many different disciplines and involves many activities including a lot of basic research.

4. You are not free to follow your own interests or to be innovative
Not true on both counts. Innovation and creativity are strongly encouraged and scientists spend significant time exploring new hypotheses and approaches.

5. The science is not as good as in academia
Not true. Pharmaceutical companies claim many high-profile publications, patents, and groundbreaking concepts every year.

Why Do Scientists Choose Industry?

The majority of drug discovery scientists are motivated by the chance to discover a new medicine. Imagine being the first chemist to synthesize an important new treatment for Alzheimer's disease. Imagine being the first biologist to champion a new therapeutic approach for the treatment of cancer, and see it work. The desire and opportunity to do good science motivates industry scientists, just like their academic colleagues. In addition, the pharmaceutical industry offers a substantially higher salary (often double the academic level), better working conditions, plentiful equipment, and a superior work environment.

That said, industry isn't for everyone. Some scientists detest the idea of being accountable to a budget, of having to be part of a company culture, or following company strategy. Some scientists will always prefer to write grants and carve out their own niche, which works best in academia—not within a large company. But when you are deciding whether industry or academe is best for you, don't base your decision on the myths that circulate in academic circles (see Tabulation 2). Most are untrue much of the time; others are wrong all of the time.

Love Science, Hate the Lab

Many scientists want to stay in the science world, but don't like the idea of a lab-based career. The good news is that drug discovery is unique in offering multiple career options that let you stay close to science without

the daily grind of laboratory life. A platform in basic science can be the stepping stone to careers in pharmaceutical patent law, business planning and strategy, project management, operations management, publishing, media, communications and promotional activities, management consulting, competitive research, regulatory support, and business development (setting up alliances with biotechnology partners). These functions are all critical to drug discovery, are intellectually stimulating, and give a great opportunity to stay within science while leaving the lab behind.

What Next?

Drug companies are always keen to attract and recruit the best scientists. They are looking for a solid university track record, good publications, and evidence of good communication, team, and leadership skills. If you desire a career in the pharmaceuticals industry, think of yourself as a valuable commodity and network relentlessly. Annual reports and Web sites are great places to start looking for information. Medline is a good resource to identify researchers' names and scientific fields of interest.

Conferences are a great way to introduce your self to companies. Don't limit yourself to the accompanying career fairs. Visit posters and attend talks presented by drug companies and make a point of expressing interest in what they do and asking about potential job openings. Take along CVs and publication reprints. Take advantage of your personal connections; network via colleagues and friends. At the very least, get your resume out to the human resources directors at pharmaceutical or biotechnology companies that interest you. See if internship programs are available. Remember: The more contacts you make, the greater the chance of hitting upon a company that works in a technology or research area that you are interested in, and the greater the chance that one of those companies will be interested in you.

There is no way to tell for sure that a career in industry is right for you, but it has one piece of compelling data in its favor; scientists who move from academia into industry rarely move back again.

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http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2940/making_the_leap_when_how_and_why_a_career_in_drug_discovery_may_be_right_for_you/

4. Networking

GUERRILLA MARKETING YOURSELF

by Dave Jensen

I have a library full of business books on marketing. It's one of my favorite subjects. As a business owner, I've had to strategize the successful marketing of my company's services for many years. Although I've never had formal training in marketing, I can trace my love for this science back to a book that I first read in 1983: *Guerrilla Marketing* by Jay Conrad Levinson.

Fourteen million copies of this book and its sequels have been sold in the years since its publication, and Levinson's term "guerrilla marketing" has become part of our popular language. But it wasn't until 2005 that Levinson applied his marketing concepts to job-hunting in his latest book, *Guerrilla Marketing for Job Hunters*, co-written with executive recruiter David E. Perry and published by Wiley.

In this month's column, I'll take the best of Levinson and Perry's concepts from this excellent book and adapt them to the world of the sciences. Some adaptation is required because, despite its great value, the book suffers from the same problem as most generic job-seeking advice: Not every career tip you'd recommend to a widget salesperson makes sense for a scientist.

“Personal branding is not about presenting a false image. It is about understanding what is unique about you—your accomplishments, experience, attitude—and then using that to differentiate yourself from other job hunters. Your brand is your edge in the job market.”
—Levinson and Perry

Marketing Yourself on the Cheap

I read an interview with Levinson many years ago in which he was asked why his innovative marketing approach was targeted only to small businesses. The author responded with a term that I remember to this day. He writes for firms, he said, that “suffer from resource poverty,” so his guerrilla marketing methods are cheap. That’s what I like about this approach. Postdocs and grad students suffer from resource poverty as well.

One of the major concepts in the *Guerrilla* series is that you need to avoid doing what everyone else is doing. Thousands of scientists—your competitors—read the local newspaper ads every Sunday and scan the back sections of journals. Their job-search time is consumed by filling out Internet forms and mailing letters that start with that polite, old address, “Dear Sir or Madam.”

Make no mistake: Levinson and Perry don’t believe that you need to walk away from all the usual elements of the job search, such as writing applications and sending CVs. But if you want to catch the really big fish, they argue, you need to play in a smaller pond.

Moving to the Smaller Pond

One of the first things that these authors recommend is to set up what they call “the war room,” a place where you can be sheltered from all distraction. This is your private space, where you go specifically for job-seeking efforts. This distraction-free zone—which needs to have a desk, a chair, a computer, and a telephone—will help you focus, even if it is just the corner of an apartment. Think of it as a radio announcer’s cubicle, with an “On the Air” sign on the door (even if it there really isn’t a door).

> It is critical that you do not try to run a project like a job search from that small desk across from your lab bench. Too many distractions.

Once you’ve established your war room, turn your sights to what the crowd *isn’t* doing. I’ve written about networking many times in this monthly column, so we won’t go deeply into the subject this month; more information on networking can be found in a search of the “Tooling Up” archive.[1] But it’s hard to talk about guerrilla marketing without touching on networking because most people don’t like to network, so they neglect it. Guerrilla marketers recognize that if other people are neglecting it, that makes it a fine, small pond to play in!

The war room is where you go to make e-mail and phone contact with an ever-broadening list of networking contacts. It’s also the place to plan your own public relations (PR) campaign.

PR has gotten a bad rap in the last couple of decades. We hear about "spin doctors" who represent the oily side of PR, putting a positive, dishonest gloss on even the most negative stories and situations. But that's just one small side of PR; PR can also mean putting across a positive message that happens to be true. In a job search, PR is important because getting your name out there is half the battle. PR is really about trying to put yourself in the right place at the right time by means of a publicity campaign and some creative prowess. I'd call it "networking on steroids."

Here Are Three Ways to Go About Getting Your Name and Capabilities in Front of Others. (1) Anyone can have a business card, not just those who have "real" jobs. In industry, exchanging cards is much more common than handing over a CV or résumé. Your card should have the logo of your university or institution and possibly even a few comments about your area of expertise on the reverse side. Have you ever seen business cards from employees of Apple Computer? Some of them read "Software Wizard," or "Business Development Guru" in place of a stuffy title.

> With a little humor, you can sometimes get across a short who-am-I statement with more punch than a three-minute verbal introduction.

(2) Participate in local meetings of associations and trade groups in your field of interest. Get on their committees and volunteer for jobs that no one else wants to do. You'll gain a reputation as a person to count on, and it will benefit you with increased visibility. It always surprises me how a savvy postdoc can find a spot on a committee filled with "insiders," those few people every association must have to succeed. Even desirable committees such as the "social committee" have jobs that no one readily volunteers for (clean up after events, keep the e-mail database, etc.). No matter what your role is, you will have gotten your foot in the door and a chance to work with these insiders.

(3) Write (and publish) an article on a topic that has nothing to do with your project. Get your name out there by writing about career issues for a site like this one, or write for your local paper on what it is like to be a scientist in today's job market. You would be surprised what can come back to you in the form of job leads from just getting exposure—*any* exposure. (Although for movie stars it's sometimes said that even bad publicity is good, in the case of a job seeker, your creative guerilla marketing approaches have to be credible and reflect well on the real you.)

A Company Called "Me, Inc."

According to the authors of *Guerrilla Marketing for Job-Hunters*, many technical professionals, scientists, and engineers have difficulty seeing themselves as anything more than a commodity. If you think of yourself as "a" Ph.D. biochemist with a background in enzyme kinetics, say, you are a

commodity for sale in a crowded market. Getting paid top dollar is very difficult when you are something that the employer can find anywhere.

You need to present yourself to the world as much more than a list of lab techniques. This involves what marketing people such as Levinson call “branding.” The best way to think about branding is to imagine yourself as a company offering a variety of services. (See my earlier article, “The Concept of Me, Inc.”[2])

Reference: Jay Conrad Levinson with David E. Perry, *Guerrilla Marketing for Job-Hunters* (Wiley, 2005). ISBN 0-471-71484-4.

“Personal branding is not about presenting a false image,” Levinson and Perry say. “It is about understanding what is unique about you—your accomplishments, experience, attitude—and then using that to differentiate yourself from other job hunters. Your brand is your edge in the job market.”

What’s the best brand for a young scientist or engineer? Certainly, you want to have a brand that speaks specifically to your area of technical expertise, but it is critical to add a personal spin to what you bring to the table. I can tell you from experience that one strong bonus to add to the marketing focus of any highly competent scientist is to become known as a *problem solver.*

Moving from a Commodity to a Brand

Think about your skills and abilities using the Challenge-Approach-Results format. With paper and pencil, sketch out all the major problems you’ve solved in your time in the lab, starting with the most current and working backward—these are the challenges —on a page that has three vertical columns. The center column, Approach, gets you thinking about the specific action that you took to solve the problem highlighted on its left. Finally, in the right column, list the result. Write succinctly, with just a couple of sentences in each section.

Now sit back and look at this document. You will be impressed by your problem-solving ability. Do you think that a person who has developed their critical-thinking and deductive-reasoning skills in this way is only of value to people who put them to work in the lab? No way! As a professional problem solver, an entirely new world will open up to you in the job-seeking process.

After many years of reading the *Guerrilla Marketing* series of books, I can tell you that moving from commodity to brand is something that can increase your short-term and lifetime income by a significant percentage. I know, because guerilla marketing worked for me. Without placing a single advertisement, my small company begun in my garage became an entity with a recognized name that, 10 years later, attracted the interest of a $4 billion company. Thinking back upon the reasons for this, I can come to no other conclusion than that Jay Conrad Levinson’s methods work well.

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1. Tooling Up Archive: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0000/tooling_up_index
2. The Concept of Me, Inc.: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/0140/the_concept_of_me_inc

HOW TO GET A GOOD CONNECTION

by David Bomzer

Surveys indicate that 50% to 75% of people found their last job through networking. You can network several ways, including networking by phone, giving a presentation, or networking face-to-face. This article will focus on three types of face-to-face networking: one to one, one to many (e.g., in a meeting), and many to many (e.g., at a conference).

> Effective networking requires creating a dialogue.

There are many opportunities for face-to-face networking, including professional association meetings, social gatherings, and job fairs. The mechanics, tips, and tools in this article are applicable to all three types and to the different situations. You must decide which types and places work best for your face-to-face networking.

But first, here is a short quiz about networking.

Why Network?
A) To meet people
B) To get a job
C) To make money
D) Next Wave told you to

Why network among strangers?
A) To tell people you're looking for a job
B) To build relationships
C) To get calls when job openings and opportunities occur
D) Next Wave said it would be good for you

When networking you should ...
A) Talk about yourself
B) Talk about your ideal job
C) Ask questions and build rapport
D) Talk about Next Wave

To determine if you make positive eye contact, think of a face-to-face conversation you had today and try to recall the other person's eye color. Practice this observation in several settings until it feels natural. This simple exercise can help you start to focus on making more genuine eye contact when in conversations.

If you answered, respectively, A, B, and C, then you are on your way to success. You'll also recognize that it's possible to break effective face-to-face networking down into three component parts: Meeting the Person(s), Establishing Rapport, and Communicating Effectively.

Meet the Person

Face-to-face networking begins with attitude and body language. You may recall learning that dogs sense fear; well they—like people—can also pick up on a person's attitude. A useful attitude is an important aspect of networking. Useful attitudes include being warm, enthusiastic, relaxed, curious, helpful, patient, and interested.

Insider's Tool #1: Finding a Positive Attitude. Try this technique to get a positive attitude before a face-to-face networking situation. Find a quiet spot, close your eyes, and picture a time you had a positive moment. Recall the sights, sounds, and physical sensations. Intensify the sensations. At the height of the sensations, squeeze together the thumb and forefinger of your writing hand, then relax them. Practice this several times. When that face-to-face networking situation arises, squeeze your thumb and forefinger as a trigger to recall the attitude.

Just as it does with other animals, human body language also sends a message. Body language can create a positive or negative presence—the degree to which individuals attract attention and how they represent themselves. There are four elements to positive body language that conveys a positive presence: standing with palms open, making eye contact, giving a welcoming smile, and offering a pleasant greeting.

Insider's Tool #2: Making Positive Eye Contact. To determine if you make positive eye contact, think of a face-to-face conversation you had today and try to recall the other person's eye color. Practice this observation in several settings until it feels natural. This simple exercise can help you start to focus on making more genuine eye contact when in conversations.

A welcoming smile offers a simple but effective message. At a recent training session I conducted, fewer than half of the participants were able to identify their own welcoming smile.

Insider's Tool #3: Practice Your Best Smiles and Greetings. Ask friends to tell you which of your smiles are most genuine and make them feel welcomed. Practice those smiles in a mirror. Make them a conscious part of your body language for face-to-face networking.

A positive greeting incorporates friendly gestures, eye contact, and a smile. The greeting should also be in a pleasant tone and use the other person's name. Use of a person's name communicates a message of familiarity. Also, repeating a person's name after being introduced immediately acknowledges that you are listening.

Establish Rapport

These basic tools will help you become ready to start meeting people. Once you've met someone, though, you will also want to create a positive connection with that person—to establish a personal rapport. One technique to build rapport is using synchronizing skills, adjusting your physical and vocal tools to be in tune with the other person. Synchronizing your physical attributes can include aligning gestures, body posture, body movements, facial expressions, and even breathing. You can also synchronize vocal attributes including tone, volume, speed, pitch, rhythm, and verbal fluency. Verbal fluency is using words that the other person prefers. It is analogous to trying to speak to someone using their native language. As with speaking a foreign language, use preferred words only to the degree that you are familiar with their proper use.

Insider's Tool #4: Practice Synchronized Conversations. Focus on synchronizing when having a conversation with a partner. After one minute, stop and reverse roles and then discuss what you each observed. Was the synchronizing subtle or was it obvious mirroring? Provide each other constructive feedback. It may help to have a third person as an observer to provide feedback.

It is important when synchronizing to make sure the words, tones, gestures, and body language are all congruent, i.e., send the same message.

> Insider's tip: To build rapport, observe the person(s) prior to approaching her or him to network. This allows you to identify physical and vocal styles.

Effective Communication

Effective networking requires creating a dialogue. You can accomplish this through exchanging information and finding ways to assist one another. The first rule of effective communicating is ask, don't tell. Use open-ended questions—those that begin with who, what, when, why, where, or how.

Another effective technique is providing details from which the listener can easily extract information and then respond. One way to do this is by adding an information tag to your greeting, for example, "Hi, I'm David and I am a scientist." This expands your greeting and provides an opportunity for the listener to respond. Often they will either mimic your response or they may respond with a question, such as, "What type of scientist?" If they respond with an open question, a dialogue can begin. If they mimic your greeting, then you need to use an open-ended question to get the person talking.

Insider's Tool #5: Practice Using Open-Ended Questions. With a partner, practice using open-ended questions by having one person start by asking

an open question to which the other person must respond with an open question. Go back and forth for a minute. The listener should notify the speaker if they do not use an open-ended question.

Insider's Tool #6: Become an Active Listener. Active listening is giving the speaker feedback that acknowledges you heard and understood what they have said. This is different from paraphrasing. In paraphrasing, you are restating what the speaker indicated. In active listening you are extracting information from what they said and responding with new information that relates to it. A simple example would be: Person A says, "The job market is very competitive." Person B responds, "Yes, jobs I have applied for have received resumes from many qualified people." People like to know that they are being listened to. This is a way to show you are listening and participating in the discussion.

Putting It All Together

By practicing useful attitude, open body language, synchronizing, and active listening, you can master the three important tools to successful face-to-face networking. This article provided you a blueprint and tools to help hone your networking techniques. However, it is up to you to apply these to gain the insider's edge on face-to-face networking.

This article appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/1470/networking_how_to_get_a_good_connection/

5. Female and Minority Experiences in Science

WOMEN AND MINORITIES: NEGOTIATING SALARIES

by Lee Kass and Kathleen Gale

The objective of this article is to heighten awareness for women and minorities about the effect of starting salary on career earnings and the materials available for assessing your potential employer. The bottom line is that a low starting salary will haunt you throughout your academic career. In general, the salaries of women are significantly lower than their male counterparts in academia, as most recently reported by the American Association of University Professors (AAUP) in its 2002 Annual Report on the Economic Status of the Profession[1]—although the discrepancies have existed for at least 30 years. One explanation is that male and female candidates have different behaviors and expectations in the job application and interview process. There may also be systemic sexism in academia (Rossiter 1982, 1995). Similarly, minority persons may also interview differently than those in the majority, and they may face covert institu-

If no outstanding minority or female students are identified at the institution, this could be an indication of the departmental and institutional climate regarding underrepresented minority populations.

tional racism. In hopes that it may help counteract prevailing trends and behaviors, we offer our own experiences and advice to people interviewing for the first time.

The interviews and salary negotiations that we describe took place at a small liberal arts college in the early 1980s. One of us already had a job and felt secure in negotiating a new contract, whereas the other was delighted simply to be interviewed and did not consider negotiating. This job would provide a secondary income, so salary was less critical. Neither of us considered that the future might require our financial independence, which it ultimately did. Both of our starting salaries were low, but a minimal negotiation significantly raised the initial salary for one of us.

Ten years later, by examining the pattern of salaries by gender at our institution and by looking at the data published in *Academe,*[2] the journal of the AAUP, we realized the consequences of our failure to adequately bargain fair and comparable starting salaries. Not only were our salaries unfairly low, but so were those of other women in our institution. By examining national averages at all levels of colleges and universities, we learned that this was a national pattern. If a class of people starts with a low base-rate salary, even high percentage raises will not allow them to catch up with peers in other groups.

In view of our experience, we offer the following advice to young women and minorities who are applying and interviewing for academic jobs:

- Consult *Academe* for the average salaries of the institution in question.
- Know your worth in your field.
- Ask your interviewer about the salary range for the position that you hope to be offered.
- Discover other aspects of the institution.
- Before going to the campus, talk to other faculty, graduate students, and undergraduates about the treatment and feelings of minorities on campus.
- Include the salary you expect in your cover letter.
- Be aware that you may get a stock reaction from a discriminatory institution, in that they will not meet your fair salary request.

We found AAUP's publications most valuable for ascertaining average salaries in universities and colleges. This source is especially valuable for data on private institutions because details of their salaries are not generally available. To our knowledge, since the early 1970s, the March/April issues[3] of AAUP publications have reported on the economic status of the professions. For example, in Table 5 of the 2002 report,[4] you will find evidence of apparent salary discrimination based on sex in the aggregate data for all colleges and universities listed.

To find an approximation of your worth, examine the salary ranges published in the job advertisements in your field in the

Chronicle of Higher Education[5] and in your professional journals. This will give you an idea of what is being offered in the market. You may also talk with graduate student or postdoctoral colleagues about their interviewing experiences to learn whether the salary you have been offered is commensurate with what they have received.

We suggest you avoid applying to or interviewing at institutions that have been sanctioned or that have administrations that have been censured by the AAUP. Such organizations are listed on AAUP's Web sites. The AAUP committee on governance investigates *serious* infringement of governance standards recognized by the association. If an institution fails to meet these standards, AAUP may sanction that institution to force compliance with its guidelines as set forth in its Statement on Government of College and Universities and derivative governance documents. Three institutions are currently on the AAUP sanctioned list, one first cited almost 10 years ago.[6] The AAUP Committee on Academic Freedom and Tenure censures administrations that are not observing the generally recognized principles of academic freedom and tenure endorsed by the association in its 1940 Statement of Principles on Academic Freedom and Tenure.[7] A surprisingly large number of administrations—53 at this writing—are currently under censure because of infringement or violation of faculty freedom to teach, conduct research, or publish. You may want to refrain from accepting an appointment with a censured administration.

> To determine the environment for women and minorities on the campus in question, first find the university's or college's Web site or get a copy of its bulletin.

Locate the department to which you are applying, review the names of faculty listed in that department, and note the diversity of its faculty members. Contact a few of them by e-mail or by phone and discuss their attitudes toward women and minorities. Ask for the names of their best graduate, undergraduate, and minority students and contact those students. If they fail to mention outstanding minority or female students, this could be an indication of the departmental and institutional climate regarding underrepresented populations.

Our experience on search committees has taught us that it is usually effective to ask for the salary you expect. We observed that white males are more assertive in this regard than are women or minorities. However, if you are qualified for the job and have asked for a salary that is reasonable in terms of the data you collected, but you don't get an interview or receive a job offer, you may be experiencing institutional discrimination. We know of an interview at which a well-qualified woman asked for a salary at the top of the range. Her request was unequivocally denied and her interview was immediately terminated. However, the man who was eventually hired for that position was less qualified but was given the uppermost salary. You may wish to notify AAUP in writing if you believe you have been unfairly treated during your interview process. Such documentation is valuable if

"In practice, only a limited number of chemicals have been properly tested for reproductive toxicity, so many hazards are not known about," says toxicologist and U.K. government adviser Paul Illing.

the AAUP investigates that institution.

We invite you to use our checklist when you apply and interview for jobs. We urge you to document and discuss your experiences with your colleagues. You can influence the outcome of your interview by being well prepared, assertive, confident, and knowledgeable. However, only excellent documentation and collective action can identify institutional racism and sexism. We wish you successful negotiating.

This article first appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/1960/women_and_minorities_negotiating_salaries/

1. 2002 Annual Report on the Economic Status of the Profession: http://www.aaup.org
2. *Academe*: http://www.aaup.org/publications/Academe/index.htm
3. March/April issues *Academe:* http://aaup.org/publications/academe/2006/06ma/06matoc.htm
4. 2002 Annual Report: http://www.aaup.org/surveys
5. *Chronicle of Higher Educatio*n: http://www.chronicle.com
6. 10 years ago: http://www.aaup.org/governance
7. Statement of Principles on Academic Freedom and Tenure: http://www.aaup.org/Com-a/Censure.htm

THE TOP FIVE CHALLENGES FOR PREGNANT SCIENTISTS

by Lynn Dicks

Pregnancy changes your life. When you become pregnant, you become a different entity in employment law and in the eyes of those you work with. Your research can be affected in many ways, many of them unforeseeable. Here's a guide to handling the new challenges.

Challenge 1: Know Your Rights

The most important thing for scientists starting a family is to understand the rights of European mothers in the workplace. The 1992 European Directive on pregnant workers and new mothers,[1] which has since become law in every member state, gives women employees a number of important rights.

Your employer is obliged to carry out a risk assessment[2] on your work once you have given notice of your pregnancy. In most countries, you have to do this in writing. It is a good idea to notify your employer as soon as possible, because some risks are higher early in pregnancy. Any risks identified by the risk assessment should be avoided. If it is not possible to avoid them, you are entitled to paid leave for the period of the pregnancy.

The directive demands a minimum of 14 weeks paid maternity leave. It protects you from being dismissed because of pregnancy and entitles you to time off for antenatal checks. It also covers women who are still breastfeeding when they return to work. Breastfeeding mothers are protected from chemical and biological hazards in the same way as pregnant mothers, and employers are required to provide a private, comfortable space suitable for breastfeeding or breast-milk extraction (not a toilet).

If you're a student, Ph.D.or otherwise, this law does not protect you. Still, most funding bodies will pay a period of maternity leave for postgraduate students, and institutions and companies whose premises they work on will treat them as members of staff in terms of health and safety. But whether students are entitled to paid extended leave due to a pregnancy-related risk is still a grey area in most institutions. It's worth finding out from your supervisor or institute where you stand before the situation arises.

Challenge 2: Your Ability to Do Your Job

Some parts of your job may become uncomfortable or impossible when you are pregnant. Manual lifting is dangerous, because your ligaments are softened. Lone fieldwork is not advisable, and activities that put your body under stress, such as diving or climbing, are out. Long hours and working in hot conditions should be avoided. Sitting on uncomfortable lab stools or standing for long periods are not only difficult but increase the risk of low birth weight or preterm delivery. In early pregnancy, the smell of chemicals you are working with may make you vomit. These are all recognised risks. Make sure the person doing your risk assessment knows what difficulties you are facing.

It isn't always practical to set aside your work-related responsibilities, but the health of your future child may depend on it. "Often the solution is simply to rotate your job with someone else or vary your duties, so you are not in one place for so long," says Jane Paul, a health and safety expert who advises the International Labour Organisation[3] (ILO).

Sometimes it is the employer or the authorities, rather than the scientist herself, that imposes the restrictions, and this can lead to frustrating conflicts. As a pregnant ecology student in the United Kingdom, I was forced by my funding body to be accompanied during fieldwork. This was a serious inconvenience. I was left responsible for finding someone to join me and with no resources to pay them.

The European Directive on pregnant workers states that you cannot be required to do night work while pregnant. In some countries, including Germany, night work is actually illegal for pregnant workers, which could be a serious problem for young scientists eager to get access to big equipment at off-peak times.

In general, the solution is to anticipate the problem and plan your work carefully. Scientists at the British Antarctic Survey (BAS) can no longer "go south" when they get pregnant. Several women at BAS have

had children recently or are about to, but there has been little inconvenience. Eric Wolff, a principal investigator at BAS, says: "We have not yet had a team member who was unable to go at the last minute because of pregnancy. I suspect people plan their babies or their trips south quite carefully."

If you have recently become pregnant or are planning to, it can be helpful to work in a team so someone else can cover the work you can't do. Nadine Johnston, a marine ecologist at BAS working on feed webs in the southern ocean, is seven months pregnant. "My data are samples of krill and fish, which others can collect for me to analyse," she says.

Challenge 3: Keeping Your Baby Safe

The greatest risks to your foetus at work are chemicals known to be embryotoxins and infectious diseases that can cause birth defects or spontaneous abortion. Ionising radiation is also a problem, especially if it comes from radionuclides of bone-building elements such as calcium and phosphorus, which are preferentially taken up by the foetus. Safety levels for radionuclides are lower for pregnant women. In the case of lead, levels are lower for all women of childbearing age.

That's because the foetus is most vulnerable in the early weeks of pregnancy, when you may not know you are pregnant. Irene Figa-Talamanca, a toxicologist at the University of Rome "La Sapienza," would prefer to see all workers explicitly protected from reproductive hazards. "Many occupational risks have effects very early in pregnancy and determine subfecundity in men and women," she says. "Specific measures for pregnant women may have negative consequences for women's employment opportunities."

Toxicologist Paul Illing, an adviser to the U.K. government on the safety of chemicals at work, asserts that the health and safety regulations assume all women are in the early stages of pregnancy. "In theory, everyone is protected," he says. "In practice, only a limited number of chemicals have been properly tested for reproductive toxicity, so many hazards are not known about." Figures from ILO indicate that of the hundreds of thousands of chemicals in regular use in labs, about 2,500 of them have been tested for reproductive effects, says ILO's Paul.

Even groups of chemicals that have been tested can be steeped in controversy. The ethylene glycol ethers used in the semiconductor industry are known to be embryotoxins, for example, but there is disagreement between American and British studies about whether there is a real effect on human pregnancies.

If you work with chemicals you think may pose a risk but are not on any list of recognised hazards, the only solution is to familiarise yourself with what is known about them and let your employer know you are uncomfortable about the safety of your baby. Without legislation, an employer is not obliged to take any action, but you may reach an agreement.

If you work with chemicals you think may pose a risk but are not on any list of recognised hazards, the only solution is to familiarise yourself with what is known about them and let your employer know you are uncomfortable about the safety of your baby.

When it comes to infectious diseases from animals, David Buxton, head of pathology at the Moredun Research Institute in Edinburgh, United Kingdom, is used to handling the risks. He works on the causes of infectious abortion in sheep. The intracellular bacterium *Chlamydophila abortus* and the protozoan parasite *Toxoplasma gondii* are two of his main subjects. They are also the reason why all pregnant women are told, antenatally, to avoid contact with farm animals, particularly sheep and lambs.

Buxton's team manages hundreds of sheep and often works with animals that have been deliberately infected. "Our safety regulations are ferocious," he says. "If a woman is pregnant, she is not just excluded from the sheep pens. She's excluded from the labs as well"—and confined to her desk. Women are told that if there is any chance that they might be pregnant, they must say so immediately. Buxton admits that the rest of the team have to work harder to support women who cannot be involved with the practical work.

Challenge 4: Taking Maternity Leave

Taking time off to have your baby has its own problems, especially if you work in a fast-moving field. A year later, your work may be superseded and your command of the literature weak. Get the paper published before you go.

"Taking time off to have children reduces your visibility in the international community," says Wolff. "Regular attendance at conferences is important. If you are off the horizon, people forget to invite you as a speaker or involve you in collaboration." BAS goes to considerable lengths to ensure that mothers and mothers-to-be are able to attend at least one conference a year.

"The number of invited talks is one of the factors included in the Research Assessment Exercise, by which university departments are rated nationally," says Penny Gowland, professor of physics at Nottingham University in the United Kingdom. Gowland encourages women to come back from maternity leave with confidence. "Do not allow yourself to be sidelined because you have been away for a while and you can no longer engage in the long-hours culture," she says.

Other useful Web sites

» European Agency for Safety and Health at Work[4]

» United Kingdom Health and Safety Executive[5]

» Royal Society of Chemistry guidance on pregnancy and chemicals at work[6] (soon to be superseded by a new edition).

Alvord believes in a system of health care, especially but not exclusively for Native Americans, based on both modern medicine and traditional wisdom.

Challenge 5: Coping with Discrimination

The Spanish word for pregnant is *embarazada*. Are scientists who find themselves “embarrassed with child” treated differently by their colleagues because of their condition? There is little sign of this in the public science sector, universities, and research institutes. Female scientists report full support from those around them. But there is plenty of evidence of discrimination in other sectors. “There is widespread prejudice against pregnant women, particularly in small companies,” says Paul. “There is an assumption that maternity absence is expensive. Women don’t want to tell their employer they are pregnant, in case there are redundancies coming up.”

In the world of small biotech and pharma businesses, this situation is all too familiar. Recent research by the Equal Opportunities Commission[7] in the United Kingdom found that 7% of pregnant women—30,000 people a year—lose their jobs because they are pregnant. Paul warns that scientific companies must guard against this discrimination; not only is it illegal, it risks losing the huge potential of women in the workforce.

Across Europe, only 15% of scientists in the private sector are women, half the proportion you find in the public sector. Ragnhild Sohlberg represents the energy company Norsk-Hydro and was co-chair of the European Commission’s Committee on Women in Industrial Research.[8] Coming from Norway, where women actually dominate in areas such as biomedical science, she has a different perspective. She believes science, particularly engineering and physical sciences, is a good career for women because so much of it is computer-based and can be done at any time.

Sohlberg was shocked one day to hear a German colleague suggest that female scientists should not have children because it will ruin their careers. What is the Scandinavian secret? “It’s to do with attitude,” she says—the attitude of the government, the scientific community, and of families themselves. In Norway, women scientists are very well supported. Maternity pay is one year; child care is largely taken in charge by the state. “We need some tremendous changes of attitude on the continent,” says Sohlberg. Individual scientists working while pregnant can help bring about this change, as long as they stay effective by exercising their rights and keeping their work comfortable and safe.

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1. Pregnant workers and new mothers: http://osha.europa.eu/data/legislation/10
2. Risk assessment: http://www.europa-eu.int

3. International Labour Organisation (ILO) http://www.ilo.org
4. European Agency for Safety and Health at Work: http://osha.europa.eu/OSHA
5. United Kingdom Health & Safety Executive: http://www.hse.gov.uk
6. Guidance on pregnancy and chemicals at work: http://www.rsc.org/pdf/ehsc/pregnancy.pdf
7. Equal Opportunities Commission: http://www.eoc.org.uk
8. Committee on Women in Industrial Research: http://ec.europa.eu/research/science-society/women/wir/index_en.html

BRIDGING THE CULTURAL DIVIDE IN MEDICINE

by Edna Francisco

You might say that Lori Arviso Alvord was predestined to become a doctor. According to a Navajo tradition, parents bury their newborn's placenta and umbilical cord at a special site that represents their dreams for the child. Because Alvord's father was stationed at a military base in Tacoma, Washington, Alvord was born at one of the local hospitals, and there her placenta remained. Years later, Alvord became a regular presence in hospitals as the very first Navajo woman surgeon.

As an associate dean of student and multicultural affairs at Dartmouth Medical School in Hanover, New Hampshire, Alvord is attempting to bridge two worlds of healing: Navajo and Western medicine. Alvord believes in a system of health care, especially but not exclusively for Native Americans, based on both modern medicine and traditional wisdom. "My whole objective is to try to achieve a better way to deliver health care not just for native people, but for everyone," she explains. Alvord hopes, too, that such an approach will inspire young Native Americans to become physicians and address many of the conflicts between Western medicine and Native American traditions.

During her medical training, Alvord struggled because being Navajo and a female surgeon was rare. (It still is.) Making it through training meant going against some native traditions and adapting to some nonnative ways. But these experiences gave her a pioneering point of view on how healing can be improved.

Separated for the First Time

Half Caucasian and half Navajo, Alvord grew up on a reservation in Crownpoint, New Mexico. As a child, her biggest dream was to get a college degree. Because Dartmouth College had a small and supportive group of Native American students, Alvord applied there and nowhere else. After being accepted at Dartmouth, Alvord started learning how to survive in a high-pressure academic world.

Leaving home for college was not easy for Alvord because it violated *hozho*, or "walking in beauty," a Navajo lifestyle that encourages balance

Unlike non-Indian doctors who focus solely on the diseased part of the body, Alvord says, the healers examine the patient's entire life, looking for things that are unbalanced. In Navajo traditions, illness is seen as the result of being out of harmony or balance in some area of life.

and harmony. The Navajo believe the four sacred mountains that surround their traditional land provide protection and that moving away would cause disorder in the lives of the people.

Alvord, among the first women and Native Americans to attend Dartmouth College, had a difficult time adjusting as a result of the sexism and racism on campus. Male students generally disliked the presence of female students. The unofficial Dartmouth mascot resembled a Hollywood Indian, with war paint and fake feathers. She also had difficulty relating to non-Indian students because of cultural differences. Yet despite these problems, Alvord was grateful for the opportunity to be a part of Dartmouth's efforts to provide Native Americans with an Ivy League education. She graduated in 1979 with a double major in psychology and sociology and hoped to work on her reservation.

New Career, Bigger Challenges

Majoring in psychology fueled her interest in the human brain, and she landed a job as a research assistant in a brain physiology lab at the University of New Mexico (UNM). She had once given up on science after receiving a "D" in college calculus, a result of poor high school preparation. Dartmouth, however, quickly remedied her educational shortcomings.

Alvord's research experience prompted her to take premed courses at UNM. Soon she found resonances between science and traditional Navajo teachings. In her autobiography, *The Scalpel and the Silver Bear* (Bantam Books, New York, NY, 1999), Alvord described her new passion: "The way the white blood cells attack an intruding virus, the way too much or too little of anything disturbs the body functions ... it was all *hozho*, the beautiful balance of the universe, rephrased in scientific terms."

Alvord eventually attended medical school at Stanford University, but she continued to struggle with cultural differences. Alvord disliked attracting attention to herself and being competitive. She wasn't comfortable bombarding her patients with questions, touching them, or looking them directly in the eye. These actions violated Navajo notions of respect. She also feared dissecting cadavers because Navajos believe they harbor evil spirits. In time she dealt with these challenges and learned to place them in the context of Western medicine.

New Ideas to Improve Health Care

Alvord returned to serve her people whenever she could during her medical training and early practice. Being around other Navajo people benefited her by making her feel comfortable and raising her confidence as a surgeon. Ron Lujan, another Native American surgeon, showed her ways to do her job while honoring native traditions—a practice that put her and her patients at ease: touching patients respectfully and only when she had to, not rushing her patients for answers, treating them like family, and generally working to gain their trust. Alvord noticed that when patients felt cared for and respected by their caretakers, they seemed to do better during and after operations.

Alvord also learned that Navajo healers' ways of curing people were beneficial, so she worked to integrate them into her caregiving methodologies. "Science is beginning to catch up with Native philosophies," she says. "We now know that reducing stress and anxiety can have positive effects on how our bodies function and that the mind is able to help the body heal. [Navajo and other] healing ceremonies are designed to help the mind heal the body, through a variety of mechanisms."

> Unlike non-Indian doctors who focus solely on the diseased part of the body, Alvord says, the healers examine the patient's entire life, looking for things that are unbalanced. In Navajo traditions, illness is seen as the result of being out of harmony or balance in some area of life.

In the long run, Alvord believes Navajo philosophies should be used to treat patients of any cultural background. She argues that many people feel that their doctors don't understand them and don't care enough about them. She also points out that Western medicine has been businesslike and based upon a history that has been dominated by white men. Converting old hospitals into "beautiful healing environments," rather than just having square, cold rooms with bare walls, will also help relieve patients' stress and accelerate healing.

The young woman who faced barriers from two cultures—her own and the dominant one—has evolved into an influential force in medicine and one who "loves breaking stereotypes." Today Alvord continues to "walk in beauty" with her husband and two children.

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6. Leadership and Management in the Lab

LEADERSHIP ON THE MOUNTAIN: Lessons for the Lab

by Kathy Barker

"Challenge is the core and mainspring of all human activity. If there's an ocean, we cross it; if there's a disease, we cure it; if there's a wrong, we right it; if there's a record, we break it; and, finally, if there's a mountain, we climb it."
—Climbing historian James Ramsey Ullman

Scientists are coming to terms with the fact that running a lab really is running a business. Yet, in looking for inspiration, most scientists find management and business leadership books—with their bottom line of sell, sell, sell—less than palatable. Scientific research is a product, but for most of us it isn't all about the money. It's about the science and the challenge. When it comes to management and leadership tomes, we want to read about leadership motivated by needs other than getting rich and pleasing stockholders.

Look to the mountains! Or, more practically, look to the large genre of mountain-climbing books for inspiration on leadership and for guidance on how to build and motivate a team.

Decisions in the lab do not have a simple endpoint like getting to the summit, nor do laboratory errors have immediate life-or-death consequences. Usually. But the concentrated stories of conflict and triumph, cause and effect found in mountaineering books—these stories measured over weeks and months instead of years, as they might be in the laboratory—make for accessible, easily transferable lessons.

Choosing and Cultivating Your Team

Leaders on the mountains and in the lab often feel, at first, similarly unequipped for the job. One chooses to become a principal investigator (PI) or an expedition head because of technical skills, but success depends on emotional resilience and communication skills. Mountains are not climbed alone, and research is not done in a vacuum; if the expedition leader or PI doesn't know how to choose and get the most out of team members, a project has little chance of success.

> *"Most of all, our expedition needed a leader, someone with a strong personality who could gather the right people around him and fuse them into a close-knit unit that could work smoothly under the most miserable circumstances."*
> —Art Davidson, *Minus* 148°: *First Winter Ascent of Mt. McKinley* , p. 21

As in a lab, on a mountain bad people are worse than no people, and the leader needs to be careful to choose personnel well and to intervene if members of the group are having problems working together. Convinced that one of the reasons for the failure of the 1975 expedition to summit K2 had been the relative inexperience of most of the team members, leaders of the 1978 expedition decided that they would choose only highly motivated climbers with experience over 20,000 feet (6,100 meters). Choosing team members with compatible personalities was not a major consideration, and several team members known to be contentious were included.

Although the 1978 expedition would get four members to the summit of K2, the rancor within the group is what many remember and what is the subject of great discussions in *A Life on the Edge* and *Addicted to Danger*. There were storms and issues with the route, but problems among the climbers created an atmosphere that poisoned everyone.

"Constantly frustrated by the weather, people's nerves were fraying. Despite my attempts to run a democratic operation that gave everyone an even chance, different levels of skills and motivation were sorting us into two groups. Mediating between the two was difficult, not to mention thankless."
—Jim Whittaker, *A Life on the Edge: Memoirs of Everest and Beyond*, p. 192

Getting the first Americans on Everest in 1963 via the South Col route would be dangerous and exciting enough and would justify to the world the three years' worth of fund-raising and organizing. But some team members wanted to swap a "safe" South Col ascent for the additional twist and danger of the West Ridge.

One member of the climb thought that the presence of prima donnas, who believed that the climb would be easy, contributed to the unease. Some members objected to the presence of women, and some objected to favoritism in the choice of a summit team. Several team members would not compromise personal ambition in the slightest, making it impossible to forge a smoothly functioning team.

Jim Whittaker, the leader of the 1978 expedition, suggests that conflict is inevitable when diverse, highly motivated people undertake dangerous adventures. Conflict is probably inevitable when very different and highly motivated people do anything. On mountain or in lab, conflict is inevitable, but the leader must intervene to prevent that conflict from simmering or erupting into full-scale rebellion. Deal with every issue as soon as possible; problems won't go away by themselves.

"I wanted our group spirit to outweigh our individual-achievement ethic—a lot to ask. To get here had required extraordinary perseverance, even aggressiveness. Now that the final payoff was close, how could we be expected to let go of the very qualities that had got us here in the first place?"
—Arlene Blum, *Annapurna: A Woman's Place*, p. 141

The way the leader handles those problems will depend on his or her style, and on the individual dynamic of the team. The 1978 American Women's Himalayan Expedition put the first Americans on Annapurna I at a time when few women were invited on climbing expeditions. Team leader and biochemist Arlene Blum considered personalities carefully when assembling the team, knowing that "finding climbers with the right mental and physical qualifications was extremely important.... For many climbers the initial glamour of expeditionary climbing soon fades, and the actual experience—altitude, grinding hard work, damp, cold, tedium, bureaucratic hassles, the possibility of illness or injury—can be wearisome, disappointing, even devastating.... The determination needed to keep melting snow for water and cooking can ultimately be more valuable than the skill needed to climb steep ice." (Blum, p. 14) An aside: There's another lab lesson here—hire for character, not just for technical expertise.

The women were determined to climb the mountain in a spirit of togetherness, and they considered *that* to be as much of a goal as reaching the summit of Annapurna. Indeed, they climbed with relatively little conflict, albeit with constant, even excessive discussion. This style of intensive introspection and interaction was particular to the dynamic of this group, but it was, apparently, effective. There are as many ways to be a leader and to be a team, their experience and the experiences of other expeditions prove, as there are people. Do what works for you.

Choosing a Project: Risk Versus Surety

The American Mount Everest expedition of 1963 put four Americans on the summit of Everest via the already climbed South Col route, and two others via an unexplored route, the West Ridge. The expedition, led by organizer Norman Dyhrenfurth and climbing leader Willi Unsoeld, was one of the most stunning accomplishments in the history of climbing, not just for the meeting near the summit of two successful teams from opposite sides of the mountain, but for the teamwork that made the whole team much greater than the sum of the participants.

Setting the goals and choosing the right people to accomplish each part of the route was intrinsic to the teams' success. Getting the first Americans on Everest in 1963 via the South Col route would be dangerous and exciting enough and would justify to the world the three years' worth of fund-raising and organizing. But some team members wanted to swap a "safe" South Col ascent for the additional twist and danger of the West Ridge. A decision to put resources and people in the wrong place could risk the success of the entire expedition.

"The question, as Dave put it one night, was, who would be willing to put his energy into the West Ridge, with failure as a not unlikely outcome, when reaching the summit by the South Col seemed so much more assured?"
—Tom Hornbein, *Everest: The West Ridge*, p. 38

The route strategies evolved with time, as the dynamic and strengths of the team were unveiled through weeks of slowly moving up the mountain. Team leaders were aware of differences in personalities and skills—the climbers' ability to handle altitude, resilience in dealing with the cold and other hazards, motivation to climb in the face of almost certain frostbite and the possibility of death—and this knowledge helped sort the team into very compatible and successful subteams. Only when the capabilities of the team were known could the objective risks be assessed and route decisions be made.

Each scientist faces the question of the safe, fundable project versus the exciting foray into a new area. You, the leader, might be able to absorb the failure—but can your postdoc? There are no guarantees. The 1963 Everest expedition was successful, but a sudden storm, a recalcitrant team member, a bad choice of route ... any of these factors might have meant failure, or worse. You can stay on the predictable research path if you choose to, but even that might not work, especially if the field moves on without you, propelled along by someone else's successful gamble. PIs warn that it is unwise to put off trying something new too long. Constantly reassess your goals and capabilities, as well as your team's goals and capabilities, and know how much risk each person can bear.

Independence Or Nurturing? Guide Or Climber? Colleague Or Acolyte?

Until a decade or so ago, the mountains 20,000 feet or higher were climbed by expeditions peopled with trained mountaineers who functioned as a team. As more and more routes up the difficult mountains have been established, amateur climbers have started looking for someone to guide

them up an established route—and proved to pay well for this expertise. Clients often outnumber real climbers, and this has a huge impact on the way teams are made and mountains are climbed.

The main impact of this development has been on the new role of the team leader. On real expeditions teammates depend on each other, whereas on commercial expeditions, clients depend on the guides. This has led to a deep culture gap, with some guides being willing to nurture and pamper, and others expecting clients to be independent and responsible.

This uncertainty about responsibilities is highlighted in the series of books about the 10 May 1996 Mount Everest disaster, in which five people died alone in a sudden storm on the South Col route. Experienced mountaineer, journalist, and client Jon Krakauer (*Into Thin Air*), and professional climber and guide Anatoli Boukreev (*The Climb*) disagree on many details of that deadly day. But they agree that the multitude of people high on the mountain and dependent for survival not on themselves, but on a guide, was a recipe for disaster.

"Neil said, 'Anatoli, many of our members are at high altitude for the first time, and they don't understand many of the simple things. They want us to hold their hands through everything.' I replied simply, saying that was an absurd position. I repeated again my concerns that we had to encourage self-reliance."
—Boukreev, *The Climb: Tragic Ambitions on Everest*, p. 85

Unless a client is capable of troubleshooting at high altitude, or is one-on-one with a responsible guide, the person will always be especially vulnerable.

Another factor in the disastrous 10 May on Everest was that whatever the expectations were, they were not made clear. Many commercial expeditions have a defined turnaround time, a time where those who haven't summited must turn around and head back down again, lest nightfall find exhausted members still on the mountain. The leaders of the 10 May commercial expeditions were vague and contradictory about a turnaround time, and many clients and guides were still struggling to reach the Everest summit late in the afternoon, even as clouds began to envelop the mountain.

Most PIs can recognize the difficulty of this decision: How much do you help lab members who are not as independent, or as gifted, as others? Do you carefully nurture each person to his or her own capacity? Do you write a paper for the student who can't seem to get it done? Or do you refuse on the principle that since you are training potential PIs, you are doing no favors by expecting less than complete self-sufficiency?

Your choices will depend not only on your own personality, but on your situation: Your degree of mentorship may be different with a small lab than a big lab, or at a small college versus a terrifyingly competitive university. The key is to be clear about your expectations, about your philosophies. This will help you choose a team, and it will help prospective team members choose a guide. As you go, your ideas can—and should—change. Just be sure to let everyone know when they do; don't make your team members guess about what is expected of them.

"It is strange how when a dream is fulfilled there is little left but doubt."
—Tom Hornbein, *Everest: The West Ridge*, p. 183

Tenure may seem a high summit, but neither mountain peaks nor tenure assure fulfillment. Many scientists are disappointed that the milestones they reach for—tenure, or membership in the academy, or whatever—do not provide ultimate satisfaction. The last lesson from the mountains might be that it is the effort itself, not the achievement of the summit, that brings satisfaction. There is always another mountain to climb.

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PROJECT MANAGEMENT FOR SCIENTISTS

by Stanley E. Portny and Jim Austin

All science involves some boring, routine labor—repetitive work in the laboratory, grant writing, keeping the books, and so on—but scientific research is fundamentally creative, and often unpredictable. As often as not, the course the research takes is unexpected. A principal investigator's (PI's) central challenge is to keep the lab afloat while stimulating and supporting the highest levels of creative insight and technical innovation. Few scientists are trained to do this; with most, it comes only from experience. Some never learn to manage their laboratories effectively, and this puts them at a considerable disadvantage compared to their colleagues.

Small research laboratories have their predictable aspects; indeed, they must be viable business entities to survive and thrive. This means assuring a sufficient flow of funds to attract and keep top-notch staff, as well as to obtain and maintain the required facilities and equipment. Furthermore, like shareholders of a corporation, the stakeholders in a laboratory—funding organizations, host institutions, taxpayers, and so on—demand a demonstration of the value they get for the money they spend. This is especially important for the PI when the time comes to seek a grant renewal—or tenure.

Herein lies the real challenge for the small laboratory manager: How can you create and maintain an environment that allows free and unbounded creative exploration, yet assures solvency and maintains accountability to those who have a stake in the lab's operation?

The answer is effective management. You need to manage your labo-

You need to manage your laboratory the same way you do your science: boldly but methodically, with the right balance of purposefulness and opportunism.

ratory the same way you do your science: boldly but methodically, with the right balance of purposefulness and opportunism. Project management provides the tools you need to systematize the management of your laboratory, to make sure the risks you take are calculated. Best of all, you're likely to find that taking a structured approach to managing the laboratory nurtures, rather than inhibits, creativity.

What Is Project Management?

Project management was created more than 50 years ago to manage technical development and manufacturing projects of great complexity. In its early days it was a highly technical field known best, perhaps, for generating reams of paperwork. Even today, many people think of project management as a series of graphs, charts, and procedures, often implemented through a software package, designed to plan and guide to completion repetitive and highly predictable work ... or—worse—to fill the empty hours of soulless bureaucrats.

Project management has evolved over the years. Today's project management is less an arcane technical discipline than a set of principles intended to provide a structured approach to making the everyday decisions that keep a business running, even a small business. Or a laboratory.

Project management begins, as it should, by defining its subject: A project, according to project management theory, is an activity with three characteristics:

» Specific outcomes or results
» Definite start and end dates
» Established resource budgets

Projects can be large or small, planned and tracked formally or informally, and defined by a legal contract or an informal agreement. They can involve activities that have been performed many times before or entirely new approaches and technologies.

Science Projects

At first blush the above definition of projects may not seem a perfect fit for the work that goes on in a science lab. The outcomes of a research effort often lack a precise definition. While a project might have a definite start date, an end date is rarely specified. Even when the funding ends on a specific date, it's usually assumed that a renewal will be sought. Even budgets—which are, regrettably, fixed—often seem fluid.

So how can we bridge this gap between a project's technical definition and a PI's daily experience? First, by realizing that these difficulties are not limited to science. Indeed, some degree of ambiguity exists in every project. Yet, in science as in other kinds of projects, there is value in trying to eliminate as much ambiguity as possible.

Second—and this may be the most important point in relating project management to science—the specified outcomes, end dates, and budgets are always provisional. Project management allows—indeed, insists—that the components of a project be constantly revised as new information arises. Defining, for example, the desired project outcome means deciding what you hope to accomplish *as of now,* with the understanding that those definitions will probably change with time.

The Key Components of Project Management

Project management is simply guiding a project from inception to successful completion, making coordinated use of processes and systems to guide and encourage people to successfully perform a project's work.

The three key steps of project management are:

One: Planning—clarifying:

» Desired project outcomes
» Stakeholders: who will be affected by, are needed to support, or will be interested in the project outcome?
» Activities that have to be performed to complete the project
» Dates on which each project activity will start and end
» Budgets for all required project resources (including, but not limited to, money)
» Significant project risks and how they will be managed

Two: Organizing—specifying roles and responsibilities for project personnel

Three: Controlling the performance of project work—including:

» Organizing, focusing, and continually motivating project personnel
» Tracking and comparing project work and results against the plan
» Considering and making changes to plans when tracking suggests a change is called for
» Keeping everyone informed of project accomplishments, issues, and changes
» Continuously tracking and dealing with evolving project risk

Organization information systems can be used to support project planning and control, including the maintenance of records of:

» The dates on which activities are started and completed and milestones are reached
» The amount of work effort expended by people on project activities
» The funds expended on project activities

Put another way: Project management expands the concept of "budgeting" to cover not just monetary resources, but other

resources such as time and personnel.

Encouraging people to perform up to their maximum potential means:

» Helping each person to appreciate:
  –The value to him or herself and to the organization of the project in general and of his or her assignment, in particular
  –The feasibility of successfully accomplishing the project objectives
» Regularly providing project personnel information about how their actual performance and accomplishments compare to what is planned
» Acknowledging people's contributions to overall project success

Project plans, expenditure reports, and team meetings will not, in and of themselves, guarantee project success. The greatest chances for success are achieved when project information is used to align, guide, and motivate team members, and when these team members, in turn, use this information to guide their work. A project rarely sticks to a predetermined course. Projects flow and evolve; project management is a way of making sure that the key players remain motivated, and that their objectives remain aligned.

Key Premises That Lead to Project Success

The greatest chances for project success are realized when PIs, acting as managers, embrace the following premises.

Project management is a way of thinking and behaving, rather than just a way of analyzing and presenting data. Managing a project effectively means thinking before acting, identifying and dealing with potential problems before they occur, and constantly monitoring to determine whether your actions are achieving their desired results. The goal is to internalize project management, to make it second nature, a way of thinking about the decisions you make in managing your laboratory.

Attempting to control all aspects of a project assures the greatest chance of success, but you will never succeed at controlling everything. That's okay. Project plans represent your current thought, at any given time, about how the goals of the project will be achieved. Even if anticipated approaches have never been tried before, it is important to describe what you propose to do, how you expect the project to unfold, and the results you hope to achieve. The less certain you are that the plan will work, the more closely you should monitor ongoing performance to identify deviations from the plan as quickly as possible. If a planned approach seems not to be working, clear choices should be made about how to modify existing plans and guide the work in new directions.

People, not numbers and graphs, create successful projects. The major purpose of project management is to align and motivate people and to support their decision making. It is people's creative insights and performance that will ultimately lead to project success, not a number or a graph. So keep your people on the same page, but make sure they're happy and have room to breathe.

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LAB SAFETY REQUIRES TRAINING AND COMMITMENT

by John K. Borchardt

What can go wrong? What can I do to minimize risks of an experiment? What do I do if something *does* go wrong? Researchers need to ask themselves these questions whenever they begin a new experiment, advises James Kaufman, president and CEO of the Laboratory Safety Institute, a provider of safety training and other services to academia and industry. "The frequency of academic research lab accidents is 10 to 50 times greater than in industrial labs. So there is a lot of room for improving safety." Whereas the university can and should take very seriously the safety of their students, postdocs, and other workers, it would be foolish for those in the lab to depend on others to take care of things, Kaufman suggests. Keeping researchers safe is ultimately the responsibility of researchers themselves.

Before You Start

Researchers, of course, often have other things on their minds—like research. Furthermore, they usually lack specific training in the difficult task of keeping themselves and their laboratories safe—especially early in their careers. It's natural for young scientists and science students to assume that the institutions where they're training will take care of them, but that's a potentially dangerous assumption. So how should people in the laboratory go about rising to the challenge of keeping themselves and their colleagues safe?

The first step should be to learn their institution's policies and practices, says Michele Johnson of the University of Utah Environmental Health and Safety Department. Johnson proposes three questions of her own that researchers need to answer before the work in the lab gets started:

» What safety training do I need?
» How do I get it?
» Who do I go to if I have safety concerns?

"Researchers themselves must maintain labs from a safety perspective."—Jim Kapin, 2006 chair of the American Chemical Society Division of Chemical Health and Safety

This last question is important because it is the key to finding answers to the first two. On some campuses, principal investigators (who rarely have rigorous safety training) have the responsibility for ensuring a safe working environment. On other campuses it is the facilities manager. Why does it matter to researchers who's in charge? Ralph Allen, Director of the University of Virginia's Office of Environmental Health and Safety, puts it this way: "They need to protect themselves since the lab is a place where things are inherently dangerous. So it's important to know where to go for safety information and know whom to consult."

In the Lab

"Nine times out of 10, lab accidents are caused by operator error," observes Johnson—and operator error, in turn, is often due to operator fatigue, inattention, or haste. Other common causes of laboratory accidents are improper use of equipment, the use of the wrong tool for the job, and poor equipment maintenance.

At the University of Virginia, organic chemistry students were storing samples they prepared in an unlabeled refrigerator that was not explosion proof. When the refrigerator exploded, the doors to the main lab were blown to the other side of the room where they hit an apparatus used to purify solvents.

There's a happy ending. The solvent-purification setup was made of metal; similar setups, in laboratories across America, are made of glass. The metal purification system was damaged, but if it had been glass a fire probably would have resulted, causing far more extensive damage.

No one knows who chose that old refrigerator, but many people over the years—PI's, administrators, countless students, postdocs, and other lab staffers—could have recognized the threat it posed and switched it out. But until this accident, no one did.

After the accident, the university traded out all their old refrigerators for explosion-proof models and replaced glass solvent-purification systems with metal ones. If faculty members lacked funds to replace their unsafe equipment, the university paid the tab. It took a near catastrophe to identify the problem, but the UVA is now a safer place for the workers in its laboratories.

Recognizing such risks isn't easy, but it is essential if labs are to be safe places to work. "Researchers themselves must maintain labs from a safety perspective," advises Jim Kapin, 2006 chair of the American Chemical Society Division of Chemical Health and Safety and senior staff scientist with Advanced Chemical Safety, a firm that conducts academic research lab safety inspections and training programs.

In a laboratory at Ohio State University, solvent bottles fell from the top shelf of a four-shelf flammable-solvent storage cabinet because the clips used to secure the shelf failed. The clips had been modified improperly, probably in the distant past by a researcher whom no one remembers. An accident had been stalking the lab ever since.

When it finally pounced a spill resulted, and the supply of spill-control agent proved inadequate to absorb the spill. Solvent vapors forced the students to retreat and the building was evacuated. An explosion and a fire followed, destroying the laboratory. Fortunately, researchers suffered only minor injuries, but the damage was extensive.

This incident demonstrates how the choices scientists make affect not just their own safety but also the safety of their colleagues, for years to come. It also shows how important—and how hard—it can be for researchers to identify unsafe conditions in their laboratory. Improperly modified shelf supports would be hard for anyone to spot in a routine inspection, but an attentive staffer might have noticed, when placing a bottle on the shelf, that the supports seemed weak or unsteady. If she had, the problem might have been solved before the accident occurred. Laboratory workers and managers—and safety inspectors—made another serious mistake, this one far more routine and easier to spot: They failed to make sure the laboratory's spill-kit was adequate for the volume of spills that were likely to occur.

Interdisciplinary Risk

Interdisciplinary research labs may present more risks than labs doing work in established disciplines, says Kapin, because the range of risks is wider. "Chemists know how not to blow things up," he notes, "but often don't know the biological hazards of working with laboratory animals." Mixed environments also mean more opportunities for reagents, supplies, equipment, and researchers to mix in unpredictable ways, creating new risks. The only real solution in such environments is extra vigilance. "Constant vigilance and regular inspections offer the only hope for spotting these problems," says Kaufman.

Safety Glasses

Fortunately not all safety-related judgments are hard. One thing that's very easy to do—and that students, postdocs, and other lab works can take responsibility for—is always wear safety glasses in the lab. Risks to researchers' eyes, notes Kaufman, include "impact from objects such as broken glass, heat, dust, chemicals, and optical radiation." So "researchers should use the appropriate safety glasses for the particular hazards associated with their experiment." For more severe chemical splash hazards, Kaufman recommends wearing goggles and a face shield.

It's important to look beyond your few feet of bench; chemicals can splash, and glass shards can fly, a long way. "You may need safety glasses, not for your own work, but for someone else's near you," says Allen. "So pay attention to what's going on around you, not just your own experiments." And always remember that safety glasses can protect you from risks you may not have even thought of—so wear them even when there isn't an obvious reason.

In 1987, the U.S. Centers for Disease Control and Prevention issued a bulletin recommending that researchers working with monkeys wear safety glasses. Ten years later, 22-year-old researcher Elizabeth Griffin was working at Emory University's Yerkes Primate Center. She was not wearing eye protection and a macaque monkey's urine contacted her eye. Ms. Griffin wiped her

Pay attention to what's going on around you, not just your own experiments. And always remember that safety glasses can protect you from risks you may not have even thought of—so wear them even when there isn't an obvious reason.

eye with a wet paper towel and flushed it 45 minutes later. It was too little, too late: She contracted the herpes B virus and died within two months.

Three years later, the Coulston Foundation, which also used monkeys for disease research, was cited for lack of safety eyeglasses and other personal protective equipment. And even today, Kaufman observes, the use of eye protection "is not as high as one might reasonably expect." The proper use of eye protection seems to depend, more than anything else, on the example set by the PI and senior lab personnel (see the related story[1]).

Inspections

Frequent and regular lab safety inspections are "the only hope for spotting problems" according to Kaufman. Johnson agrees that "external inspections every six months or so are essential"—but, she says, they are not sufficient. Johnson recommends that research groups do their own internal inspections once a month, and that responsibility for those inspections be placed on a postdoc or senior graduate student rather than a PI; many principal investigators, Johnson observes, may not have enough recent experience in the lab to recognize the hazards. And just as airplanes undergo a safety check before every flight, Kaufman notes, most laboratory equipment should be safety-checked before every use.

Training

Aren't most researchers already aware of the risks they face in the laboratory? That, says Allen, "is a dangerous assumption." Specific training is essential; in laboratory safety, common sense can only take you so far. It is important that all incoming students and postdocs undergo safety training that goes beyond which form to fill out and who to report an accident to. "New researchers need to consult with their principal investigator to determine what specific training they need to do their research and how to get this training," advises Johnson. They need to become well versed in the specific risks the research they'll be doing presents, and in industry-standard methods of mitigating these risks. Also, they need to know what to do whenever the most likely and predictable accidents occur.

But even this kind of training is insufficient. Researchers need to learn to improvise, and to evaluate their surroundings for potential hazards—like hazardous electrical wiring and weak shelf supports—beyond those listed in user manuals, training courses, and materials safety data sheets. Such hazards are best evaluated using common sense and an attentive eye.

"Researchers' best bet to work safely is to educate themselves about the hazards of their laboratories and know who to go to for information that they can't find themselves," advises Kapin. "Take the time to find out what can go wrong," says Allen. Determine "what you can do to be prepared and don't assume anyone else will be looking out for you."

Reliable Sources of Lab Safety Information
Besides your own university's safety Web site and the references your principal investigator or lab safety officer recommends, the following are useful sources of reliable information:

Web sites

- Advanced Chemical Safety [2]
- Lab Safety Institute [3]
- U.S. Department of Labor – Health and Safety Topics: Laboratories [4]
- American Industrial Hygienists Association – Health and Safety Committee[5]
- Where to find Material Safety Data Sheets on the Internet [6]

Books

Handbook of Laboratory Health and Safety
R. Scott Stricoff, Douglas B. Walters
Wiley-Interscience; 2nd edition (March 20, 1995)

Improving Safety in the Chemical Laboratory: A Practical Guide
Jay A. Young (Editor)
Wiley-Interscience; 2nd edition (June 1, 1991)

Handbook of Chemical Health and Safety
Robert J. Alaimo (Editor)
ACS Handbooks (Hardcover)
American Chemical Society Publication (April 19, 2001)

OSHA Medical Radiation Safety Guidebook
Bruce Gordon, Daniel Farb
UniversityOfHealthCare (July 2005)

Safety Sense: A Laboratory Guide
Cold Spring Harbor Laboratory
Cold Spring Harbor Laboratory Press (September 1, 2001)

This article first appeared on ScienceCareers.org (Next Wave) at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2006_08_04/lab_safety_requires_training_and_commitment/

1. Related story: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2006_08_04/wear_your_safety_goggles/(parent)/68
2. Advanced Chemical Safety: http://www.chemical-safety.com
3. Lab Safety Institute: http://www.labsafety.org/
4. U.S. Department of Labor – Health and Safety Topics: Laboratories: http://www.osha.gov/SLTC/laboratories/index.html
5. American Industrial Hygienists Association – Health and Safety Committee: http://www2.umdnj.edu/eohssweb/aiha/accidents/
6. Where to find Material Safety Data Sheets on the Internet: http://www.ilpi.com/msds/index.html

7. Scientific Writing and Publishing

PUBLISHING AT THE TOP OF THE HEAP

by Jeremy M. Boss and Susan H. Eckert

"Wow, an article in *Big-Time Science Magazine!* Congratulations! You're sure to get tenure now!" So you say to your buddy with the curly red hair as you walk down the hall. During this walk/conversation, the two of you may question why you made this statement, what the real differences are between journals, and why some are considered to be more prestigious than others. This article will discuss these issues and shed some light on the process of the peer-review publication process.

To begin to look at the reasons behind that statement, it is important to consider the functions of different journals. Although all journals strive to publish the best science, the areas that they cover differ. Some are broad in their coverage of scientific disciplines, whereas others deal with a discrete area of science. Still other journals publish work from the members of their scientific society, such as the American Society for Microbiology's *Journal of Bacteriology* or the American Association of Immunologists' *Journal of Immunology*. Additionally, by publishing articles discussing the political and sociological aspects of science, some journals, such as *Science* and *Nature*, serve as information resources on the pulse of all science.

Types of Journals

Journals can be divided into four general classes: broad top-of-the-heap, near-the-top, society-level, and specialty or subspecialty journals. The broad top-of-the-heap journals have very low acceptance rates and attempt to publish articles that make conclusions that shift the current paradigm in a field. Articles in these journals tend to be highly focused and may not provide in-depth coverage of the area. Like the authors contributing the articles, these journals are also concerned with being the *first* to publish information that may be of interest to their broad audiences. Thus, there is some competition between these journals. It is also true that manuscripts may get rejected from broad top-of-the-heap journals not because the science isn't spectacular but because the area is no longer "hot."

The near-the-top journals typically represent specific fields or general areas of science (e.g., immunology, neurobiology, developmental biology, structural biology, cell biology, or molecular biology). Over the last few years, some of the top-of-the-heap journals have created high-profile spinoff journals that specialize in a particular area. These are, typically, near-the-top journals. These journals attempt to publish cutting-edge manuscripts that tell complete and in-depth stories. They, too, have low acceptance rates.

Society-level journals publish the bulk of the work coming out of most laboratories and are the workhorses of the scientific publishing industry.

These journals have moderate acceptance rates and—surprisingly—may have more citations per year than do the top and near-top journals discussed above. This last fact indicates that these are important journals and that the work published in them is of high quality.

Specialty and subspecialty journals publish work in a restricted area. Although this work may be of high quality, too, the readership may be limited to only those in the field.

The Review Process

It is important to appreciate how manuscripts are processed, and how and when peer review plays a role. Several different systems are used, and each journal has its own system in place. One thing that's important for you, the author, is the quality of the review and the length of time it takes for your work to get reviewed and, once accepted, into print.

The most basic distinction between journal review processes is whether manuscripts are triaged. Triaging processes are used by editors who

attempt to prescreen manuscripts so that they send out for review only those that have a chance of being selected for publication. Many of the broad top-of-the-heap and near-the-top journals employ triage systems. An advantage to you as a manuscript submitter is that the triage review may take only a few days, so you really don't waste a lot of time waiting to find out if the manuscript has a chance of being published. Of course, the disadvantage is that the editor may not appreciate the significance of your title and abstract, and your paper will be returned without the input of an expert in your field.

Journals that review every paper before a publication decision is made run their editorial processes in different ways as well. In a single-step, hierarchical organization, an editor-in-chief is responsible for each decision and relies on an editorial board and a host of reviewers to help make accept/modify/reject recommendations. The editor-in-chief's office finds the reviewers and solicits reviews before making a decision.

Other journals use a multiple-level editorial board to spread out the work of handling the large number of manuscripts received each year. In a two-step system, the journal office receives the manuscript and assigns it to a member of the editorial board, who, in turn, either solicits reviews or reviews the manuscript personally. These editorial board members make recommendations directly to the editor-in-chief.

If the journal receives thousands of manuscripts a year, a system such as this one will require a huge editorial board. For this reason, many large journals use a multistep system, with three (or more) levels of editors. One of these editors will solicit reviews and make a recommendation to the editor at the next level up in the chain. This system works best for journals that receive a lot of manuscripts and maintain their efficiency and quality by having a small number of people making the final decisions on the manuscripts.

Although the editorial decision-making processes are different for different journals, perhaps the most critical question from the author's point of view is: Do reviewers rate a paper differently if it is sent to the top-of-the-heap as opposed to lower-ranked journals? In general, the answer is yes! The biggest difference, though, is not one of absolute quality, as you might expect. A good experiment is a good experiment, regardless of where it is published. All journals expect this. The difference lies in the reviewer's perception of the novelty and importance of the work for the broad field to which it relates. Thus, similar comments about experimental design and interpretation are often seen in manuscript reviews from different journals, and the same reviewer may accept the work for the society-level journal but not for the top-of-the-heap journal if he or she feels that the work is not novel enough.

Journal Rankings

Going back to the hallway discussion, that comment you made about your buddy being assured of getting tenure was based on your perception that the journal *Big-Time Science* is better than other journals. Your perception may be due to the journal's low acceptance rate and/or the large number of people who would read the article. Together, these reasons might begin to describe your view of the likely scientific impact of your buddy's manuscript. Your view, though, might not be correct.

The impact of an article or journal can be measured directly by the number of times the average article is cited in other articles. This number—the Impact Factor—is a real measurement often used by chairpersons (or tenure dossier reviewers) to measure the prowess of a faculty member coming up for promotion. The assumption here is that articles published in journals with high impact factors count more than do articles published in journals with lower impact factors.

What exactly is an Impact Factor? The Institute for Scientific Information's Web of Knowledge (www.isinet.com) provides such comparisons between journals, and it can tell you how many times a particular article has been cited. For a journal, the Impact Factor is defined as the number of citations a journal receives in a given year for articles it published over the previous two-year period, divided by the number of articles it published in that period. Although this math may seem fuzzy, the bottom line is that the higher the number, the higher the journal's ranking. See the table below for a comparison of journals in the field of immunology.

Journal Citations and Impact Factors for 2005*

Journal**	2005 Total Citations	Impact Factor	Articles
Reviews			
Annual Reviews of Immunology	14,745	**47.4**	29
Trends in Immunology	4,538	**10.174**	108
Current Opinion in Immunology	7,715	**9.103**	92
Advances in Immunology	2,310	**5**	23
Articles			
Science	345,991	**30.927**	827
Cell	132,371	**29.431**	319
Nature	372,784	**29.273**	1,065
Nature Immunology	16,989	**27.011**	130
Genes & Development	47,853	**15.61**	273
Immunity (Cell Press)	21,730	**15.156**	115
J. Experimental Medicine	64,170	**13.965**	354
Proceedings National Academy Sciences	357,239	**10.231**	3,200
J. Allergy & Clinical Immunology	21,872	**7.667**	169
Molecular and Cellular Biology	68,516	**7.093**	950
J. Immunology	112,686	**6.387**	1,916
AIDS	18,968	**5.835**	351
European J. Immunology	21,352	**4.876**	359
Infection & Immunity	45,582	**3.933**	1,023
Immunology	8,008	**3.507**	169
Cellular Immunology	3,925	**1.558**	95

* Data derived from ISI Web of Knowledge
** Ranked by Impact Factor

For the sake of comparison, some top-of-the-heap and near-the-top journals are included. Notice in this example that the society-level *Journal of Immunology* has an impact factor of 7, whereas the near-the-top immunology journal *Immunity* has an impact factor of 17.5. However, the *Journal of Immunology* publishes 11.2 times more papers and has nearly 5.3 times the number of total citations as *Immunity*. Thus, it is likely that some papers in the *Journal of Immunology* have more citations than those in *Immunity* do. Also note that *Science*, *Nature*, and *Cell* have the highest impact factors in this list, suggesting that these journals are, as you would expect, the top of the heap.

If you continue your search on the Web of Knowledge site, you will find that review journals and review-and-methods articles have the highest impact factor. Surprised? Consider that when you're writing a paper, it's easier to reference a whole field of work with a single citation than it is to cite all the relevant primary papers. Review articles, therefore, are usually cited more than primary work is. Although this kind of objective quantification is something that we, as scientists, like, the high ratings of review articles show that these measures can be biased. Importantly, such quantitative measurements do not *evaluate* the science itself, which, of course, ought to be the most important measurement.

Publishing in High-Quality Journals

Do the journals I publish in really matter when it comes to my tenure decision? Your tenure decision will be based on an evaluation of your scholarship, teaching, and service to your institution. Depending on where you work, scholarship may be the predominant (or even the only) area considered. If this is the case, you will be judged on the impact your publications have on your field and the promise that you show for future productivity. Thus, you will need to publish your work in strong, highly visible journals that are read by members of your broad field of interest. Remember that in making your promotion/tenure decision, your department will seek the advice of leaders in your field and the broader area of your research. These outside reviewers will—let's hope—have seen your papers as they came out, and they will have followed your career through the literature. Your publications are more likely to be noticed if they are published in quality journals, so publishing in society-level, near-the-top, and broad top-of-the-heap journals will help your cause.

This doesn't mean that publishing your work in specialty or subspecialty journals is bad. It's a very rare lab that produces only science of high potential impact and broad relevance; even if you're focused on important problems, you're bound to produce some science that's just as good but of significance to a narrower audience. Although publishing in specialty or subspecialty journals may not aid your case as much as papers that are published in higher impact journals will, it does help in terms of promotion, as long as the sum total of your published work influences your field.

The Bottom Line

Almost 20 years ago, an adviser commented to a group of us discussing where to send our papers that it doesn't really matter what journal your work is published in, because if the science is good enough people will find it, read it, and cite it. This statement is even truer today, thanks to the ease with which the literature can be searched and articles can be downloaded, which saves scientists the effort of trudging over to the library stacks.

Some may believe that publication in *Big-Time Science* is equivalent to two or three society-level articles, but the most important thing is to get your work out there where people can see it by publishing regularly in journals that are widely respected, read, and cited by your peers. Make sure your most important work is published at least at the level of your scientific society journals. If your work has more heat and is closer to the cutting edge, you should definitely send it to the journals closer to the top of the heap; after all, you can't publish there if you never send your papers to them in the first place. Good luck!

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I CAN'T BELIEVE THEY DIDN'T LIKE IT!

by Jeremy M. Boss and Susan H. Eckert

What do they mean, it's 'too ambitious'? How do they think I am going solve the Big Problem if I'm not ambitious? Who are these idiots? They aren't qualified to review my work! None of the experiments they say we need to do will tell us anything! They are just giving us busy work!"

Whew! Wasn't it a relief to get that out of your system? If you have made statements like these, you know that within a few minutes, or days, you will collect your thoughts and decide on a reasonable response to that negative grant review or rejected manuscript.

Almost everyone in science has received a nonfundable grant score or had a paper rejected, usually both. If this is your first experience with such a rejection, congratulations and welcome to the club! The key now is to know how to move forward, to understand the appropriate roles of the reviewer and the reviewed, and to determine how to respond to critiques so that you get that grant funded, eventually, or that paper accepted. In Part 1 of this series we will discuss the ins and outs of dealing with manuscript peer review. Part 2 will focus on responding to grant critiques.

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The Job of the Reviewer

The reviewer is just fulfilling a role. It's not personal. And although you may think that you know the name of the person who reviewed your work—you may even be sure of it—you're probably wrong. Journal editors tell us that when authors blame Dr. Stukittume for a negative review, Dr. Stukittume usually wasn't even on the list of potential reviewers. Besides, even if Dr. Stukittume did in fact review your paper, it doesn't matter. The need is the same, whoever the reviewer might be: to move the work forward and figure out how to satisfy the reviewer.

The job of the reviewer is to determine if the work is suitable for publication in the journal to which it is submitted. As discussed in "Publishing at the Top of the Heap" (above), different journals have different criteria that the work has to meet. Reviewers must justify their opinions on acceptance, revision, or rejection of each manuscript. Reviewers justify their recommendations to you through their critique of the work.

However, what you see and what the editor sees are two different things. As you most likely are aware, as a reviewer you get to provide a numerical score or qualifying statement ranking the significance and novelty of the work, the quality of the data, and so on. Reviewers also recommend to editors whether the work should be accepted, returned for revisions, or rejected. But almost all journals have a section where reviewers can make "top-secret" comments to the editor about what they *really* think about the work. Because you don't get to see these comments, you must infer what you must do from the editor's letter and the anonymous reviews. Sometimes it's easy. Sometimes it's not.

The Job of the Reviewed

That's you. Your job is simple: to get the work published. The reviewer of your manuscript expects that you will at the very least address his or her comments. This is very important, since most revisions are re-reviewed by the same people, so they will be looking for you to acknowledge and consider their comments. Reviewers' comments address a range of categories, including novelty, significance, and relevance; the quality and novelty of the experimental design; data interpretation; and style and presentation of the data. The approaches we recommend for responding to each of these categories are discussed below.

Assessing Comments on a Rejected Manuscript

If your manuscript was rejected, the first question to ask is "Why?" Consider the categories listed above. Rejections based on novelty or significance and relevance to a field indicate that the paper was submitted to the wrong journal. To correct this, reassess your work and choose a more appropriate journal. If the paper originally went to a top-of-the-heap journal that publishes only work of broad significance, then consider sending the manuscript to a journal closer to your field, such as the journal of your scientific society. But if the work was rejected for these reasons from a journal that represents your field, you will need to point out the work's significance and how your work adds to what has already been published before you send it out again. However, if you cannot point out how your work adds to your field, then perhaps you will need to wait on publication until your results do in fact add to your field.

Some top-of-the-heap or near-the-top journals reject all manuscripts they do not immediately accept—that is, there aren't any conditional acceptances—and the letters they send out do not explain this fact. If you need clarification on what a rejection letter really means, call the editorial office and ask. If you still can't figure out what to do, seek the advice of a senior colleague in your department. Your colleague may be able to suggest some options that did not occur to you.

Before you press the reformat button and hit the print keys to produce another version of the manuscript for a different journal, you may want to consider the rest of the comments. You may think it unlikely that Dr. Stukittume—the one who *really* stuck it to you, not the one you thought it was—will get your manuscript again if you send it to a different journal. But the world of science is small, and even if you're changing journals, you aren't changing disciplines, so there's a good chance you might get the same reviewer. Some of those comments may improve your work and increase the likelihood that it is accepted. All in all, responding to those comments would be prudent, even if you send the paper elsewhere.

Reviewers almost always comment on the experimental design and the quality of the data. While everyone has a different way of doing an experiment, in the end the data and method of data collection must support the conclusions that you draw. When reading the comments and looking through your paper, ask yourself these questions:

» Is the title of the manuscript supported by the data?
» Do the data support your interpretation?
» Is your interpretation the only interpretation the data support?
» What controls are necessary to nail the point you're making?
» Is there a better way to collect the data?
» Are the results statistically significant?
» Can you get a better autorad reading, etc., than the one that you submitted?

If the reviewer comments on any of these issues, you will need to address them either by doing additional experiments or by providing more information, discussion, or justification before resubmitting your manuscript.

Assessing Comments for a Major Revision

Many journals provide authors with a second or, sometimes, a third chance to get their work accepted. This is most likely when the work is sound and interesting to the reviewer but is incomplete in either experimentation or interpretation. The letter you receive will likely state that the work is not acceptable in its current form. The letter may also state that if you wish to submit a revised manuscript after more work has been done, you will need to indicate how you responded to the reviewer's concerns. A journal editor's assumption is that you will follow the reviewer's advice whenever

Yes, you can rebut a rejection decision: You write the editor a letter explaining why you believe the reviewers came to the wrong decision.

possible, even if you aren't happy about it.

Responding to experimental/data issues requires work—sometimes lots of it—and work takes time. To minimize the amount of time and effort, you must prioritize: What are the most important points that the reviewer wants addressed experimentally? Start doing those experiments right away. But sometimes the experiment being recommended simply can't be done in your system. This is not the end for this paper; you may be able to perform a different experiment that would support the conclusion just as well. Often reviewers and editors are happy with this "bait and switch" tactic. If a requested experiment is easy to do, just do it, even if it doesn't tell you anything you did not already know. This sends a message to the reviewer and editor that you are doing your best to follow their advice.

Assessing Comments in a Minor Revision

Sometimes you will receive a letter that tells you that the work is "accepted upon satisfactory responses to the reviewer's concerns." Congratulations! You are almost there. Don't mess it up now! The concerns here usually can be addressed by doing simple experimentation, acknowledging the reviewer's interpretation in the manuscript, or adjusting a few words here and there. These are all easy to fix, so do it. You can actually say: "The possibility exists that the system may also include the brilliant interpretation of reviewer 74; however, much of the data presented here and also by Superstar *et al*. argues that the system will behave as predicted." It might be best to leave out the "brilliant" part, though; the reviewer may think you're being sarcastic. If a reviewer suggests that you change some of the wording to make it more palatable, do it. In the end, the copy editor may change the wording to something completely different anyway.

Responding to Critiques

Your letter to the editor should start politely. Response letters should state that the author thanks the reviewers for their time and effort and their contributions to the work. Moreover, almost all say that addressing the comments of the reviewers and/or doing the recommended experiments strengthened the work. This is basically true, and it tells the editor that you paid attention. Of course, if you decided to do nothing, do not say that you followed the advice of the reviewers. Instead, you should provide a point-by-point response to each reviewer's concerns. If your response is supported by the literature, quoting papers and supplying references will strengthen your point. In places where you and the reviewer agree, you should note in the manuscript where you have made revisions reflecting the reviewer's concerns. This will help the editor and the reviewer (if the manuscript is sent out for re-review) locate your changes and determine if you have really addressed the issues. These point-by-point letters are often very long, sometimes longer than the article itself. Be as succinct as you can be while also being clear, and avoid derogatory remarks about the review.

Rebutting a Decision

Yes, you can rebut a rejection decision: You write the editor a letter explaining why you believe the reviewers came to the wrong decision. Note how the above sentence is phrased. It doesn't blame the reviewers for not doing their job. If the rejection was based on a misinterpretation of the results by the reviewer, or the lack of an experiment for which you have the results but did not include, then you may have a shot at getting the manuscript re-reviewed. There is the chance that Dr. Stukittume may see your work again, so saying that the reviewer is an idiot and missed the point won't help your cause. You may, however, say, "Reviewer 2 did not realize that the results said blah, blah, blah, and therefore we have now reworded the section to make it more clear."

Before you rush to rebut your rejection, realize that there is a good chance that rebuttal will be rebutted. Your best bet may be to make the changes and submit your manuscript to another journal.

Data Presentation and Poor Writing

Sometimes reviewers have trouble with the way a figure or table is assembled or presented. Certainly, if a reviewer comments that data are not presented clearly, you should fix it. However, to avoid such statements, show the figures to colleagues and ask for their suggestions before you submit your paper.

Receiving a comment that the work needs to be edited by someone who speaks and writes English as his or her primary language is one that should be taken seriously. There are professional science writers who can help. Use them.

Bottom Line

As hard as it is to receive a rejection letter, the key to success in science is to receive criticism as openly as possible and without bitterness, and to respond by incorporating or debating the critique in your revised manuscript. It isn't personal. And remember: You can always revise the work and resubmit it to another journal. Good luck, and happy publishing.

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NOTE: Part 2 of this article can be found at: http://sciencecareers.sciencemag.org/career_development/previous_issues/articles/2730/academic_scientists_at_work_i_can_t_believe_they_didn_t_like_it/part_ii_grant_proposals/

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Chapter 1: CV WRITING AND INTERVIEW SKILLS – THE ESSENTIALS
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