3. Skills for the Academic Scientist

Tips for Publishing in Scientific Journals

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By Katrina Kelner— First published April 6, 2007

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

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

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

Choose a Good Environment for Publishing

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

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

Think in Figures

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

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

Choose an Appropriate Journal

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

Submit a High-quality Paper

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

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

Help Ensure That the Review Process Goes Smoothly

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

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

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

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

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

Respond to Reviewers' Comments Positively and Constructively

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

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

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

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

How to Deal with Rejection

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

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

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

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

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

Passion—Fuel That Fans Flames of Success

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

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

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

Standing upon the Shoulders of Giants

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

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

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

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

No Man (or Woman) Is an Island

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

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

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

Winning at the Lab Business

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

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

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

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

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

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

Creative Funding Strategies

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

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

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

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

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

Teaching the Teacher

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

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

Playing Politics

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

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

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

Tenure Track

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

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

Love of Learning

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

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

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

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