This course will NOT be me dictating to you how to accomplish all of what is listed below. Instead, I will relay some facts and offer you my opinions, as well as those of others with whom I've consulted. These opinions will be mere starting points for discussion, not conclusive directions. I want and expect you to debate some of the various opinions brought forth. More importantly, discuss these with your advisor, as ultimately, that person's opinion will matter greatly.

Running themes will be taking initiative on your own direction, thinking in the long-term while not losing sight of the short-term, maximizing bang for your time (& buck), etc. Many parts will also be largely informational, such as details on peer-review processes associated with various journals or funding agencies. Guest lecturers may be brought in as appropriate.

Outline:
What to do in your first year
Picking an advisor and a direction
Expectations and complaints about advisors/graduate students

Choosing a research project: balancing safety with novelty

Publishing- associated challenges and benefits, impact factors, open-access, etc.
Peer review procedure at various journals

FUNDING: what sources are available, and how do you get them
Peer review procedure at various funding agencies

How to be a "good grad student"
What to do a year before you want to graduate

Postdocs- unique benefits and challenges of this step

Alternative careers to academia

Preparing a CV, and teaching & research interest statements
Applying for academic jobs

What happens after all that? Tenure/promotion, building a national reputation, etc.
Grad School 101
Suggested further reading

Websites:
"Resources for the development of early career scientists" - includes online books on scientific management, etc.
http://www.hhmi.org/resources/labmanagement/

"How to be a good graduate student"
http://www.cs.indiana.edu/how.2b/how.2b.html

Books:

**Building a Successful Career in Scientific Research**
By Phil Dee
*Paperback*: 142 pages; Dimensions (in inches): 0.5 x 8.8 x 6
*Publisher*: Cambridge University Press (March 20, 2006)
*ISBN-10*: 0521617405
*ISBN-13*: 978-0521617406

**Getting What You Came for: The Smart Student's Guide to Earning a Master's or a Ph.D.**
By Robert L. Peters
*Paperback*: 400 pages; Dimensions (in inches): 1.11 x 9.02 x 6.02
*Publisher*: Noonday Press; Revised edition (April 1997)
*ISBN*: 0374524777

**The Ph.D. Process: A Student's Guide to Graduate School in the Sciences**
By Dale F. Bloom, Jonathan D. Karp, Nicholas Cohen
*Paperback*: 224 pages; Dimensions (in inches): 0.65 x 9.19 x 6.08
*Publisher*: Oxford University Press; (December 1998)
*ISBN*: 0195119002

**How to Do Ecology**
By Richard Karban and Mikaela Huntzinger
*Paperback*: 168 pages; Dimensions (in inches): 0.5 x 8 x 5
*Publisher*: Princeton University Press; (August 2006)
*ISBN*: 0691125775

**At the Bench: A Laboratory Navigator**
By Kathy Barker
*Hardcover*: 460 pages; Dimensions (in inches): 1.25 x 10.50 x 8.25
*Publisher*: Cold Spring Harbor Laboratory; Spiral edition (December 1998)
*ISBN*: 0879695234

**At The Helm: A Laboratory Navigator**
By Kathy Barker
*Hardcover*: 352 pages; Dimensions (in inches): 1.09 x 10.30 x 7.26
*Publisher*: Cold Spring Harbor Laboratory; 1st edition (January 15, 2002)
*ISBN*: 0879695838
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Salaries in industry (*Genome Technology*)
Salary survey results (*Science*)
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Government jobs- web help
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How to get a job at a primarily undergraduate institution (A.S. Cell Bio)
Sample job application
Sample application summary for ecologist position
Questions to ask or answer in job interviews
Transitioning: What colleges and universities want in new faculty (Adams)
Several letters from faculty at different types of colleges/ universities
Ready, Set, Hire! (*Nature*)
Balancing act- new faculty
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The job search- Ethical issues in switching jobs
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FIRST YEAR-
GETTING STARTED
Rules for Starting Graduate School Successfully

You're not an undergraduate any more, so don't act like one!

1) Gone are the days of sitting in a classroom like a baby bird with your mouth open, waiting for the professors' regurgitation of "facts" to be dropped in. You will need to figure things out for yourself. Although you can ask questions, you will be expected to figure out, on your own, significantly more than what you will be told. It will be important to read a ton yourself, identify primary literature (not just Google and Wikipedia!) in your area, figure out within published papers what's real vs. BS or hype, and generally identify, think about, and work through problems rather than waiting for someone to show you how to do X or Y.

2) Also gone are the days of getting up at 10am and having your nights and weekends free to do whatever you want. One of the best ways to turn off a rotation mentor is to ask, "How many hours do I have to be at work per week?" What he/she will hear instead is, "I am not here because I'm passionate about science, and I want to snake by on the minimum possible." Your mission is to complete as much research as possible. There's a positive correlation between time at the bench and getting more research done. That said, you can't be at work every second of every day, and people sometimes work better when they have an "outlet" that's outside of work. Still, expect to be doing some type of work (including reading papers—really reading them, not having them on your lap while you watch American Idol) well over 40-hours per week, and plan to be at the bench most of that time.

3) Show real initiative in thinking about science. Keep a notebook of "crazy project ideas", and write down notes in it. Look up papers on the topic you're researching well beyond those pointed out to you. Annotate papers as you read them with comments. Think about other experiments that could be done, and talk about these ideas with others in the lab and the PI. Are there alternative approaches to the experiments you are doing, and what are the pros and cons? Take notes at seminars, and discuss the findings with others. What could they have done better (scientifically)? Is there anything you can learn from their studies?

4) *Think about why you're here.* You should be here because you love science, love figuring things out, and generally love what you're doing. This is a career track, not a part-time job. If you don't act and feel passionate about it, then you'll have a very hard time achieving more than mediocrity in it. Find that passion and excitement in yourself for your work: both your research and your reading.

5) Hold a high (but reasonable) standard of responsibility for yourself. Typical bad undergrad will have excuses for why X or Y couldn't get done at all or in time. Star graduate student will instead have contingency plans. Don't wait until the last second for getting assignments done (or even "printed"). Plan ahead. And think seriously—excuses like, "I didn't finish and couldn't call or e-mail because I was out of town" are lame in this decade of cell phones, internet cafes, home cable modems, etc.
What to do/ expect in your first year

2 RULES:

Read a lot, in a wide variety of subdisciplines within you discipline of interest (e.g., ecology, evolution, biochemistry, physiology, etc.). DO NOT become a "specialist" on day 1 and ignore all papers that are not on salamander mating displays. Read papers on different organisms (yes, even different kingdoms), different questions, different approaches, etc. Regardless of what you think or what you've done previously, you are not ready to specialize that much yet.

Meet people. Show up for department seminars and talk to people (both faculty and students). Get at least 4 faculty to know who you are beyond a face in a classroom. Go to BioGrads activities. Introduce yourself to the office staff, to folks in the labs next to the one in which you're working, etc. It'll be important to talk with the pre-existing graduate students about various issues (e.g., what classes to take) that come up, so it's especially important to get to know them.

CLASSES:

Some faculty will not know what classes are good or bad, so get multiple opinions and opinions from both faculty and students who've taken the courses. Talk to the professor who teaches the classes you'd like to take, and get a syllabus.

Take a statistics class of some sort (unless you've already had a good class in it). You'll always think you can get away without it, and you'll be wrong.

PICK AN ADVISOR:

While some of you will do "rotations" in various labs, others may join a lab group directly. In deciding on a lab/ advisor, talk with the advisor's former students who have graduated and gone on elsewhere. Their input may be more fair than the current students, who may have had an especially good/ bad week and have their stated opinion based more on that week than overall. That said, with any feedback you get, keep in mind that people's interactions and expectations are different: among those within a lab, it is not unusual for one student to be consistently very happy while another is miserable.

Do your best to pick someone with whom you feel you can work with, communicate with, and interact with closely over the next 5-7 years and beyond (you'll need letters for many years thereafter). It's better to switch advisors in your first year than after you've been there for several years, so now's the time to evaluate this relationship VERY closely. However, you should voice concerns directly, too- don't just turn around and leave one day. Treat your potential advisor with the same respect you want to be treated, and if you're not getting what you want, tell him/ her directly. It's always better to hear it directly than from a third person as gossip.
Picking a Lab / Advisor

Some people come to graduate school specifically to work in a particular laboratory, while others come and rotate among several labs, choosing at the end of the rotations where they'd like to be housed. One thing to keep in mind: even if you came to work in a particular laboratory, do evaluate when you first begin whether you feel it is a good match. It's always better to jump ship early than to do so halfway through a PhD!

1) Unequivocally, the #1 question has to be this one: **Are you sufficiently excited about the type of research being conducted in this laboratory that you can see yourself diving into it for the next several years?** If you are hesitant or only lukewarm on the research after a few months, that could be a grave warning sign. The value of your PhD will be defined by your research success, and you cannot be successful if you're not excited about what you're doing.

2) **Are you and the advisor a good match in terms of working together?** If you're someone who wants a lot of attention/ structure, is your potential advisor accessible/ responsive? There's a lot of variance in what students want/ need, and there's a lot of variance in advisor behavior, so try to find someone with whom you'd be able to have a successful scientific partnership for the next 5 years. Do you get (and want) weekly individual meetings? Do you get (and want) timely feedback either on your progress or on manuscripts/ proposals/ etc.? Do you feel your advisor makes unreasonable demands of you, and if so, what is his/ her response if you indicate that sentiment?

3) **What has been the success of previous graduate students in this laboratory?** Have previous students in this lab gone on to win awards, get good postdocs or other positions, etc.? Did they publish many and/ or influential studies from their time in graduate school? Obviously, this question is unfair for new faculty, but among faculty that have been around a long time, it's a good thing to consider.

4) **Are the resources for the type of research I want to do available?** Many laboratories undergo periodic lapses in funding or staffing, but a long-term lapse could be symptomatic of a greater concern. Relatedly, how does the advisor handle missing resources- swift attempts to find alternatives or empty promises that are rarely fulfilled?
Advisor / Graduate Student Complaints

Major issue: Advisors and their students generally **fail to communicate** their expectations *a priori*. Students typically blame this completely on the faculty member, without remembering that many faculty members have only mentored a few students in the past, so are perhaps equally inexperienced.

About advisors by students:

1) Failure to communicate  
2) Not treated with respect or as a priority (insufficient time)  
3) Micromanaging, or lack of feedback on probability of success of proposed work  
4) Irresponsibility or inconsistency  
5) Overloading of students with too many sidelines  
6) Taking favorites  
7) Failure to consider timelines for letters/ feedback on proposals/ etc.  
8) Insufficient positive feedback or direction  
9) Relationship boundaries

About students by advisors (as listed by students, not advisors):

1) Insufficient number of hours spent doing research  
2) Too much time devoted to activities besides research  
3) Lack of visible forward progress, or failure to communicate progress  
4) Too much personal travel  
5) Not going to scientific meetings  
6) Lack of effort at obtaining funding  
7) Requesting comments/feedback/letters at the last second  
8) Not reading the primary literature in their area of study  
9) Passing off non-work as work (e.g., e-mail in lab, web surfing, chit-chatting, etc.)
The Role of the Advisor

(Excerpt from "Graduate School in Science and Engineering: Tips for Students and Faculty")

The mentor/advisor is one of the most important persons in a graduate student's life. "Why do you need a mentor? You can't graduate without one. That's the bottom line." The advisor will guide your research, provide funds for your materials and equipment, provide (or not provide) your financial support and, generally, will have a great deal of influence on the success of your graduate studies. Selecting a mentor/advisor should not be a "snap" decision...do some research before committing yourself to a laboratory group.

What should your advisor expect from you?

Following this section is a list detailing a number of things you will want your advisor to do for you. However, the relationship between a graduate student and his/her advisor must be mutually beneficial in order to work well. The term "graduate studies" is inaccurate...we should use the term "graduate work." You should consider graduate work your job for the next few years...and you should do your best to prove that it is a job that you can do well! With that in mind, we have developed a list of tips for working with your mentor/advisor:

Let your advisor know that you are serious about completing the degree...Don't Assume That This Is A Given! Your advisor may have had students before who really were not dedicated to completing the degree;

Discuss with your advisor what you hope to do with your degree, such as conduct research in a university setting, work in industry, or be a full-time teaching professor;

Be Visible!

Attend seminars sponsored by your department;

Work! Graduate school is the time for working long hours...you don't have to live in the lab, but be sure you're getting the work done, even if it means staying late;

Think of your graduate work as a job. Your advisor is putting time (and money, if you're a graduate student researcher) into training you. Show up at work every day and on many weekends. You don't have to give up your social life but this is not the time to go on road trips every weekend!

Early in your graduate work, begin to build your advisor's trust in you...listen to his/her advice. Sometimes accepting this advice can be painful but, unless you feel it is unethical, malicious, or really off target, take it! If you feel the advice is not in your best interest, confer with another faculty member on your advisory committee.
Confer often with your advisor. It is recommended that, once you start working on your dissertation, two weeks should not pass without conferring with your advisor;

Get to know other graduate students (both new and experienced) and other faculty members in your department. Talk with them frequently at lunch or before/after seminars. Learn how to collaborate...the old saying about friendship holds true - before you can have colleagues, you have to be one.

In general, put your mentor at ease. Let him/her know that you're serious, that you're motivated, and that you're eager to earn a place in both his/her lab and in the national network of researchers in your field.

In General, A "Good" Advisor Should:

Be involved in a research area that you are interested in. DO NOT choose a particular mentor/advisor just because they are "nice!" You must be interested in doing serious work over a long period of time in his/her research area...you should not expect him/her to support you in a new research field. Conversely, if you can tell that the faculty member absolutely rubs you the wrong way and that your personalities will clash, you may wish to reconsider your selection or at least have a discussion with several of his/her graduate students;

Counsel you and direct your research - your mentor should be candid about your progress and should feel free to tell you not only when you're doing things right but also when you're wrong;

Direct your course selection and course load - a good mentor won't let you get in over your head or take a worthless course;

Steer you away from people in the department who will create barriers for you (in courses, collaborative work or sharing equipment, for example);

Offer encouragement;

Assist you in understanding and meeting the milestones and deadlines you have to meet (for example, course work, preliminary exams, proposal preparation, and dissertation);

Give you some research freedom...after working in the laboratory for a while, you should have the opportunity to propose experiments...you should not spend your entire graduate work acting as a laboratory technician to carry out someone else's work;

Provide opportunities for you to participate in annual meetings of professional associations, including opportunities to prepare and staff a posters;

Assist you in learning to prepare research papers for submission to professional journals;
Introduce you to colleagues from other institutions, both when they visit your campus and when you attend annual meetings of research associations;

Make every effort to support his/her graduate students financially;

Establish and encourage absolute intellectual honesty in the laboratory group. You should ask other graduate students whether laboratory discussions are open and free.

Make efforts to establish a "cooperative" laboratory group where:

- a network of cooperative interaction exists within the lab group...this should include postdoctoral fellows, both new and experienced graduate students, technicians;

- the mentor encourages students and postdoctoral fellows to continue exploring problems begun in his/her laboratory when they move to a new position;

Make sure that arguments about the interpretation of data or development of theories are kept separate from personal barbs or attacks;

Work to make his/her laboratory a part of the informal national network of laboratories in his/her field...for example, does he/she collaborate with other persons around the country?...does he/she act as a reviewer for grants and research journals?

Expose students to the funding process, including opportunities to draft sections of grant proposals, read grant proposals, and discuss how-to's on working with funders;

View science as fun, challenging and exciting work, but also as a very human endeavor.
Your PhD Boss: Adversary or Super-Advisor? Part One

A few of you reading this won't have seen your PhD supervisor for many months; others may well be like two peas in a pod with your boss. But whether close or at a distance, a good working relationship is essential--much of your initiation into the 'real' world of science comes from your advisor. As in dating, there are 'Rules' for getting the best from your scientific nearest and dearest. This month we look at the first three Rules that lay the foundations for a successful relationship.

Rule Number One, the Ground Rule: Remember That Your Boss Is on Your Side
PhD dogma states that 'he who becomes isolated from his boss fails to submit! I've seen this happen once and it's not at all nice. The person in question fell out with their advisor and managed to eventually lose all contact with them--not a smart move.

Rule Number Two: Keep Them in the Picture
As you get more confident, you'll find yourself drifting free from the burden of checking everything first with your boss. But beware of this slippery slope, especially if your boss is geographically distant. Sometimes I've gone for days, even a couple of weeks, without my boss knowing what I've been doing. Even for a workaholic like me, the subconscious temptation is to let things slip, 'when the cat's away, and all that. This nasty habit leads to a student with a false sense of independence (I've got plenty of time and I'm in control) and a boss with a false sense of security ('I've not heard anything from them so I assume everything is OK'). Regular feeding of information to your boss, if only by e-mail, is the best way to focus your mind on exactly how much, or how little, you have achieved since the last time you told them anything. It's also a good chance to sound them out on your new ideas. Scheduling this event once a week gives you a regular, and scary, target to aim for. There's no fear like the fear of saying 'I haven't done anything at all since last week'. Also, bosses like getting these e-mails: It gives them the delusion that they are in control. N.B. Only tell them stuff you are certain you want them to hear. Applying this Rule is a discipline that leads to happier students ('Regularly telling my boss what I've achieved seems to be really driving my project forward') and happier bosses ('I don't have to hope they are making progress, I know they are').

Rule Number Three: Find Out What Makes Your Boss Tick
To get this relationship working really efficiently, you'll need to find out which sort of scientific animal you are dealing with. We all know that underneath a scientist's usually quiet exterior lies constant mental activity. But is your boss an aggressive activist, who is always looking for their next experimental 'fix', or a more cautious completer-finisher, who only moves onto the next level when everything else is in place?

So if you wish to avoid ending up working in the local library, you need to a) submit your thesis (surprise, surprise!) and b) maintain at least a reasonable relationship with your boss in order to get to that point. You'll also need to keep them on board for the long haul so that you can access their network of contacts and vastly improve your job-hunting prospects. Having offered you the studentship over a number of other 'possibles', something about you must have appealed to your boss. Without being a lap dog, aim to work at keeping them pleased that they chose you. You might ask if your advisor is likely to keep up their interest in you after your 3 years of possibly less than world-class research? This question is especially pertinent if your advisor has a large number of other students. The answer is most definitely yes, but only if you work at maintaining the relationship.

Next month we'll look at the final three Rules that will build on these foundations and propel you into a more dynamic student-boss relationship.
Your Ph.D. Boss: Adversary or Superadvisor? Part 2

A good relationship with your Ph.D. supervisor is essential, but, as in dating, there are 'Rules' for getting the best from your scientific nearest and dearest. Last month, Part One of this article considered the three ground-rules of 'boss-handling': remembering that they are on your side, keeping them regularly informed of your progress (or lack of it), and finding out what makes them tick. Here we look at the three essential 'Rules' for developing a more dynamic student-boss relationship.

Rule Number Four: Earn Your Boss's Respect

I once knew a capable Ph.D. student who used to habitually kow-tow to his boss's ideas simply because he lacked the conviction to believe in his own ideas. The truth is the boss was equally frustrated by this student's lack of initiative. You need to know that earning your boss's respect doesn't only come from amassing lots of good results, important as they are.

Rule Number Five: Assert Yourself With Your Boss

Ph.D. students often complain that they are just skivvies: cheap labour. It's a bit of a cliché, and I guess we've all said it at least once. My response is that we shouldn't be so defeatist. In my experience many students are often not used to making demands of people in positions of authority and end up being far too submissive. If you apply Rule Four, you have the immediate advantage of being in a much stronger bargaining position: Your boss respects you. Remember that you are being trained to be an independent research scientist. So forget the old student-tutor relationship, this is something new. Start to negotiate with your boss about your project aims, your workload, anything. If you are new to tackling bosses, don't be too pushy. Get yourself on an assertiveness training course. This will show you how to listen to your boss and use what they say to approach them in a way that will increase the chance of a successful outcome. Such a result only gets you what you need. If you are assertive in the true sense of the word, your boss will feel that they got what they wanted too. Once you've experienced the feeling of leaving a meeting that, due to your behaviour, went well for both parties, you'll want to do it again.

Rule Number Six, The Golden Rule: Write for Your Boss

The Golden Rule is obvious. If you want an easy ride with your boss you have to be proactive about writing, especially writing papers. They applied for the funding and brought you in primarily to increase their own personal tally of papers. That's what everyone is judged on these days. Ultimately, that's what your boss wants from you. If your boss already respects you and is used to you behaving assertively with them, early delivery of good quality writing will utterly convince them that you are worth investing even more of their time in. So as soon as your results are in start getting it all together on paper. Daunting as it seems you can write the outline of a paper within a week, if you put your mind to it. When I handed my boss the best part of my first paper he was like a dog with two tails: I've got a great working relationship with my boss, but I had never experienced interest in my work from him like this. Clearly, nothing gets a scientist's attention like the prospect of submitting another paper with their name on it. The Golden Rule is the hardest to apply but has the most wonderful effects. Firstly, your boss will love you and gladly read several drafts of your thesis. Secondly, writing and defending your thesis will be a whole lot easier with at least some of your work submitted for publication.

So there's your complete six-step guide to becoming a good 'boss-handler'. Follow these Rules and you'll be more likely to find yourself with a boss who is also your greatest ally.

1. Sisters Doing It for Themselves
   By Kirstie Urquhart, 10 Nov 2000
As academia is not a 9-5 job, I don’t expect you to be a 9-5 student. Hence, you should often find yourself doing research on weeknights and/or weekends. Your objective is to execute your research in a careful and precise yet expeditious manner. As a rule of thumb, I suggest a minimum of about 40 hours a week of productive research in the lab or field. This length of time does not include time spent on e-mail, socializing, or coursework. This number could drop to a minimum of perhaps 20-30 hours a week if you are TA’ing and taking heavy coursework.

I expect you to follow the lab rules that will be given to you when you begin and potentially updated each semester. This includes all required safety training.

I expect you to read the primary literature in your area of study. I will give you a list of about a dozen journals that you should peruse regularly, and you should read articles in those journals and others that are relevant to your work, in the general area of your work, or that look interesting to you. This may sometimes be a small fraction of the articles in any particular issue. Do not rely on me to point you to all relevant articles.

I expect you to update me regularly (at least once every 2 weeks) about your progress on your research, informally. This is in addition to formal updates in lab meetings.

I expect Ph.D. students to have submitted 3 first-author peer-reviewed papers for publication before I sign off on their dissertations. All these publications must be from research done while in our lab pursuing a PhD, not prior work.

I expect you to actively pursue funding for your project and support (in the form of Sigma Xi grants, NSF DDIGs, or NSF predoctoral fellowships).

I expect you to present the results of your research at national meetings at least every other year. I will attempt to assist with your expenses at least sometimes, but the unequivocal condition for any assistance is that I see a complete draft of what you’re presenting at least 10 days before the first day of the meeting. If not, I will not reimburse any expense of your travel.

I expect you to attend many departmental seminars and to participate in other departmental activities.

I expect you to communicate to me concerns that you have about your research or our interactions. Communication is critical for both of us to keep our relationship productive.

I expect you to treat me, and others in the lab, with respect and dignity.
Noor lab- My expectations of me as an advisor

I will always make time to talk with you about your research and/or your academic training. Although I will not be available at the drop of a hat, I will always be available for at least 30 minutes once a week for you with advance request. It will generally be much more than that, but I will commit to a minimum of 30 minutes in even the worst weeks.

I will advise you on how to proceed according to the career path that you select (e.g., how to get a postdoctoral position, academic job, etc.). Alternatively, if I am not familiar with the career path you have chosen, I will refer you to people and/or resources that can help to guide you.

I will read and comment on any manuscripts, grant applications, or other written materials you give me within 2-3 weeks (excluding theses/ dissertations). It will generally be in less time than that, but I can guarantee within 2-3 weeks. Please get these to me at least this long before your deadline, as I may refuse to read such materials if you give me less than that amount of time.

I will give you copies of recommendation letters that I write for you. If I cannot accurately tell you about your performance, then I am not doing my job as an advisor.

I will provide you with resources for your research provided that they are available to me, your project has been approved, the expense is reasonable given the laboratory priorities, and you are actively pursuing further funding for it.

I will update you on my opinion of your progress, both in research and in your overall training upon request.

I will introduce you to others in the field and help you make contacts that will be useful throughout your career.

I will treat you with respect and dignity.
SOME MODEST ADVICE FOR GRADUATE STUDENTS

Stephen C. Stearns

Always Prepare for the Worst

Some of the greatest catastrophes in graduate education could have been avoided by a little intelligent foresight. Be cynical. Assume that your proposed research might not work, and that one of your faculty advisors might become unsupportive - or even hostile. Plan for alternatives.

Nobody Cares About You

In fact, some professor care about you and some don't. Most probably do, but all are busy, which means in practice they cannot care about you because they don't have the time. You are on your own, and you had better get used to it. This has a lot of implications. Here are two important ones:

1) You had better decide early on that you are in charge of your program. The degree you get is yours to create. Your major professor can advise you and protect you to a certain extent from bureaucratic and financial demons, but he should not tell you what to do. That is up to you. If you need advice, ask for it: that's his job.

2) If you want to pick somebody's brains you'll have to go to him or her, because they won't be coming to you.

You Must Know Why Your Work is Important

When you first arrive, read and think widely and exhaustively for a year. Assume that everything you read is hogwash until the author managed to convince you that it isn't. If you do not understand something, don't feel bad - it's not your fault, it's the author's. He didn't write clearly enough.

If some authority figure tells you that you aren't accomplishing anything taking courses and you aren't gathering data, tell him what you're up to. If he persists tell him to bug off, because you know what you're doing, dammit.
This is a hard stage to get through because you will feel guilty about not getting on your own research. You will continually be asking yourself, "What and I doing here?" Be patient. This stage is critical to your personal development and to maintaining the flow of new ideas into science. Here you decide what constitutes an important problem. You must arrive at this decision independently for two reasons. First, if someone hands you a problem, you won't feel that it is yours, you won't have that possessiveness that makes you want to work on it, defend it, fight for it, and make it come out beautifully. Secondly, your Ph.D. work will shape your future. It is your choice of a field in which to carry out a life's work. It is also important to the dynamic of science that your entry be well thought out. This is one point where you can start a new area of research. Remember, what sense does it make to start gathering data if you don't know - and I mean really know - why you're doing it?

**Psychological Problems are the Biggest Barriers**

You must establish a firm psychological stance early in your graduate career to keep from being buffeted by the many demands that will be made on your time. If you don't watch out, the pressures of course work, teaching, language requirements and who know what else will push you around like a large, docile molecule in Brownian motion. Here are a few things to watch out for:

1. The initiation-rite nature of the Ph.D. and it's power to convince you that your value as a person is being judged. No matter how hard you try, you won't be able to avoid this one. No one does. It stems from the open-ended nature of the thesis problem. You have to decide what a "good" thesis is. A thesis can always be made better, which gets you into an infinite regress of possible improvements.

Recognize that you cannot produce a "perfect" thesis. There are going to be flaws in it, as there are in everything. Settle down to make it as good as you can within the limits of time, money, energy, encouragement, and thought at your disposal.

You can alleviate this problem by jumping all the explicit hurdles early in the game. Get all of your course requirements and examinations out of the way as soon as possible. Not only do you thereby clear the decks for your thesis, but you also convince yourself, by successfully jumping each hurdle, that your probably are good enough after all.

2. Nothing elicits dominant behavior like subservient behavior. Expect and demand to be treated like a colleague. The paper requirements are the explicit hurdle you will have to jump, but the implicit hurdle is attaining the status of a colleague. Act like one and you'll be treated like one.

3. Graduate school is only one of the tools that you have at hand for shaping your development. Be prepared to quit for awhile if something better comes up. There are three good reasons to do this.
First, a real opportunity could arise that is more productive and challenging than anything you could do in graduate school and that involves a long enough block of time to justify dropping out. Examples include field work in Africa on a project not directly related to your Ph.D. work, a contract for software development, an opportunity to work as an aide in the nation's capital in the formulation of science policy, or an internship at a major newspaper or magazine as a science journalist.

Secondly, only be keeping this option open can you function with true independence as a graduate student. If you perceive graduate school as your only option, you will be psychologically labile, inclined to get a bit desperate and insecure, and you will not be able to give your best.

Thirdly, if things really are not working out for you, then you are only hurting yourself and denying resources to others by staying in graduate school. There are a lot of interesting things to do in life besides being a scientist, and in some the job market is a lot better. If science is not turning you on, perhaps you should try something else. However, do not go off half-cocked. This is a serious decision. Be sure to talk to fellow graduate students and sympathetic faculty before making up your mind.

**Avoid taking Lectures - They're Usually Inefficient**

If you already have a good background in your field, then minimize the number of additional courses you take. This recommendation may seem counter-intuitive, but it has a sound basis. Right now, you need to learn how to think for yourself. This requires active engagement, not passive listening and regurgitation.

To learn to think, you need two things: large blocks of time, and as much one-on-one interaction as you can get with someone who thinks more clearly than you do.

Courses just get in the way, and if you are well motivated, then reading and discussion is much more efficient and broadening than lectures. It is often a good idea to get together with a few colleagues, organize a seminar on a subject of interest, and invite a few faculty to take part. They'll probably be delighted. After all, it will be interesting for them, they'll love your initiative - and it will give them credit for teaching a course for which they don't have to do any work. How can you lose?

These comments of course do not apply to courses that teach specific skills: e.g., electron microscopy, histological technique, scuba diving.
Write a Proposal and Get it Criticized

A research proposal serves many functions.

1. By summarizing your year's thinking and reading, it ensures that you have gotten something out of it.

2. It makes it possible for you to defend your independence by providing a concrete demonstration that you used your time well.

3. It literally makes it possible for others to help you. What you have in mind is too complex to be communicated verbally - too subtle, and in too many parts. It must be put down in a well-organized, clearly and concisely written document that can be circulated to a few good minds. Only with a proposal before them can the give you constructive criticism.

4. You need practice writing. We all do.

5. Having located your problem and satisfied yourself that it is important, you will have to convince your colleagues that you are not totally demented and, in fact, deserve support. One way to organize a proposal to accomplish this goal is.

   a. A brief statement of what you propose, couched as a question or hypothesis.

   b. Why it is important scientifically, not why it is important to you personally, and how it fits into the broader scheme of ideas in your field.

   c. A literature review that substantiates (b).

   d. Describe your problem as a series of subproblems that can each be attacked in a series of small steps. Devise experiments, observations or analyses that will permit you to exclude alternatives at each stage. Line them up and start knocking them down. By transforming the big problem into a series of smaller ones, you always know what to do next, you lower the energy threshold to begin work, you identify the part that will take the longest or cause the most problems, and you have available a list of things to do when something doesn't work out.

6. Write down a list of the major problems that could arise and ruin the whole project. Then write down a list of alternatives that you will do if things actually do go wrong.

7. It is not a bad idea to design two or three projects and start them in parallel to see which one has the best practical chance of succeeding. There could be two or three model systems that all seem to have equally good chances on paper of providing appropriate tests for your ideas, but in fact practical problems may exclude some of
them. It is much more efficient to discover this at the start than to design and execute two or three projects in succession after the first fails for practical reasons.

8. Pick a date for the presentation of your thesis and work backwards in constructing a schedule of how you are going to use your time. You can expect a stab or terror at this point. Don't worry - it goes on like this for awhile, then it gradually gets worse.

9. Spend two to three weeks writing the proposal after you've finished your reading, then give it to as many good critics as you can find. Hope that their comments are tough, and respond as constructively as you can.

10. Get at it. You already have the introduction to your thesis written, and you have only been here 12 to 18 months.

**Manage Your Advisors**

Keep your advisors aware of what you are doing, but do not bother them. Be an interesting presence, not a pest. At least once a year, submit a written progress report 1-2 pages long on your own initiative. They will appreciate it and be impressed.

Anticipate and work to avoid personality problems. If you do not get along with your professors, change advisors early on. Be very careful about choosing your advisors in the first place. Most important is their interest in your interest.

**Types of Theses**

Never elaborate a baroque excrescence on top of existing but shaky ideas. Go right to the foundations and test the implicit but unexamined assumptions of an important body of work, or lay the foundations for a new research thrust. There are, of course, other types of theses:

1. The classical thesis involves the formulation of a deductive model that makes novel and surprising predictions which you then test objectively and confirm under conditions unfavorable to the hypothesis. Rarely done and highly prized.

2. A critique of the foundations of an important body of research. Again, rare and valuable and a sure winner if properly executed.

3. The purely theoretical thesis. This takes courage, especially in a department loaded with bedrock empiricists, but can be pulled off if you are genuinely good at math and logic.
4. Gather data that someone else can synthesize. This is the worst kind of thesis, but in a pinch it will get you through. To certain kinds of people lots of data, even if they don't test a hypothesis, will always be impressive. At least the results show that you worked hard, a fact with which you can blackmail your committee into giving you the doctorate.

There are really as many kinds of theses as there are graduate students. The four types listed serve as limited cases of the good, the bad and the ugly. Doctoral work is a chance for you to try you had at a number of different research styles and to discover which suits you best: theory, field work, or lab work. Ideally, you will balance all three and become the rare person who can translate the theory for the empiricists and the real world for the theoreticians.

Start Publishing Early

Don't kid yourself. You may have gotten into this game out of love for plants and animals, your curiosity about nature, and your drive to know the truth, but you won't be able to get a job and stay in it unless you publish. You need to publish substantial articles in internationally recognized, referred journals. Without them, you can forget a career in science. This sounds brutal, but there are good reasons for it, and it can be a joyful challenge and fulfillment. Science is shared knowledge. Until the results are effectively communicated, they in effect do not exist. Publishing is part of the job, and until it is done, the work is not complete. You must master the skill of writing clear, concise, well-organized scientific papers. Here are some tips about getting into the publishing game.

1. Co-author a paper with someone who has more experience. Approach a professor who is working on an interesting project and offer your services in return for a junior authorship. He'll appreciate the help and will give you lots of comments on the paper because his name will be on it.

2. Do not expect your first paper to be world-shattering. A lot of eminent people began with a minor piece of work. The amount of information reported in the average scientific paper may be less than you think. Work up to the major journals by publishing one or two short - but competent - papers in less well-recognized journals. You will quickly discover that no matter what the reputation of the journal, all editorial boards defend the quality of their project with jealous pride - and they should!

3. If it is good enough, publish your research proposal as a critical review paper. If it is publishable you've probably chosen the right field to work in.

4. Do not write your thesis as a monograph. Write it as a series of publishable manuscripts, and submit the early enough so that at least one or two chapters of your thesis can be presented as reprints of published articles.
5. Buy and use a copy of Strunk and White's Elements of Style. Read it before you sit down to write your first paper, then read it again at least once a year for the next three or four years. Day's book, How to Write and Publish a Scientific Paper, is also excellent.

6. Get your work reviewed before you submit it to the journal by someone who has the time to criticize your writing as well as your ideas and organization.

**Don't Look Down on a Master's Thesis**

The only reason not to do a master's is to fulfill the generally false conceit that you're too good for that sort of thing. The master's has a number of advantages.

1. It gives you a natural way of changing schools if you want to. You can use this to broaden your background. Moreover, your ideas on what constitutes an important problem will probably be changing rapidly a this stage of your development. Your knowledge of who is doing what, and where, will be expanding rapidly. If you decide to change universities, this is the best way to do it. You leave behind people satisfied with your performance and in a position to provide well-informed letters of recommendation. You arrive with most of your Ph.D. requirements satisfied.

2. You get much-needed experience in research and writing in a context less threatening than doctoral research. You break yourself in gradually. In research, you learn the size of a soluble problem. People who have done master's work usually have a much easier time with the Ph.D.

3. You get a publication.

4. What's your hurry? If you enter the job market too quickly, you won't be well prepared. Better to go a bit more slowly, build up a substantial background, and present yourself a bit later as a person with more and broader experience.

**Postscript**

This comment was originally entitled "Cynical aids towards getting a graduate degree, or psychological and practical tools to use in acquiring and maintaining control over your own life." It originated as a handout for the Ecolunch Seminar in the Department of Zoology, University of California, Berkeley, on a Monday in the spring of 1976. Ecolunch was, and is, a Berkeley institution, a forum where graduate students present their work in progress and receive constructive criticism. At the start of the semester, however, no one is ready to talk. This was such a time.
On Friday morning at Museum Coffee, Frank Pitelka, who was in charge of Ecolunch for that semester, asked me to make the presentation on the following Monday. "Asked" is probably a misleading representation of Frank's style that morning. Frank bullied me into it. I had just given a departmental seminar on the Ph.D. work I had done at British Columbia, and did not have much new to say about biology. Frank's style brought out the rebel in me. I agreed on the condition that I had complete freedom to say whatever I wanted to, and that the theme would be advice to graduate students. Frank agreed without apparent qualms. Then I charged upstairs to Ray Huey's office to plot the attack.

I whipped out an outline, Ray responded with a more optimistic and complementary version (see the following Commentary article), and I wrote a draft at white heat that afternoon. We felt like plotters. We were plotters. There were acts of self-definition in the air. On Monday, I recall that I made a pretty aggressive presentation in which, to emphasize how busy faculty members were, I kept looking at my watch. Near the end I glanced at my watch one last time, said I had to rush off to an appointment, left the room suddenly without taking questions, and slammed the door. They waited. I never came back, but Ray took over and presented his alternative view. Ray told me later that Bill Lidicker turned to him and said, "You mean he's not coming back?" I wasn't. Fortunately, they took it well. They were and are a group of real gentlemen.

I mention these things to explain the tone of our pieces. We would not write them that way now, having been professors ourselves for some years. We never intended to publish them, having regarded the presentations as a one-time skit, but our notes were xeroxed and passed around, and eventually they spread around the United States. In the fall of 1986 I got a letter from Pete Morin at Rutgers suggesting that we publish the notes. Its survival for ten years in the graduate student grapevine convinced me that there might actually be a demand for them. I had lost my original, and Pete kindly sent me a copy, which turned to be an nth generation version with marginal notes by a number of different graduate students. On rereading it, I find that I agree with the basic message as much as ever, but that many of the details do not apply outside the context of large American universities.

Ten years later, I have one after-thought.

**Publish Regularly, but Not Too Much**

The pressure to publish has corroded the quality of journals and the quality of intellectual life. It is far better to have published a few papers of high quality that are widely read, then it is to have published a long string of minor articles that are quickly forgotten. You do have to be realistic. You will need publications to get a post-doc, and you will need more to get a faculty position and then tenure. However, to the extent that you can gather your work together in substantial packages of real quality, you will be doing both yourself and your field a favor.
Most people publish only a few papers that make any difference. Most papers are cited little or not at all. About 10% of the articles published receive 90% of the citations. A paper that is not cited is time and effort wasted. Go for quality, not for quantity. This will take courage and stubbornness, but you won't regret it. If you are publishing one or two carefully considered, substantial papers in good, refereed journals each year, you're doing very well - and you've taken enough time to do the job right.

Acknowledgments

Thanks to Frank Pitelka for providing an opportunity, to Ray Huey for being a co-conspirator and sounding board and for providing a number of the comments presented here, to the various unknown graduate students who kept these ideas in circulation during the last decade, and to Pete Morin for suggesting that we write them for publication.

Some Useful References


Stephen C. Stearns

Department of Ecology and Evolutionary Biology
Yale University
P.O. Box 208106
New Haven, CT 06520-8106 USA
When Steve showed me the preliminary outline for his talk, my first response was to say, "Steve, this is really cynical, even by your standards! You can't possibly present such a negative view of graduate education." My second response was to draft an alternative outline, which I intended as a direct challenge to Steve's, and which I presented after Steve so rashly stormed out of Ecolunch.

A decade has passed since we performed that amusing skit. In transcribing our old outlines into text, Steve and I have tried to preserve the intentionally argumentative, point-counterpoint format and flavor of our original presentations. We do so, not because we remain convinced that our old views are necessarily correct (I am pleased to note that Steve now recants his views, at least in part), but because we want to emphasize a diversity of views of how to be a graduate student.

Our main point is this: there is no one way to be a graduate student. Each of us is an individual - each of us has individual needs, goals, capacities, and experiences. Advice that is productive for one student may be disastrous for another. So think about these and other views, but don't accept them without question.

Initial Premise

Graduate school provides an opportunity for you to change from being someone who reads to someone who is read. That is a major metamorphosis, indeed. Not surprisingly, it presents challenges as well as opportunities.

Always Expect the Best

If you anticipate the worst, you are likely to experience it. Instead, develop a positive attitude, decide what you want (T.A. position, research funds, etc.), and then get it. Go outside your university whenever possible for advice and for funds. Don't merely rely on your major professor. In short, be active and independent, not passive and dependent.
Some People Do Care

People are more likely to care about you if you act like a professional (see below) and if you make yourself valuable. Obtain a skill (multivariate statistics, electrophoresis) that you can share (and of course yourself). Avoid being used, however.

Seek out and collaborate with fellow graduate students, especially ones who are doing interesting work and who are enjoying it. You are likely to learn far more from graduate students than from your advisor, if only because you have more in common and spend more time with them. In short, use these interactions as an opportunity to be introduced to different viewpoints and techniques and to become excited about your career.

Seek out emeritus or near-emeritus professors, at least ones who are still active. They have a wealth of knowledge and experience, and often have the time and interest to share it. Moreover, they can give you a personal appreciation for the history of your field. Science is an historical activity, and progress in science is often enhanced by an understanding of the past.

On "Exhaustive" Thinking

Thinking "widely and exhaustively" can be mentally exhausting if you aren't academically and emotionally prepared. You may instead make better use of your first year by making up deficiencies in your course background (do so as quickly as possible!). Moreover, some people simply need time before they are ready to think independently. That maturation process can sometimes be accelerated by starting your research with a problem that your advisor "hands you."

Ultimately, however, you must begin to think and do research independently, and you must understand why you are doing a particular project.

On Psychological Problems

Expect them. Everyone will go through periods of intellectual insecurity or stress, most likely in the first year or two. You can often minimize these problems with some simple tricks.

1. Get requirements out of the way as soon as possible. You will be surprised at how much your attitude toward graduate school and your research will improve once you pass all language requirements and qualifying exams. Keep in mind that faculty are inevitably impressed by students who aren't intimidated or slowed down by academic hurdles.

2. Some people simply need time to mature academically. So, fight directives and pressure to complete your Ph.D. in 4 years. You may need to take some extra time or even take a leave of absence. Changing schools or advisors sometimes helps, especially if you can first obtain a Master's degree.
Becoming a Professional

Think of yourself as a professional, someone who will be a biologist for the rest of your life. Start to accumulate a library and reprint collection, develop a computerized list of references and addresses, attend meetings, meet with visiting seminar speakers, correspond with people working on related problems, send out copies of your articles as they are published, etc.

Treat each project (even a literature review) as if it is potentially publishable.

Faculty are more likely to treat you as a professional if you act like one. They are a good source of suggestions in this regard. Ask their advice on efficient ways to organize your reprints and reference files, or ask them to recommend key papers (their own, or those of others) that influenced their thinking and careers. Read those papers, then go back and discuss them with the professor. (Note: Many graduate students have not read most of their advisor's papers, or those of other relevant faculty in their department.)

Despite your best efforts (and theirs), the faculty may have a difficult time treating you as a colleague rather than as a student. Therefore, develop contacts outside of the department and the university, thereby gaining a new perspective on biology and on your own work. Go on a tour of other universities, meet with faculty and students working in your area, volunteer (if appropriate) to give an informal seminar of your thesis work. If possible, spend a term and take courses at another university (or a field station), especially if a course is special and especially if you are spending your graduate career at one university. These outside contact not only broaden your perspectives but may also increase you chances for a collaborative research project, a postdoc, or even a job.

Join appropriate scientific societies, attend their yearly meetings, give papers or posters, get to know your future colleagues. Meetings can be exciting and a chance to find out what is new. Moreover, you get practice at speaking in front of a "foreign" (e.g., nonsympathetic audience).

On Courses

Never pass up a lecture course from a great professor, even if it is somewhat outside your main area. Seek courses that challenge you to think rather than to memorize. Auditing courses can often be an efficient way to get an overview of a field, at least if you are self-disciplined.

Take short courses that can save you time over the years. Many libraries give instruction on efficient literature searches (see also Smith's book, cited by Steve); and most universities offer introductions to computers, statistical packages, etc. If you don't know these critical skills already, immediately learn speed typing and word-processing.
On Proposals and Grants

Grant writing is a key skill. Ask professors for copies of their successful grant proposals (perhaps ask for unsuccessful ones as well). In other words, find out what makes a good proposal before you start writing; don't waste time "reinventing the wheel."

Be a scholar. Showing that you know and understand the literature makes a good impression, and it gives you an awareness of the key issues in your field.

Use the working proposal Steve describes as a basis for a real grand proposal. Many societies, government agencies (NSF), and organizations give grants to graduate students - ask your major professor and other graduate students for the names of such organizations. Prod your department or advisor to start a permanent file on such grants.

Getting your own grant has important benefits beyond simply funding your research. (1) It gives you something to add to your C.V. (2) It helps establish your independence from your advisor and your department. (3) It really impresses your advisor and your committee!

Interactions with Your Advisors

(Tangent. Even after a decade, I can still hear Steve pontificating the first sentence in this section. His expression, "a baroque excrescence," is my fondest auditory memory of Berkeley.)

Onward. A thesis shouldn't be a culmination of your research career, but its beginning. You probably never really had your creativity challenged as an undergraduate. Here is your opportunity. Push yourself - you'll respect yourself more than if you are too cautious and try a no-risk project.

Remember that your future research directions need not be constrained by the topic of your thesis. In fact, your thesis experiences may convince you that your interests and talents are elsewhere. Use a Master's-to-Ph.D. switch or a postdoc to change directions, if appropriate.

Publishing

Contrary to widespread opinion, writing and publishing can be fun. More important, the process of writing is a positive learning experience - my understanding of my own research is invariably enhanced while developing a paper or grant proposal.

Writing and publishing aren't always fun, of course, but you can minimize problems by being careful, by organizing your thoughts before you write, by taking pride in crafting sentences carefully, and by having people critically review your papers before you submit them for publication. This review process should be sequential: First, give it at an "Ecolunch." Second, write a draft and have your fellow graduate students and advisor review it critically. Third
(optional, but advised), send it to one or a few experts in the field. Fourth, submit the manuscript.

(Having now been an editor of several journals and books, I would add several caveats. Make certain you follow the "Instructions to Authors" for the journal: If you use the wrong format, the editor will suspect that (1) your paper was previously rejected by another journal, or that (2) your work style is casual and not necessarily to be trusted. Also, carefully check the citations in the text against the literature cited section. Check text, tables, and figures for accuracy and neatness. (A paper that is neat and well designed is easy to read.) If you are writing an invited chapter for a book, do your very best to meet all deadlines. Editors cherish contributors who actually meet deadlines and follow instructions.)

Publishing is an important responsibility - you share your insights with others. It is also essential. People occasionally get good jobs or a grant despite of a weak or nonexistent list of publications, but the odds of this happening are slim, indeed.

Although over-publishing is a mistake (as Steve notes) don't be embarrassed by writing one or a few minor papers - ample precedent exist. Moreover, we are often our own worst judge of what is truly significant (see Bartholomew 1982). (After gaining the benefits of the experience, you can eventually obscure any truly trivial publications by using the following widely used technique - simply change your official "List of Publications" to a "Selected List of Publications" or to a "List of Publications since 19xx"!)

**Miscellaneous**

Watch for and take advantage of opportunities. If someone is organizing a special field trip, ask if you can go along and help. If there is a job search in your department, look through the applications and learn first hand what makes a good C.V. and what makes a clear statement of research and teaching interests. (Note: Not all departments permit graduate students to read application files.) Find out your advisor's opinion of the candidates' job seminars. Thus when you start applying for jobs, you will have some idea of what works and what doesn't.

**Concluding Remarks**

Appearances to the contrary, graduate students need not be oppressed. You actually have as much freedom as you ever have (except perhaps as a postdoc or during a precious sabbatical). Be positive, not cynical.

**Postscript**

"Ten years later," I wish to emphasize one comment and then make one addition. First, do spend time around students and faculty who are doing significant research and who are
excited about their careers. In short, surround yourself with good people. Enthusiasm is contagious. Second, learn to respect and to practice the art of being organized. Thus, be efficient and don't waste time. This will almost certainly enhance your productivity and your enthusiasm for your career.

Acknowledgments

I am, of course, grateful to Steve Sterns, whose outrageous views prompted this reply. T. Garland, Jr. made useful comments on a draft.

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Raymond B. Huey

Department of Zoology Box 351800
University of Washington
Seattle, WA 98195 – 1800
Getting Along in the Lab

The first and most important situation in which you will present yourself is to the people in your own laboratory. Most of what you make of yourself in science has its basis in how your fellow researchers perceive you and your data, and it is well worth expending energy to deal with the other lab members.

Chapter 1 describes some of the usually unspoken rules to follow when you first start work in a new lab. But the nature of your communication with other lab members will evolve as weeks turn into months, and new issues will take on importance.

• Absentee P.I. People in labs complain that either the P.I. is oppressively present and wants to know every detail of what is going on, or is never around. If the P.I. of your lab isn’t around a lot, take it upon yourself to stay in touch. Leave a note about a good result, pop into her office for 5 minutes, try to have lunch together. It’s your career, and you are the one to be hurt if the P.I. can’t remember you when it is time to write a recommendation.

• Bay- and benchmates. These are your physically (and often, emotionally) closest colleagues in the laboratory. Your bench- and baymates will be the first to see great raw data, the first to know that the Big Experiment didn’t work; the first to hear your ruminations and give advice on your experiments. And you will offer the same services to your benchmates. Enjoy the scientific expertise and companionship so close at hand: But in this intimate situation, you must sometimes allow for privacy: There are times when you must just back off and leave your bay- or benchmate alone.

• Collaborations and credit. Although most collaborations are worked out before the experiments really begin, they can move in unplanned directions. The usual problem is that the importance of the individual experiments has changed, and the assumed first author will be relegated to another position on the credit list. Ask the P.I. to mediate all disputes.

• Confrontations. Most lab confrontations involve a lab member angry because another lab member broke a piece of equipment and didn’t deal with it, didn’t do the assigned lab job, used up a reagent without ordering more, or used a “private” reagent or equipment without permission. If you are the offended party, deal only with the immediate issue, and don’t make personal
remarks or ascribe an evil agenda to the perpetrator. If you are the guilty party, confess and deal with the problem as soon as possible, without excuses or resentment.

Another class of confrontation deals with intellectual (and emotional) property. Someone may be angry because she believes another lab member infringed on her project, or discussed sensitive data with an outside person. It is worth the two parties trying alone to fix this, but it is usually necessary to ask the P.I. to mediate. Don't bring personal disagreements to the P.I.

- Deadlines. Follow deadlines, your own and others, religiously. It keeps you organized, and it helps everyone to whom you have made a commitment. Try to set a deadline when someone asks you to do something (or when you ask someone for a favor): For example, if you ask someone to read a manuscript, you could say “Can you read this manuscript this week? If not, let me know and I'll ask someone else.”

- Difficult P.I.s. The P.I. has a lot of control over the path of a researcher's career, and there will always be some people who deal badly with this kind of power. Although you should have checked out the personal dynamics of the lab before joining (by asking others in the lab and department how well they enjoy working there), you may find yourself in a nasty situation. The difficulty can take many forms, and you must be able to sort out the trivial from the important. If you think there is a serious problem, document all complaints, include witnesses for confrontations, and seek collaboration of the problem from other lab members before deciding what to do.

- Favorites. In a lab, there always seems to be someone who has the P.I.'s attention and admiration. Look carefully. Is it deserved? Maybe you can learn something. And if it isn't deserved, mind your own business and learn to not let it bother you. It is only a problem if you feel it results in detrimental treatment to yourself.

  Concentrate on your experiments.

  The favorite could be you! If so, don't abuse the situation, and don't let it get to your head. You might be out of favor tomorrow.

- Gossip and bad-mouthing. It is true that the line between gossip and information isn't clear. People do talk about people. But be careful. You have to live with your labmates, so don't sabotage the relationships by passing on information that isn't anyone's business. The intimate atmosphere of the lab demands a high level of respect and consideration, even for people you may not like.

  Most large labs find a scapegoat, someone to blame for the missing gel combs, radioactive ice buckets, and dearth of good results. Don't jump on the bandwagon. The talk may be true, but it is also possible that a long-ago personal
problem with one person became unfairly expanded. Make your own unbiased judgments as time goes on.

It is also common for labs to dislike the work of certain other labs, usually competitors. Do not assume this idea is right, and continue to assess competitors' work honestly and fairly. Don't disparage other people's results without good cause. It is not true that making someone look bad makes you look good. Nothing is to be gained by bad-mouthing anyone.

- Harassment. The atmosphere can cause one to assume too much and get quite sloppy. Never be casual about racist or sexist remarks. If you feel you are the target of harassment, speak your mind firmly and in front of other lab members before you think about official action.

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For the nonnative English speaker

- Resist the urge to speak your native language in the lab, even if the majority of the lab members speak the same language. Speak only English at work.

- Keep your lab notebook in English.

- Take a speaking or writing class in English. Many universities have conversation groups, where you can practice English once a week with other nonnative English speakers. You could also start your own conversation group.

- Practice speaking with people who are willing to correct you. Let other lab members know that you want mistakes to be pointed out to you.

- Always ask a native English speaker to read through and correct everything you write.

- Ask lab members to clarify what you don't understand. For experimental protocols, this is particularly important. If a repeated explanation still isn't satisfactory, ask the person to write down what they are saying.

- Before any oral presentation—even for an informal lab seminar—go through your talk with a native English speaker. Incorporate that person's comments and practice the talk again in front of the same person.

- Ask a person who speaks your native language, but speaks and writes English well, to comment on your speech and on your written work. People speaking the same language tend to make many of the same mistakes, and this person can point out patterns of mistakes.

- For your first seminar, write out exactly what you are going to ask the other lab members to correct. If you feel you are not sure about grammar, a good way to test your lecture.

- Socialize with other lab members. Go to lunch or a happy hour in Chile, and try to join in the conversation. Don't forget to ask people to correct your
• In or out. Your data are good, the P.I. thinks you are good. The data are nonexistent, the P.I. thinks you are nothing. Have a thick skin, and don't rely on results as the sole basis for your feeling of self-worth.

• Language. If English is not your native language, it is imperative that you learn to speak and write English as well as you can. Most people in the lab will respect your scientific skills and admire you tremendously for assuming the task of doing science in another language. But some, in the lab and outside, might still avoid working with you if they can't understand you. Without good language skills, it will be difficult to advance in your job or obtain a new job that you are otherwise qualified for.

• Letters of recommendation. Letters of recommendation will be an issue for many years, because they are required for many grant and job applications, even at the full professor level. This is not to say that you should curry favor with people because of the letters you may need. But keep in mind that you should be enough a member of the scientific community that you could easily give several names of scientists who know you and know your work. If you can't think of three people from whom you could expect a good letter, you are probably not interacting enough with other scientists.

• Personal and political differences. Almost everything gets discussed in labs, sometimes quite heatedly. Try not to let disagreements get in the way of lab interactions.

• Socializing. Very important! This is especially important if you have children or commute, and don't get to hang out in the lab at night. Many collaborations are forged over lunch or a beer. Make it a point to join, at least occasionally, in lab parties or outings.

• Time. There is no unit of time smaller than half an hour in the lab. If you are arranging a time to get together with someone, always add 30 minutes to your most generous estimation of when you will be ready.

• Vacations. There is probably an unofficial vacation policy, as well as an official one. Find out what the lab policy is, and try to conform to it. If it is the custom to take no vacations (a strange and macho custom in some academic institutions), you should take one anyway, but be prepared to deal with sullen resentment and snide remarks.

Try not to arrange any vacation at a particularly bad time for the laboratory. Give the P.I. plenty of notice about the date and extent of your vacation! Tell her, in person. Then write down the dates of your departure and return, and give it to the secretary. It is also useful to post a notice on your desk or bench, so others in the lab know when to expect you back. Even if you decide to take just one day off, always let someone in the lab know.
On the very first day of Hans Weber’s first doctoral project, his adviser showed him to a freshly renovated room with a host of equipment for electrophysiology experiments that needed to be assembled and installed. “I had the manual in one hand and a screwdriver in the other,” Weber recalls.

Two months in and ready to start his first experiment at the research centre in central Germany, he needed to calibrate the amplifier that powered the experiments. It blew up on the first try. “I destroyed a €15,000 amplifier and I thought: ‘This should not be the way a PhD goes,’” he says.

It took a year for Weber to realize that a lack of supervision and a near-impossible project did not make him a bad or lazy scientist. But like many before him, he carefully weighed up whether he should persevere or move to another laboratory.

Deciding to move — whether because of an unhappy situation, a change in interests or a lab group relocating — almost certainly means some lost time and a transition to an unknown situation. But most lab-switchers say the benefits of changing groups usually outweigh any negatives.

Should you stay or should you go?
Weber admits that he had days of self-doubt and considered quitting science altogether — a not uncommon reaction to this kind of situation. But he realized when talking to family and friends that the neuroscience fanatic in him was going to prevail. And after two older scientists encouraged him to find another group, he began discreetly e-mailing, calling and eventually visiting other groups around Germany.

“I didn’t see any chance that things would change in that first lab,” he says. “I think when you doubt your PhD for longer than two or three months, you should just change.” Weber eventually joined a neurobiology group at a different university.

Although it seemed like a natural progression to him, Weber weighed the pros and cons of his situation, both in and out of the lab, and he spoke to people at the university and outside it. First, figure out if the problems you are facing come from your project, your lab, your university or your environment.

“If you are enjoying your work, your project, then don’t quit just because you don’t like your location,” advises Mhairi Dupré, a first-year doctoral student in evolutionary biology at the University of Oxford, UK. She left a PhD at a university in Montreal, Canada, and took some time away from science before re-enlisting at Oxford a year later. But, if you are dragging yourself into the lab with dread, says Dupré, “There’s no point going on with something you are not enjoying.”

Make the smallest move that will accomplish your goals: for example, switching projects in the same lab will be easier than switching labs at the same university, which, in turn, will be easier than changing universities.

Sudarshan Anand, a fourth-year student, decided to switch from a general molecular-biology graduate programme at a Maryland university to an immunology programme at the Mayo Clinic in Rochester, Minnesota. He moved again when his supervisor relocated the lab from Minnesota to Johns Hopkins University in Baltimore, Maryland. Moving between programmes, universities and states was a hassle, but proved worthwhile for his long-term plan of doing translational research.

Students and postdocs say that the biggest question you should ask yourself is what resources you need for your planned career path and which lab best fits that list. The second half of the decision-making process should probe external perspectives. When Carmen Drahl’s adviser moved to a new university, she drew on “contacts I did not even realize I had” to help her decide whether to move with her adviser, stay behind and be advised remotely, or switch labs altogether. She talked to her family, college professors, an industry researcher she met at a seminar, her group colleagues and the faculty members at her graduate department.

“Branch out and use your resources,” she says.
“There was not a unanimous position, but I went with my gut and the consensus that another lab might hold new opportunities for me.” If your adviser takes a new position, there are a few considerations to take into account before deciding whether to move with them. There are also things advisers can do to make that decision less painful (see "Trading places").

Staying behind and being advised from afar may seem attractive, but it means less face-to-face time and delays in trouble-shooting. The problems multiply if the supervisor moves into an administrative role or an industry job, where their former research is no longer their primary focus.

“There’s a reason why labs have principal investigators,” says Rob, a biochemist who moved his lab group across the United States to build a large research programme at another university.

Rob recalls that communication became difficult with lab members who stayed behind, and the project’s momentum flagged. It is best if those members move into new labs to get local support, he says. He also notes that moving can be more attractive if the lab head ensures that downtime for experimental work is minimized. “That there is going to be huge down-time is a fallacy,” says Rob; his lab members who moved were running experiments in about three weeks. “We waste a lot more time doing the wrong experiments than we did moving.”

Now what?
Once you decide to switch between laboratory groups, how do you ensure it’s not ‘out of the frying pan, into the fire’? When looking for a new lab home, you must put your best foot forward to impress that group. But you must also critically evaluate your potential new lab mates and adviser.

Do your homework on groups that interest you: find lab mates. And equip yourself with the story of your project’s history, assess their resources and equipment, and see how successful former lab members have been. Then begin conversations with those groups and determine how you might fit into their research (see Nature 422, 784–785; 2003).

During his visits, Weber says he asked himself a number of questions: “How is the team? How is communication? Do they help each other? Is the supervisor open-minded when you discuss the project you might do or are they strict about it?”

Samantha Zeitlin, a postdoc at the University of California, San Diego, says her priorities changed when she began looking for a new lab. Her former adviser was thinking of retiring and she needed a place to finish her project and publications. “I had to stay local,” she says. “I picked my new adviser because she was really open to my project. She also had money and space.”

Determined to finish her original project, Zeitlin made it her top priority to find a lab that would support that effort.

Drahil also had a slightly different set of criteria when choosing a graduate adviser the second time around. She looked for a lab with stable funding, successful graduates and teamwork. “The research was definitely a factor, but I was looking more at a cluster of practical needs.”

You also have to convince a new adviser to take you. Drahil made sure to point out her assets — a fellowship from the National Science Foundation that would cover some of her salary, and a deeper knowledge of biochemistry that would help in some of the lab’s collaborations. Zeitlin adds that you need to take yourself seriously, so that others will too. “Don’t wait until you have that look of desperation in your eyes,” she says.

If you decide to switch between fields or programmes, be prepared to play a bit of catch-up by reading and doing extra coursework. Drahl sat in on classes to absorb more organic chemistry and relied heavily on the technical guidance from her new senior lab mates.

Added bonuses
Although changing labs may seem like a setback in a young science career, many switchers say the relatively short time lost is usually worth the outcome. Anand, who not only switched graduate programmes, but also later moved with his new adviser to another university, says all the transitions have actually given him “the best of both worlds”. He says he has a much broader training in molecular biology, immunology and computational biology than he would have had otherwise.

Their transitions may have made for a rough couple of years, but Weber and Dupré both say that they would do it all over again because they now have exciting projects and a deep sense of ownership of their research. “Sitting at my microscope, I forget about everything else. I could talk about my project for hours,” says Weber.

Zeitlin has followed her chromosome-biology projects through many pitfalls during graduate school and two postdoctoral labs, but her enthusiasm for the science has kept her going: “You have to like what you are doing most of the time. If you are venting and whining every day, get out!”

Kendall Powell is a freelance science writer based in Broomfield, Colorado.

*Some names have been changed to protect privacy.
Gender and ethnicity in science
(Modified from handout by Susan Alberts)

I. Increase your awareness of hidden biases

A. Take an "Implicit Association Test"- https://implicit.harvard.edu/implicit/demo
   Take gender/career or gender/science tests. Look at other tests available.

B. Remember you are the object of biases (people will be biased towards you because of your gender or race) and a producer of biases (you will be biased towards others). Even if you are of an underrepresented group, you may still have biases, and you should be conscious of these in your teaching and mentoring.

II. Educate yourself about the effects of biases and discrimination on behavior

A. See the work of Claude Steele and Joshua Aronson (http://www-psych.standard.edu/~steele/). They have shown that biases can cause people to live up to (or down to) perceived expectations of them.

B. Listen carefully to students and colleagues. Don't dismiss their experience or engage in self-reassurance that you are not the problem.

C. People do misinterpret things that happen to them based on their experiences, including whether they have been affected by discrimination. Even when such misinterpretations happen, the problem is not necessarily just in that person's head, but may reflect a larger truth about the expectations that society has about that group.

III. Protect yourself from being a victim of discrimination

A. Stay informed about gender/ethnicity issues in your profession
   1. Be aware of statistics on women and minorities in science and the challenges they face, including salary issues, promotions, etc. Sources can include the NSF Scientific Resources Division, the AAUP, etc.
   2. Other societies (e.g., NAS, AAAS) also post regular reports.
   3. Be familiar with your university's policies and programs: sexual harassment, consensual relations, diversity programs, etc.

B. Consider the consequences of your actions/behavior/self-presentation. While you may want to make a point that dressing a certain way shouldn't affect your job interview, you may end up proving yourself wrong irrespective of whether you had the moral high-ground.

C. Assume the best. Try not to overly dwell on comments by others, and be true to yourself.

D. Focus on the science and be a good (but not self-sacrificial) citizen. This will make you the best colleague you can be.
PUBLISHING
Searching the literature

"Yahoo" and other search engines are NOT satisfactory in this regard!!!

Four main online resources for finding journal articles:

- PubMed
- Biological Abstracts
- Web of Science
- Google Scholar

**PubMed** is the most user-friendly and free to all but perhaps has the smallest number of papers outside of genetics, neurobiology, biochemistry, etc. For example, most ecology or behavior journals are not indexed. It can be accessed at:


Merely then enter the search criteria in the box at the top. You can use modifiers such as AND or OR with multiple terms, though make sure the modifiers are in all-caps. You can search for authors (e.g., "NOOR-MA AND COYNE-JA" yields two papers) or subjects (e.g., "courtship AND Drosophila" would yield >300 papers) or a combination. It searches the title, authors, and abstract all automatically. Look at the “Help” link for ways to search other things, like the author’s institution. The journals covered are often medical but also include those with a lot of biochemistry, genetics, neurobiology, development, etc. The very top journals (e.g., *Nature, Science, Proceedings of the National Academy of Sciences*) will all be listed, and recent years of nonmedical journals may be in there (e.g., *Evolution*).

**Biological Abstracts (WebSPIRS)** has many more journals that are ecologically or behaviorally oriented, which are largely missed by PubMed. This is not a free service, but Duke subscribes.

http://web5.silverplatter.com/webspirs/start.ws?customer=c9867&databases=(BXCD)

You specify if the search terms are in the "subject", "title", "author", or "anywhere" for Simple Searches, but I recommend clicking "Advanced" for more options. Again, you can do searches by author (e.g., "Noor-Mohamed-A-F" yields >45 records). However, it is dense: doing the same search as "Noor-Mohamed" yields none. The advanced search option does, however, allow you to combine search words easily. The advantage to BA over PubMed is that MANY biological journals are covered, not just medical ones. However, it’s not complete: the *Journal of Heredity*, for example, is not indexed there, but it is in PubMed.
Searching the Literature (continued)

**Web of Science** can be used like the ones above, but it has another feature that is far more powerful and unique to it. Again, this is not a free service, but Duke subscribes.

http://isi17.isiknowledge.com/portal.cgi/wos

Click on "Web of Science". The "General Search" option that then comes up is similar to BA above. I recommend WoS for the "Cited Ref Search" option though. This is a way of searching FORWARD in time rather than back. If you have found a significant study from 1975 and want to know if people followed-up on it, this is how you could do it. For example, you can enter "Noor MA" in Author and "Nature" in cited work, then click "LOOKUP". It then presents to you a study from 1995 which has been cited >100 times. Clicking in the checkbox beside it and then clicking "Search" will tell you what these studies are that have cited it. You can then go read those papers to see if people built upon that work (or disproved its conclusions!). This is an important thing to do if you are not familiar with an area- don't assume the first paper you find from 1990 is still true and accepted today!

**Google Scholar** is extremely powerful as well, and like Web of Science, it, too, can show you papers that cite a particular paper, allowing a FORWARD search. It's also extremely fast, but unlike WoS, it can be accessed from anywhere.

http://scholar.google.com

Duke subscribes to many other literature search engines: see

http://library.duke.edu/metasearch/db

to view the many options.

There are others also available that specialize in scientific information:

http://www.scirus.com/srsapp/

Last AND least are the standard web search engines. These will not yield the scientific literature as readily as what random bozos have posted on the web, which may or may not be true. I recommend using meta-engines rather than single ones. Hence, **Dogpile** or **Metacrawler** will yield for you a wider variety of sources than **Yahoo**.

http://www.dogpile.com/t/tools/custom

http://www.metacrawler.com/customize/

You **MAY NOT** cite webpages as sources, even if from very reliable organizations (e.g., the USDA).
Of all the decisions that a student makes during his or her graduate career, the selection of a dissertation project is perhaps the most important and most difficult. This decision can come early in their graduate school careers, often before students have developed an understanding of all of the factors to be considered. This problem is particularly acute for Ph.D. students who have not first obtained a master's degree and, therefore, have that much more to learn about conducting research. I have advised doctoral students in evolutionary biology over the past eight years and have served on seven search committees to fill tenure-track research positions in evolutionary biology. In this article, I articulate the many ramifications of selecting a dissertation topic and outline how students might go about making this decision wisely. I have intended this article for graduate students interested in pursuing a research career in biology, but my central theme is relevant to graduate students in any doctoral program.

Frequently, graduate students attempt to evaluate project ideas without having first determined criteria that would allow them to differentiate good ideas from bad. Criteria sometimes considered by students when evaluating potential projects include logistic feasibility, originality, and size—often simply whether a project seems large enough to earn a doctoral degree. These criteria are necessary but insufficient for a wise decision. For students who view the Ph.D. degree as a means of obtaining a preferred job, the single most important question to consider when evaluating potential dissertation projects should be: What is the likelihood that this research will generate sufficient interest to launch a successful career? Although other graduate advisors may not agree with the points I make, I hope the article encourages them to articulate more clearly the criteria they use to evaluate doctoral dissertations.

**What is the goal?**

A graduate student may make the mistake of seeing the doctoral degree as the goal. Obtaining a Ph.D. does represent a significant hurdle. However, it is unwise to focus primary attention on the degree while ignoring the far more difficult hurdle that follows quickly on its heels: the job market.

The degree guarantees nothing beyond the opportunity to apply for postdoctoral positions and jobs. The dissertation research and resultant publications are the primary factors that determine whether job interviews and offers are to be forthcoming—often even when research is not a primary responsibility in the desired position. Consequently, potential dissertation topics must be evaluated with respect to the jobs the student is interested in obtaining. The ideal dissertation project would be one that guarantees results and insights that are exciting to the search committees that eventually decide one's professional fate. Unfortunately, research is not an activity with guarantees.

The second most important question to consider when evaluating potential research projects, and one that all too often is ignored by students and advisors alike, is whether the project is of inherent interest to the student? It is essential that students be genuinely excited about the research projects they select. The successful completion of a doctoral program is difficult enough when students are enthusiastic about their research project. Selecting questions and organisms that students find only moderately interesting can convert a difficult task to an overwhelming one. Advisors and fellow graduate students can offer their opinions about the relative merits of various projects, but only the student who plans to conduct the work can decide whether a project is suitable for himself or herself.

The following suggestions are likely to improve the student's ability to design an optimal project. My general guidelines for dissertation research are presented in Figure 1. I elaborate on several key components below. I directly address the students, specifically those interested in pursuing academic research careers in biology.

**Concepts first**
When designing a dissertation project, it is critical that your starting point be broad issues. Few people are hired in biology because they work on a particular species or set of species and have insights about those organisms. Search committees select new colleagues on the basis of the concepts they are investigating and the exciting insights that result. Pick questions that are of broad interest and select study organisms that maximize the probability of finding far-reaching answers. In reality, most biologists select a broad taxonomic group on which to work (e.g., birds), then the questions and issues they wish to investigate. Finally, they choose the most appropriate species within their broad taxonomic group.

By stressing the conceptual foundation of dissertation projects, I do not mean to imply that all dissertations themselves must be broad. Many excellent dissertation projects are narrowly focused (e.g., a single question investigated with a single species). However, the question selected must be of interest to a broad audience and the broader implications of the narrowly focused study must be explored and communicated.

**Improve the odds**

Science is exploration. Every scientific study has many possible outcomes. To evaluate a project properly as a potential dissertation, you must articulate, as fully as possible, the spectrum of possible outcomes.

When students first consider a project, they have a strong tendency to think of it as a linear series of events, often with a predetermined outcome. They imagine they are to conduct experiments, collect data, employ their various analyses, and then announce to the world new insights on a burning question.

However, science does not work that way. Each step of a study has an element of uncertainty associated with it. Data collection might not go as planned, and some variables may have to be dropped, requiring modification of subsequent steps of the study. Experiments may be inconclusive, requiring additional alterations to the research program. Every component of a scientific study has multiple outcomes. The number of potential outcomes of an entire dissertation-scale scientific study is enormous.

A complex flowchart is a better representation of science than is a simple linear sequence of events. By designing a flowchart for projects you consider seriously, you can identify a reasonable subset of the possible outcomes of the project. You cannot hope to anticipate the entire universe of possibilities, but the subset you do identify is likely to be representative. The critical question you must then ask is: Just how interesting are each of these potential outcomes? In other words, if your study terminates with outcome #1, #2, or #3, how competitive are you likely to be in the job market?

How does this exercise enable you to select a dissertation project? If you anticipate 20 alternative outcomes of a project, only one of which is likely to make you competitive for jobs, then you have not, in my opinion, identified a good dissertation project. It does not matter how exciting and revolutionary that one outcome might be. Do you really want to gamble your chance at a career on the possibility that your research will proceed along a single path?

**Be attentive and flexible**

The unpredictable nature of biological research leads to two inseparable characteristics of an excellent dissertation program: attentiveness and flexibility. Do not treat your research as you would a computer program that you can write, initiate, and walk away from until the program run is complete. Once you begin collecting data, you should continuously evaluate your research progress so that you can modify your program in the early phases of the study, when it is most beneficial.

Two factors may lead you to adjust the design of your study: First, problems encountered in conducting your research may make an experiment or even a whole study impossible. Second, you may need to modify your study in response to an unexpected discovery with profound implications. You should constantly evaluate your progress not only to detect problems but also to identify tangential lines of inquiry that may be more fruitful than the one you originally selected. Recognize golden opportunities and be flexible enough to pursue them.

**Experience**
Although search committees look primarily at a candidate's dissertation research and resultant publications, there are two additional considerations: the ability of the candidate to be successful in the nonresearch component of the job and the range of expertise the candidate is likely to bring to the staff. You should view your dissertation as an opportunity to acquire a wide range of expertise. Depending on the type of job you seek, good skills to develop include teaching, grant writing, scientific writing, popular writing, presenting papers at meetings, supervising personnel, fund raising, and public speaking. In addition, maximize the range of techniques, organisms, habitats, and geographic areas with which you have experience. The emphasis you place on each of these items should depend on the kind of jobs that interest you.

**Conclusions**

If you select a dissertation focused on broad issues, it is likely that your work will appeal to an audience beyond those scientists interested in your study organisms. By selecting a broad conceptually based dissertation that has many interesting possible outcomes, you increase your chance of success in the job market. If you constantly reevaluate your progress while conducting your research, you should be able to identify and correct problems as they develop. By constantly reevaluating your progress you maximize the probability of recognizing and pursuing significant discoveries. As you strive to acquire a broad array of expertise, you become more likely to fit both the stated and unstated objectives of search committees. Finally, by selecting concepts, organisms, and techniques that are of inherent interest to you, you make it easier to commit the time, energy, and intellect required to produce an excellent dissertation.

Do not squander your opportunity to prepare to enter the job market. You should determine the kind of jobs you want to pursue when you graduate, identify the characteristics needed to compete successfully for those jobs, and design your dissertation and graduate career to guarantee that you develop those characteristics.

by Scott M. Lanyon

Scott M. Lanyon is Pritzker Curator of Systematic Biology at the Field Museum of Natural History, Chicago, IL 60605, and co-chair of the Committee on Evolutionary Biology at the University of Chicago, Chicago, IL 60637. He, and the students he advises, use molecular data to derive hypotheses of phylogenetic relationships of birds, which are then used as the foundation for investigations of behavioral and morphological evolution.
An Algorithm for Discovery - David Paydarfar and William J. Schwartz

As academic physicians, we are experiencing the rush to restructure medical services and have participated in the development of algorithms for the evaluation and treatment of patients. It has been argued that such algorithms are a critical tool for evidence-based medicine, for improving patient management, and for raising the community standard of clinical care.

One day, during a particularly lengthy commute in our carpool, we began to wonder whether the process of creating new knowledge--asking the right question, pursuing the unknown, making discoveries--might also benefit from such an algorithmic approach. Surely a formula for boosting the rate and magnitude of discoveries would be most welcome. Of course, there are many great treatises on discovery in science, but we were thinking of something more compact for everyday use, a kind of flow chart that could be carried on a laminated card. Many carpools later, we came up with the solution shown on the right.

After rigorous computer simulations of this algorithm's performance over a broad range of parameters, we unexpectedly discovered that its properties could be reduced to five simple principles.

1. **Slow down to explore.** Discovery is facilitated by an unhurried attitude. We favor a relaxed yet attentive and prepared state of mind that is free of the checklists, deadlines, and other exigencies of the workday schedule. Resist the temptation to settle for quick closure and instead actively search for deviations, inconsistencies, and peculiarities that don't quite fit. Often hidden among these anomalies are the clues that might challenge prevailing thinking and conventional explanations.

2. **Read, but not too much.** It is important to master what others have already written. Published works are the forum for scientific discourse and embody the accumulated experience of the research community. But the influence of experts can be powerful and might quash a nascent idea before it can take root. Fledgling ideas need nurturing until their viability can be tested without bias. So think again before abandoning an investigation merely because someone else says it can't be done or is unimportant.

3. **Pursue quality for its own sake.** Time spent refining methods and design is almost always rewarded. Rigorous attention to such details helps to avert the premature rejection or acceptance of hypotheses. Sometimes, in the process of perfecting one's approach, unexpected discoveries can be made. An example of this is the background radiation attributed to the Big Bang, which was identified by Penzias and Wilson while they were pursuing the source of a noisy signal from a radio telescope. Meticulous testing is a key to generating the kind of reliable information that can lead to new breakthroughs.

4. **Look at the raw data.** There is no substitute for viewing the data at first hand. Take a seat at the bedside and interview the patient yourself; watch the oscilloscope trace; inspect the gel while still wet. Of course, there is no question that further processing of data is essential for their management, analysis, and presentation. The problem is that most of us don't really understand how automated packaging tools work. Looking at the raw data provides a check against the automated averaging of unusual, subtle, or contradictory phenomena.

5. **Cultivate smart friends.** Sharing with a buddy can sharpen critical thinking and spark new insights. Finding the right colleague is in itself a process of discovery and requires some luck. Sheer intelligence is not enough; seek a pal whose attributes are also complementary to your own, and you may be rewarded with a new perspective on your work. Being this kind of friend to another is the secret to winning this kind of friendship in return.

Although most of us already know these five precepts in one form or another, we have noticed some difficulty in putting them into practice. Many obligations appear to erode time for discovery. We hope that this essay can serve as an inspiration for reclaiming the process of discovery and making it a part of the daily routine.
Choosing a Research Project

This is one of the hardest parts about graduate school for many people, yet your research project is the most important tangible thing you will accomplish through your time.

1) Will my advisor hand me a project, or do I have to come up with one? This is one of the big questions, and you'll find the full spectrum amongst advisors. Some literally hand their students a project, methods and details included, and tell them to get started. Others will do nothing more than act as a sounding board while you bounce ideas off them until you hit a "good one." These are the two extremes, of course, and you should make sure to communicate regularly with your advisor on exactly his/ her expectations and perceived role in this regard. Make sure the two of you are in a good match: a very independent graduate student can't work well with a micromanager, and a grad student who needs a lot of hand-holding can't work well with someone who expects them to completely come up with their own project.

2) What is a "good project"? Again, no good answer. A novel approach to a long-standing problem is always good for publication, but the problem with novel approaches is that they often don't work. Hence, grant agencies, and sometimes advisors, are down on completely novel approaches, even if the potential yield is high. Discuss this with your advisor, and be sure to balance "safety" (the probability that, no matter what the outcome, you'll have a publishable product) with "novelty" (high-risk projects that may come up with something really exciting).

My advice to my graduate students is 2/3 safety, 1/3 high-risk-high-reward. I personally would like my students to have dissertations with about three significant components, and they are welcome to try a high-risk part for ONE of those three only. This ensures that, even if that part totally fails, they'll still have two significant products when they finish. This is, however, only one person's opinion.
Publications While in Graduate School

Advantages to publishing while still in graduate school over waiting until after defense:
1) Gets your name out.
2) Have work to cite that relates to your later work, so less "justification" necessary.
3) Makes writing thesis/ dissertation easier- can often xerox or cut/ paste.
4) Increases odds of obtaining funding and postgraduate opportunities.
5) Increases odds of merit-based awards and supplements within department.

Disadvantages to publishing while still in graduate school over waiting until after defense:
NONE. It's virtually never worth waiting. Hurrying up to "defend" is not generally a good option, as you end your salary while giving yourself poorer odds at postgraduate opportunities.

Keys to publishing a scientific paper:

1) **Having something novel to say.** Doing the same thing others have done in a different taxonomic group is not the way to publish in a major journal. You should, if possible, be addressing **fundamental** scientific issues that are not specific to your system-of-interest or that address something about its uniqueness. The work should incorporate novel experiments and/ or novel ideas, preferably heavy on both.

2) **Conclusions must follow from the results presented.** It's not enough to just be attempting to tackle a big question, but you must be able to conclude something on the basis of your study. Negative conclusions are often not as publishable as positive conclusions (e.g., "therefore, X is not a factor influencing Y"), so it's good to have multiple, alternative tests.

3) **Clarity.** A paper that nonexperts cannot follow is not publishable in a major journal. Clarity is not limited to writing clearly, but to making your points come across, particularly the broad significance of the study you performed. Distinguish fact from hypothesis from speculation, and limit the last to very little. Minimize jargon.

**GO FOR THE MAJOR, TOP-TIER JOURNALS over taxon, ecosystem, or subdiscipline-specific ones!!!** This will substantially increase your marketability. For example, publish in *Evolution* over *Condor*, *Development* over *Invertebrate Reproduction and Development*, etc.
## SAMPLE 2005 IMPACT FACTORS

The impact factor is calculated by dividing the number of current citations to articles published in the two previous years by the total number of articles published in the two previous years.

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Reviewing a Scientific Paper

This is one of the most fundamental parts of science—peer review of work to evaluate significance and quality. Unfortunately, it also is often deeply flawed. As we’re all human, we tend to be biased by 1) what interests us, 2) our perceptions of the authors, 3) our own experiences with the particular journal, etc.

Unfortunately, we need anonymous peer review. All science is not created equal, and even though the system is flawed by having humans involved (though some are only questionably human), an attempt must be made to filter out both work that is not significant and low-quality work. The former can be corrected through the use of specialty journals—work not published in top-tier journals can be resubmitted to more appropriate outlets. Reviewers should keep the audience of their journal in mind when evaluating papers.

Format

A typical review starts with a short (2-sentence up to 1 paragraph) summary of the main findings of the paper. A good review does not merely restate the abstract but has elements from the body to make it clear the reviewer has actually read the paper.

Following this first section, the reviewer makes an overall comment on the significance of the work in the context of the literature. Does this substantially advance a general question in this area? Will most of the readership of this journal find this result interesting? After a quick comment, more detail is given. Are there other papers that either have shown this previously or that have obtained data that contradicts this? If so, are these appropriately mentioned, cited, and commented upon in the current manuscript? It is important to check that the work remains focused on big questions and doesn’t get overly focused on minutia of the genes/species/whatever being studied. Jargon should be minimized as well: the author must remember the readers don’t necessarily work on the same genes/species/whatever.

Next, the reviewer covers the technical aspects of the work presented. Were the methods appropriate? Were there better methods that should have been employed? Do the results substantiate the conclusions? Are there alternate interpretations of the data analysis that are not presented? Are there alternative hypotheses (feasible ones) that were not tested? Are the statistics employed appropriate?

Finally, the reviewer will comment on trivial details. Point out typographical errors, unclear or excessive verbiage in sections, whether some tables/figures could be cut or should be added.

It is typical to include a cover letter for the editors that synthesizes your comments briefly and indicates whether you feel the paper should be accepted, accepted pending revisions, needs a major overhaul and re-review, or should be completely declined.

Keep in mind when writing the review that the authors are human. Avoid nastiness. Be as cool and objective as you can, merely stating the strengths and weaknesses of the study. Try to be objective, too, even if the paper is by someone you deeply respect or disrespect. Finally, try not to be overly biased by your own interests and experiences.
This study investigates a very interesting question: the relative contribution of selection vs. other forces in driving the evolution of traits associated with reproductive isolation, and therefore perhaps ultimately speciation. Much of the evidence thus far supports the role of strong directional natural selection in driving the evolution of genes associated with hybrid sterility and inviability (- as well as genes associated with assortative fertilization in marine invertebrates -). The authors investigate quantitative genetic patterns of variation in hybrid sterility among families & populations of Lemur catta (examined as testes follicle length) at various known distances from a hybrid zone. They observe variation within purportedly "pure" populations of these species, and infer that this variation would not have persisted within the populations had an allele been favored by selection. They also failed to observe a population effect, and interpret this as evidence this variation is not a result of introgression from the hybrid zone itself. They also find asymmetry across the cline, which also fits a neutral prediction.

Alas, I did not find myself convinced by the evidence presented, and there are many errors besides in the manuscript itself. First, is variation within a population really evidence that selection does not affect these alleles, and instead that they are evolving neutrally via genetic drift? Most certainly not. Indeed, the authors themselves present one alternative on page 10: balancing selection. Temporal or spatial heterogeneity in selection pressures, or frequency dependent selection, may also affect these alleles. Indeed, all the authors may have evidence against is strong directional natural selection.

Even this last possibility I find rather unconvincing, as I do not think the lack of a population effect necessarily suggests that the genetic variation is not due to introgression of alleles from the hybrid zone. Are these populations really fully isolated from intraspecific gene flow? I suspect not, and no evidence suggesting they are completely isolated is provided. Further, if one of these "pure populations" is slightly more isolated than another, this may explain the difference in the traits observed.

The asymmetry of the clines can also have multiple possible causes besides neutral evolution-this claim was wholly unconvincing as diagnostic evidence for the role of natural selection vs. genetic drift. Some traits may easily introgress more readily than others. Absence of evidence for selection is not evidence for absence of selection.

Finally, even if all the claims herein were true, they do not support the claim that "selection is not a prerequisite for speciation to occur". First, the taxa studied are not classified as "species", so this has not occurred. Second, given that hybrids in the hybrid zone are purportedly fertile, this is obviously not an effective barrier to gene flow between these races, yet they persist nonetheless, suggesting sterility is not the only, or even the relevant, barrier to gene flow between these taxa.

I have several lesser yet still very relevant comments about this manuscript:
1) page 4- the steady increase in reproductive isolation between allopatric populations with time does NOT necessarily implicate drift over selection. This represents a pervasive conflation in the field of speciation about effects vs. numbers of substitutions.

2) The statement "as reference males are mated to females from increasingly distant populations, so the testes dysfunction of the male offspring increases" (page 6) seems to directly contradict one of the main observations of the study.

3) This study was extraordinarily cryptic about the actual results: there is variation in mean follicle length, but how much variation? All that is presented is an ANOVA table. There are "a few individuals having apparently normal testes with sperm production": how rare were these individuals?

4) Contrary to the statements on page 14, there are actually multiple studies that have identified variation for hybrid dysfunction traits within species. The authors are urged to read pages 270-271 of reference 2 for a partial list. Even the statement that "no comparable study has considered variation within populations influencing sterility" is incorrect: see for example Reed & Markow (2004) "Early events in speciation: polymorphism for hybrid male sterility in Drosophila" Proc. Natl. Acad. Sci. USA.
Reviewing Peer Review

PEER REVIEW, IN WHICH EXPERTS IN THE FIELD SCRUTINIZE AND CRITIQUE scientific results prior to publication, is fundamental to scientific progress, and the achievements of science in the last century are an endorsement of its value. Peer review influences more than just science. The Intergovernmental Panel on Climate Change and other similar advisory groups base their judgments on peer-reviewed literature, and this is part of their success. Many legal decisions and regulations also depend on peer-reviewed science. Thus, thorough, expert review of research results—without compensation—is an obligation that scientists shoulder for both science and the general public.

Despite its successes, peer review attracts its share of criticism. Reviewers can exhibit bias or only support expected, pedestrian results. They can be overtaxed, uninformed, or ask for unnecessary experiments (see Letter by Raff et al., p. 36). Recent studies have explored the value of open review, double-blind review, or whether reviews are useful at all. At Science, we read thousands of reviews and author responses each year. From this vantage point, the system does not appear to be irretrievably broken and continues to serve science well. Reviews improve most papers, some dramatically so. Our authors sometimes thank reviewers for catching an embarrassing conclusion or for revealing a new one. We’ve seen peer review expose fraud (alas, not always), clarify results, and spur new insights.

But peer review is under increasing stress, in ways that are perhaps not fully appreciated. The growth of scientific publishing is placing a burden on the entire scientific enterprise. Papers today are more interdisciplinary, use more techniques, and have more authors. Many have large volumes of data and supplementary material. To compound the problem, papers are often being reviewed multiple times. Most of those rejected by Science go on to be considered at other journals, where the rejection rates have also increased. Before finding a proper venue, a paper may have received four, six, or even eight reviews. So even if the journal that finally publishes the article responds rapidly, the process is often painful and prolonged.

The responsibility for addressing this growing inefficiency is shared. Scientists can help by selecting the appropriate journal for their work, and seeking critical input from colleagues and all coauthors, before submitting an article for publication. Senior scientists should also mentor their students and postdoctoral fellows in good reviewing practices, enlarging the pool of qualified referees.* The possibility of repurposing reviews among journals, already practiced by some groups of journals with a single publisher, should be considered seriously. We note a recent experiment in which some independent neuroscience journals have agreed to share reviews.

The way scientists and research institutions are evaluated also needs revision. An inappropriately high value is placed on publication in certain journals. Increased competition for the limited slots in these preferred journals exacerbates the natural aggravations of peer review experienced by authors. Efforts like the Faculty of 1000, where experts scan a large set of biology journals and select the best contributions wherever published, can be very helpful. Such efforts can reduce the pressures that many group leaders feel from young scientists, who often place undue emphasis on publishing in a few high-profile journals—where the criteria used for evaluation may not match their research, no matter how valuable the contribution.

Finally, and perhaps most important, authors, reviewers, and journal editors should keep in mind the ultimate goal of scholarly scientific publishing to advance our understanding of the natural world. Competition among labs and personal striving for excellence are forces that can be harnessed to accelerate our progress. But in excess these factors can be impediments. The scientific community must collectively ensure that the peer review process continues to serve the loftier goals of our enterprise, which ultimately benefits us all.

– Bruce Alberts, Brooks Hanson, Katrina L. Kelner

*Science’s guidelines and additional resources are available at www.sciencemag.org/about/authors/review.dtl.

Published by AAAS
Coping with peer rejection

Accounts of rejected Nobel-winning discoveries highlight the conservatism in science. Despite their historical misjudgements, journal editors can help, but above all, visionaries will need sheer persistence.

Not many people spend tens of thousands of dollars to tell the world that they were robbed. But that is what Raymond Damadian and his company did last week when he discovered that he hadn’t won the Nobel Prize in Physiology or Medicine, and complained in full-page advertisements in The New York Times and other prominent newspapers (see page 648). He claims in his advertisement that he should have shared the prize won by Paul Lauterbur and Peter Mansfield for their work on magnetic resonance imaging.

Whatever the merits of Damadian’s case, the episode highlights the difficulties in assessing ground-breaking work. If it is controversial 30 years after the event, one can imagine the divergences of opinion that arise over truly innovative research before history has had a chance to consider its verdict — when papers are submitted to journals and applications sent to grant funding panels. In the latter case, researchers can keep their ambitions masked, stating goals that are predictable extensions of previous work, thereby — as cynics would have it — maximizing the chance of funding. But in the case of journals, they have no choice but to stake their genuine claim.

Some funding agencies, to their credit, are setting out to encourage riskier, visionary applications. The US National Institutes of Health has a new roadmap that includes a Director’s Challenge with precisely that aim. The European Commission is also setting up a fund for visionary research, the New and Emerging Science and Technology programme, which will shortly issue a call for proposals (see www.cordis.lu/nest/home.html).

Reasons to publish

A straw poll of Nature journals’ editors confirms that risk-taking and hopefully enlightened acceptance by editors persists — although whether at the Nobel level it is too early to say. Confidentiality prevents us from being specific, but papers in (for example) stem-cell development, cell signalling networks, genetic linkage to disease, telomerase dysfunction and extrasolar planets were accepted for publication in recent years despite significant scepticism, and were subsequently well cited.

Other examples, for instance in mammalian evolution and muscle crossbridge dynamics, were published with editors and referees suspecting that their conclusions were probably wrong but giving the papers the benefit of the doubt because there were no insurmountable technical objections and they seemed important. Such cases have proved stimulating for their fields, even though (in at least one case) the conclusions, as techniques have improved, have indeed required revision.

What are the moral of these tales? Certainly we need a diversity of good journals. The laureates’ rejected papers ended up being published somewhere respectable. And in particular there is perhaps some continuing virtue, along with the pitfalls, in the old elitist model of learned-society journals. The Proceedings of the National Academy of Sciences, for example, has published innovative papers that had failed to be appreciated by editors elsewhere, because the authors were academy members and so were able to publish by right.

This is strikingly reminiscent of perhaps the most celebrated editorial judgements of all, in Annalen der Physik in 1905. That was the year in which Einstein published five extraordinary papers in that journal, including special relativity and the photoelectric effect. The journal had a great editor in Max Planck. He recognized the virtue of publishing such outlandish ideas, but there was also a policy that allowed authors much latitude after their first publication. Indeed, in journals in those days, the burden of proof was generally on the opponents rather than the proponents of new ideas. One might also remember just how exceptional Nobel-winning discoveries tend to be. By and large, peer-filtering has strong virtues.

Nevertheless — a final moral — rejected authors who are convinced of the ground-breaking value of their controversial conclusions should persist. A final rejection on the grounds of questionable significance may mean that one journal has closed its door on you, but that is no reason to be cowed into silence. Remember, as you seek a different home for your work, that you are in wonderful company.
FUNDING IN

GRAD SCHOOL
Graduate Student Funding Possibilities

Department of Defense Science and Engineering Graduate Fellowship- 1/7/2008
Environmental Protection Agency STAR fellowships (stipend + supplies)- 10/23/2007
National Geographic Society ($15,000-20,000)
National Science Foundation dissertation improvement grants ($15,000)- 11/21/2008
National Science Foundation graduate fellowships ($30K stipend)- 11/7/2008
Sigma Xi, the Scientific Research Society (usually ~$1000)- 10/15 and 3/15

Women
AAUW Dissertation Fellowships for women nearing final grad school year (11/15/2008)
Association for Women in Science- many (http://www.awis.org/careers/awards.html)
Sigma Delta Epsilon Graduate Women in Science Fellowships ($4000)- 1/15/2008

Travel
Duke Graduate School Conference Travel ($500, post-prelim)
Fulbright scholarships (http://www.iie.org/fulbright/)

Specialty
American Museum of Natural History grants (http://research.amnh.org/grants/grantsprog.html)
  Lerner-Gray Fund (marine zoology)
  Frank Chapman Memorial grant (ornithology)
Animal Behavior Society
Center for Field Research- send along volunteers
Garden Club of America
Organization for Tropical Studies
SICB grant-in-aid of research (October 1, 2007)
Smithsonian Institution (and STRI) Fellowships
Society of Systematic Biologists (3/31 deadline)- $1200-2000
Torrey Botanical Society
Wilson Society (ornithology) Louis Agassiz Fuertes award

Web help
Duke Biology Grad Student Wiki
  http://www.biology.duke.edu/graduate/wiki/doku.php
**Duke Graduate School awards**
  http://www.gradschool.duke.edu/financial_support/graduate_school_awards.html
Duke ORS Funding Research Tools
  http://www.ors.duke.edu/find/tools/index.html
Career Resources for Scientists/ NextWave
  http://nextwave.sciencemag.org/
FY2004 Funding Levels of Major Fellowship and Traineeship Graduate Education and Postdoctoral Programs in the Federal Government

National Institutes of Health (NIH)
- Ruth L. Kirschstein National Service Awards $749 million
- Individual Predoctoral Awards $112 million
- Individual Postdoctoral Awards $637 million

National Science Foundation (NSF)
- Graduate Research Fellowship Program (GRF) $92 million
- Graduate Teaching Fellows in K-12 Education (GK12) $42 million
- Integrative Graduate Education and Research Training Program (IGERT) $67 million
- Vertical Integration of Research and Education in Mathematical Sciences (VIGRE) $26 million

United States Department of Education (ED)
- Foreign Language and Area Studies Fellowship (FLAS) $29 million
- Fulbright-Hays Doctoral Dissertation Research Abroad $5 million
- Graduate Assistance in Areas of National Need (GAANN) $31 million
- Jacob K. Javits Fellowship $10 million

United States Department of Defense (DOD)
- National Defense Science and Engineering Graduate Fellowship Program $27 million
- National Security Education Program $8 million

Environmental Protection Agency (EPA)
- Science to Achieve Results (STAR) Program $10 million

National Aeronautics and Space Administration (NASA)
- Earth System Science Fellowship Program $3 million
- Graduate Student Research Program (GRSP) $7 million

United States Department of Agriculture (USDA)
- National Needs Graduate Fellowships $3 million

United States Department of Energy (DOE)
- Computational Science Graduate Fellowships $6 million

United States Department of State (STATE)
- Fulbright Grants for Graduate Study and Research Abroad (includes U.S. and foreign students) $65 million
RUTH L. KIRSCHSTEIN NATIONAL RESEARCH SERVICE AWARDS (NRSA) - INDIVIDUAL PREDOCTORAL & POSTDOCTORAL FELLOWSHIPS
NATIONAL INSTITUTES OF HEALTH (NIH)

PREDOCTORAL - This program is designed to ensure that highly trained scientists will be available in adequate numbers and in appropriate research areas to carry out the nation’s biomedical and behavioral research agenda. This is the only federal program that provides support for students who are pursuing joint MD/Ph.D. degrees. There are very few other federal funds available to these students.

POSTDOCTORAL - This is one of the few programs in the federal government that supports postdoctoral students directly. The award offers health scientists the opportunity to work and receive full-time research training in areas of national need in biomedical, behavioral and clinical research, without being tied to specific researchers or large projects. Individuals are required to pursue their research training on a full-time basis of at least 40 hours per week.

NUMBER OF YEARS OF SUPPORT: Predoctoral: up to 5 years
Postdoctoral: up to 3 years

2004 FUNDING: $112 million
2005 FUNDING REQUEST: $113 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: Predoctoral: $20,772

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Competing and non-competing awards issued on or after October 1, 2003, which used the FY2003 stipend schedule, will be revised by the NIH awarding component to reflect the new stipend levels. The new stipend levels are to be used in the preparation of future competing and non-competing NRSA institutional training grant and individual fellowship applications. They will be administratively applied to all applications now in the review process.

TUITION: NIH will offset the combined cost of tuition, fees, and health insurance (either self-only or family as appropriate) at the following rate: 100 percent of all costs up to $3,000 and 60 percent of costs above $3,000. Costs associated with tuition, fees, and health insurance are allowable only if they are required for all individuals in a similar research training status at the institution regardless of the source of support.

TRAINING RELATED EXPENSES: Predoctoral: $1,650
Postdoctoral: $4,400
Expenses may be used to defray costs of research supplies, equipment, and travel.

TOTAL # OF GRADUATE STUDENTS: 2,779 in FY2004 (2,785 estimated for FY2005)

CONTACT: Walter Goldschmidts
301 451-4225
http://grants.nih.gov/training/extramural.htm

February, 2004
INSTITUTIONAL RESEARCH TRAINING GRANTS
NATIONAL INSTITUTES OF HEALTH (NIH)

National Research Service Award (NRSA) Institutional Training Grants (T32) are awarded to eligible institutions to develop or enhance research training opportunities for individuals, selected by the institution, who are training for careers in specified areas of biomedical, behavioral, and clinical research. The goal of the program is to help ensure that a diverse and highly trained workforce is available to assume leadership in biomedical and behavioral research. All NIH institutes offer grants to eligible institutions to develop or enhance research training opportunities.

NUMBER OF YEARS OF SUPPORT: up to 5 years

2004 FUNDING: $637 million

2005 FUNDING REQUEST: $651 million

STIPEND FOR 2004-2005 ACADEMIC YEAR:

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TUITION: NIH will offset the combined cost of tuition, fees, and health insurance (either self-only or family as appropriate) at the following rate: 100 percent of all costs up to $3,000 and 60 percent of costs above $3,000. Costs associated with tuition, fees, and health insurance are allowable only if they are required for all individuals in a similar research training status at the institution regardless of the source of support.

INSTITUTIONAL ALLOWANCE: Predoctoral: $2,200

Postdoctoral: $3,850

May be used to defray costs of staff salaries, consultant costs, equipment, research supplies, and staff travel.

TOTAL # OF GRADUATE STUDENTS: 14,787 for FY2004 (15,006 estimated for FY2005)

CONTACT: Walter Goldschmidts
301 451-4225
http://grants.nih.gov/training/extramural.htm
GRADUATE RESEARCH FELLOWSHIPS (GRF)
NATIONAL SCIENCE FOUNDATION (NSF)

The GRF program provides support for students in the early stages of their graduate or doctoral studies in science, mathematics, or engineering, as well as additional support for women in engineering, computer, and information science disciplines. The program is part of the NSF mission to develop a technologically literate population of fully trained scientists and engineers.

NUMBER OF YEARS OF SUPPORT: 3 years of support that may be used over 5 years
2004 FUNDING: $92 million
2005 FUNDING REQUEST: $103 million
STIPEND FOR 2004-2005 ACADEMIC YEAR: $30,000
COST OF EDUCATION ALLOWANCE: $10,500 (NSF will provide the institution an allowance on behalf of the fellow, since the fellows are exempt from paying tuition and fees during tenure.)
INTERNATIONAL ALLOWANCE: $1,000 (A one-time allowance is available to students who have arranged full-time research study at an international site for at least three months.)
TOTAL # OF GRADUATE STUDENTS: 2,455 (1,000 new awards will be made in FY2005)
CONTACT: Eugene Brown
703-292-5302
http://www.ehr.nsf.gov/dge/programs/grf/

GRADUATE TEACHING FELLOWS IN K-12 EDUCATION (GK-12)
NATIONAL SCIENCE FOUNDATION (NSF)

The GK-12 program enables graduate students and advanced undergraduates in the sciences, mathematics, engineering, and technology to serve in K-12 schools as resources knowledgeable about both the content and applications of science. Academic institutions apply for awards to support fellowship activities, and are responsible for selecting fellows. The fellows serve as resources for teachers in science and mathematics instruction. Expected outcomes include improved communication and teaching skills for the fellows, enriched learning by K-12 students, professional development opportunities for K-12 teachers, and strengthened partnerships between institutions of higher education and local school districts.

NUMBER OF YEARS OF SUPPORT: 2-3 years
2004 FUNDING: $42 million
2005 FUNDING REQUEST: $47 million
STIPEND FOR 2004-2005 ACADEMIC YEAR: $30,000
COST OF EDUCATION ALLOWANCE: $10,500
TOTAL # OF GRADUATE STUDENTS: 1,000 approx.
CONTACT: Carolyn Piper
703-292-8696
INTEGRATIVE GRADUATE EDUCATION AND RESEARCH TRAINING PROGRAM (IGERT)
NATIONAL SCIENCE FOUNDATION (NSF)

Initiated in 1997, the IGERT program offers Ph.D. scientists and engineers interactive research opportunities and training experiences that transcend traditional discipline boundaries and equip students with tools needed to synthesize scientific, technical, business, social, and ethical issues in a global environment. The IGERT program emphasizes science and engineering, work experience on and off campus, new disciplinary interfaces, and greater diversity in student participation and preparation.

NUMBER OF YEARS OF SUPPORT: Up to 5 years

2004 FUNDING: $67 million

2005 FUNDING REQUEST: $82 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: $30,000

TOTAL # OF GRADUATE STUDENTS: 1,600

CONTACT: Lenore Clesceri
703-292-8696
http://www.nsf.gov/home/crssprgm/igert/start.htm

VERTICAL INTEGRATION OF RESEARCH AND EDUCATION IN THE MATHEMATICAL SCIENCES (VIGRE)
NATIONAL SCIENCE FOUNDATION (NSF)

The purpose of the VIGRE program is: (1) to prepare undergraduate students, graduate students, and postdoctoral fellows for a broad range of opportunities available to individuals with training in the mathematical sciences; and (2) to encourage departments in the mathematical sciences to initiate or improve educational activities that lend themselves to integration with research, especially activities that promote the interaction of scholars across boundaries of academic and departmental standing. Each proposal has three components: (1) a graduate traineeship program; (2) an undergraduate research experience program; and (3) a postdoctoral fellowship program. This program addresses helps to offset the lack of funding opportunities for fellowships in the mathematical sciences.

NUMBER OF YEARS OF SUPPORT: 3 years

2004 FUNDING: $26 million

2005 FUNDING REQUEST: $28 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: $22,500 for graduate students

COST OF EDUCATION ALLOWANCE: Up to $10,500

TOTAL # OF PROJECTS: 39 sites- the number and size of awards will depend on the advice of reviewers, availability of funds, and NSF's determination

CONTACT: Richard Millman
703-292-4878
FOREIGN LANGUAGE AND AREA STUDIES FELLOWSHIP (FLAS)
UNITED STATES DEPARTMENT OF EDUCATION (ED)

FLAS provides support for the study of critical, and often under-studied, world areas and languages. It encourages graduate students in all disciplines, including professional programs, to develop language competence and interdisciplinary knowledge of world areas. The program is authorized under the Fulbright-Hays Act and Title VI of the Higher Education Act.

**2004 data is not yet available**

NUMBER OF YEARS OF SUPPORT: 1 academic year; 1 summer session

2003 FUNDING: $29 million

STIPEND FOR 2003-2004 ACADEMIC YEAR: Academic year: $14,000; summer: $2,400

COST OF EDUCATION ALLOWANCE: Academic year: $11,000; summer: $3,600

TOTAL # OF INSTITUTIONAL AWARDS: 129 institutions

TOTAL # OF GRADUATE STUDENTS: 1,010 academic year awards, 630 summer awards

CONTACT: Sarah Starke
202-502-7688

FULBRIGHT-HAYS DOCTORAL DISSERTATION RESEARCH ABROAD
UNITED STATES DEPARTMENT OF EDUCATION (ED)

This program provides grants to colleges and universities to fund individual doctoral students to conduct research in other countries in modern foreign languages and area studies for periods of 6 to 12 months. This program is valuable for students and institutions in fields where research abroad is an essential part of most dissertations. It is authorized under the Fulbright-Hays Act and Title VI of the Higher Education Act.

NUMBER OF YEARS OF SUPPORT: 6-12 months

2004 FUNDING: $4.6 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: Stipend is tied to the cost of living in each country(ies) of research

NUMBER OF GRANTS: 150

CONTACT: Karla Ver Bryck Block
202-502-7632

February, 2004
GRADUATE ASSISTANCE IN AREAS OF NATIONAL NEED (GAANN)
UNITED STATES DEPARTMENT OF EDUCATION (ED)

The GAANN program provides graduate fellowships to students through grants to academic departments at colleges and universities in areas of national need as determined by the Secretary of Education. The designated areas of national need are currently biology, chemistry, computer and informational sciences, engineering, geological and related sciences, mathematics, physics, and several multi- and interdisciplinary areas.

NUMBER OF YEARS OF SUPPORT:       Multiple years of support
2004 FUNDING:                      $30.6 million
2005 FUNDING REQUEST:              $30.6 million
STIPEND FOR 2004-2005 ACADEMIC YEAR: $30,000
COST OF EDUCATION ALLOWANCE:       $11,511
TOTAL # OF GRADUATE STUDENTS:      502 continuations; 230 new awards
CONTACT:                           Cosette L. Ryan
                                   202-502-7637

JACOB K. JAVITS FELLOWSHIPS
UNITED STATES DEPARTMENT OF EDUCATION (ED)

The Javits Fellowship program is one of the only federal fellowship programs that supports students in disciplines outside of the sciences and engineering. The program provides financial assistance to students of superior ability, as demonstrated by their achievements and exceptional promise, to undertake study at the doctoral and Master of Fine Arts (MFA) levels in selected fields of the arts, humanities, and social sciences.

NUMBER OF YEARS OF SUPPORT:       Up to 4 years
2004 FUNDING:                      $9.9 million
2005 FUNDING REQUEST:              $9.9 million
STIPEND FOR 2004-2005 ACADEMIC YEAR: $30,000
COST OF EDUCATION ALLOWANCE:       $11,511
TOTAL # OF GRADUATE STUDENTS:      190 continuations; 50 (approx.) new awards will be made in June, 2004
CONTACT:                           Cosette L. Ryan
                                   202-502-7637
NATIONAL DEFENSE SCIENCE AND ENGINEERING GRADUATE FELLOWSHIPS PROGRAM
UNITED STATES DEPARTMENT OF DEFENSE (DOD)

Initiated in 1973, the National Defense Science and Engineering Graduate Fellowship Program supports individuals earning doctoral degrees in science and engineering disciplines having the greatest payoff to national security requirements. Recipients are introduced to policymaking in the executive and legislative branches of government and provided the opportunity to contribute technical expertise and gain hands-on experience in science and technology policymaking in the Pentagon. The program is administered by the Army, Navy, and Air Force research offices.

NUMBER OF YEARS OF SUPPORT: 3 years

2004 FUNDING: $27 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: First Year-$30,500; Second Year-$31,500; Third Year-$31,500

COST OF EDUCATION ALLOWANCE: Full tuition and required fees, not including room and board

TOTAL # OF GRADUATE STUDENTS: 571

CONTACT: American Society for Engineering Education
202-331-3516
http://www.asee.org/ndseg/default.cfm

NATIONAL SECURITY EDUCATION PROGRAM (NSEP)
UNITED STATES DEPARTMENT OF DEFENSE (DOD)

The National Security Education Program (NSEP) was created by Congress in 1991 to encourage U.S. graduate students, undergraduate students, and U.S. colleges and institutions to internationalize their curricula by promoting the study of under-represented languages and areas critical to U.S. national security. NSEP has three components: the David L. Boren Graduate Fellowships, administered by the Academy for Educational Development (AED); the David L. Boren Undergraduate Scholarships, administered by the Institute of International Education (IIE); and an intensive language program. David L. Boren Graduate Fellowships provide support for overseas or domestic study, or a combination of both. Recipients are required to seek employment with an agency or office of the federal government involved in national security affairs.

NUMBER OF YEARS OF SUPPORT: 1 semester minimum; 6 semester maximum

2004 FUNDING: $8 million for the NSEP; $2.5 million for the graduate fellowship program

2005 FUNDING REQUEST: $8 million for the NSEP; $2.5 million for the graduate fellowship program

STIPEND FOR 2004-2005 ACADEMIC YEAR: $10,000 per semester for overseas study
$12,000 for domestic study
$28,000 for combined overseas/domestic study

TOTAL # OF GRADUATE STUDENTS: 147, including 101 new awards

CONTACT: Academy for Educational Development (AED)
202-884-8285
http://www.ndu.edu/nsep/
SCIENCE TO ACHIEVE RESULTS (STAR) FELLOWSHIP FOR GRADUATE ENVIRONMENTAL STUDY  
ENVIRONMENTAL PROTECTION AGENCY (EPA)

The purpose of the STAR Fellowship program is to support research in academic disciplines related to environmental research, including physics, biology, social science, and engineering. This goal is consistent with the EPA mission to provide leadership in the area of environmental science research and meet the nation’s environmental challenges.

NUMBER OF YEARS OF SUPPORT: M.S. 2 years maximum; Ph.D. 3 years maximum

2004 FUNDING: $9.5 million

2005 FUNDING REQUEST: $6.6 million

STIPEND FOR 2005-2006 ACADEMIC YEAR: $20,000

TUITION ALLOWANCE: Up to $12,000

TRAINING RELATED EXPENSES: $5,000 for expenses, which includes health insurance, books, supplies, and travel

TOTAL # OF GRADUATE STUDENTS: 100

CONTACT: Stephanie Willet  
202-343-9737  
http://es.epa.gov/ncer/

EARTH SYSTEM SCIENCE FELLOWSHIP  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

The Earth System Science Fellowship program, established in 1990, helps ensure the continued training of interdisciplinary scientists in the study of the Earth as a system. Research fields include atmospheric chemistry and physics, ocean biology and physics, ecosystem dynamics, hydrology, cryospheric processes, geology, geophysics, and information science and engineering. Specific research topics must be relevant to NASA’s Earth remote sensing science, process studies, modeling and analysis activities in support of the U.S. Global Change Research Program.

NUMBER OF YEARS OF SUPPORT: 1, renewable up to 3 years

2004 FUNDING: $3.3 million

2005 FUNDING REQUEST: $3.3 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: $18,000

TUITION: $3,000

COST OF EDUCATION ALLOWANCE: $3,000

TOTAL # OF GRADUATE STUDENTS: 150

CONTACT: Ming-Ying Wei  
202-358-0771  
http://research.hq.nasa.gov/code_y/code_y.cfm

9 February, 2004
GRADUATE STUDENT RESEARCHERS PROGRAM (GSRP)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

This program is open to students with interest in any segment of NASA’s operations – aeronautics as well as aerospace – rather than being restricted to a particular subject area. Its stated goal is to increase the number of highly trained scientists and engineers in aerospace, space science, space applications and space technology.

NUMBER OF YEARS OF SUPPORT: Up to 3 years

2004 FUNDING: $7.2 million

2005 FUNDING REQUEST: $7.2 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: $18,000

TUITION: $3,000

COST OF EDUCATION ALLOWANCE: $3,000

TOTAL # OF GRADUATE STUDENTS: 300

CONTACT: Katie Blanding
202-358-0402
http://fellowships.hq.nasa.gov/gsrp/program/

NATIONAL NEEDS GRADUATE FELLOWSHIP
UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

This program is designed to encourage outstanding students to pursue and complete graduate degrees in areas such as plant and animal biotechnology, food, forest products or agricultural engineering, food marketing or management, and water science. One of its major goals is to recruit students with non-agriculture backgrounds into agricultural disciplines, including those with backgrounds in genetics, biology, and biochemistry. The program awards grants to institutions on a competitive basis, every other year; the university then selects the fellows according to the guidelines of the program.

NUMBER OF YEARS OF SUPPORT: 3 years

2004 FUNDING: $2.8 million

STIPEND FOR 2004-2005 ACADEMIC YEAR: $22,000

COST OF EDUCATION ALLOWANCE: $1,000

TOTAL # OF GRADUATE STUDENTS: 82 (new awards will be made in December 2004)

CONTACT: Wendy Colbert
202-720-1973
http://www.usda.gov/fannf.htm
COMPUTATIONAL SCIENCE GRADUATE FELLOWSHIP (CSGF)
UNITED STATES DEPARTMENT OF ENERGY (DOE)

The Computational Science Graduate Fellowship (CSGF) program is funded by the DOE’s Office of Defense Programs and Office of Science. CSGF works to identify and provide support for top computational science graduate students in the nation. The fellowship is for undergraduate seniors or first or second year graduate students planning full-time study toward a PhD. in the physical, engineering, computer, mathematical, or life sciences.

NUMBER OF YEARS OF SUPPORT: up to 4 years

2004 FUNDING: $5.5 million (program is based on a five year (2003-2008) grant totaling $27.5 million)

STIPEND FOR 2003-2004 ACADEMIC YEAR: $28,000

TUITION: Full tuition and required fees up to 4 years of study + matching funds up to $2,500 for a computer workstation

INSTITUTIONAL ALLOWANCE: $1,000

TOTAL # OF GRADUATE STUDENTS: 71

CONTACT: Rachel Huisman
515-956-3696
http://www.krellinst.org/csgf/

FULBRIGHT GRANTS FOR GRADUATE STUDY AND RESEARCH ABROAD
UNITED STATES DEPARTMENT OF STATE

Fulbright was created in 1946 to foster understanding among nations through educational and cultural exchange. The U.S. Student Program is designed to give recent BS/BA graduates, master’s and doctoral candidates, and young professionals and artists opportunities for personal development and international experience. Most grantees plan their own programs. Projects may include university coursework, independent library or field research, classes in a music conservatory or art school, special projects in the social or life sciences, or a combination. Fulbright has proved particularly valuable in enabling students to undertake sustained research abroad. The Institute of International Education (IIE) coordinates the activities relevant to the U.S. Student Program and conducts an annual competition for the scholarships, most of which are for one academic year of study or research.

NUMBER OF YEARS OF SUPPORT: 1 academic year

TOTAL 2004 FUNDING: $64.9 million (includes funding for U.S. students and foreign students)

STIPEND FOR 2004-2005 ACADEMIC YEAR: Grants generally provide round-trip transportation; language or orientation courses, where appropriate; tuition, in some cases; book and research allowances; maintenance for the academic year, based on living costs in the host country; and supplemental health and accident insurance. Fulbright full grants are payable in local currency or U.S. dollars, depending on the country of assignment.

TOTAL # OF GRADUATE STUDENTS: 3,100, including 1,000 U.S.; 2,100 foreign (in FY2003)

CONTACT: The Institute of International Education
202-619-4290
http://www.iie.org/fulbright/us/
Sigma Xi Application Tips & Pitfalls

Given that reviews are not returned with Sigma Xi grants-in-aid of research applications that are declined, I thought it might be useful to give out some tips that might help in preparing future applications.

Applications are generally judged on the following items, generally in order of importance from most to least:

1) General significance and how much the project will truly advance the field in general (not just for "people studying hylid frogs").
2) Will the methods really address the general question, or will it be a very small piece (e.g., a single data point)? Similarly, are the methods correct or possibly flawed/ confounded?
3) How independent is this project from the advisor's research?
4) Does the student seem to be familiar with the literature on the subject and the required methods?
5) What do the letters of recommendation have to say about the student and the project?

I address each of these in turn.

**General significance**

Particularly in ecology/ evolution/ systematics/ behavior, the first of these is nearly always the reason a proposal is declined. You should be doing novel, interesting, hypothesis-based research. There are some particular projects that everybody and his/ her brother seem to be doing, and these projects are generally not favored. Basically, it involves doing exactly the same study in yet-another-species-group for a reason that is not clear to people who don't work on that species group. Specific examples:

A) The phylogeny of X group is not known and hotly debated, so we will try to figure it out. -- Basically, no one cares unless they work on X group, meaning the grant reviewer probably doesn't care.
B) Is X genus/family really monophyletic? -- Ditto.
C) What are levels of gene flow between populations of X?
D) Are extra-pair copulations occurring in X species?
E) What were the [Pleistocene] refugia for X species?
F) How do patterns of diversification/ speciation correlate with (bio)geography in X group?
G) What were the effects of domestication on X species?

You all know this- these are the papers that you see over and over and over and over again in journals. Now, that's not to say these can't be quite interesting questions, or that you shouldn't study them. However, to get funding for them at Sigma Xi or elsewhere, you need an angle. Your species or group must be uniquely suited to address some broader ecological/ evolutionary/ behavioral question, not just be something that is cool or lives in an area you want to visit.
For example, let's say that temperature-dependent sex-determination (TDSD) is something that is very rare in most groups, but you want to test if it arose multiple times in turtles. You think it might have, and a reason for that is because, unlike other reptiles, turtles can XXX. Knowing the phylogeny of a group of turtles can help to determine if TDSD arose multiple times or just once, and your question is now broad. Mention that knowing this information leads to further research on why it would have arisen multiple times in this group, suggesting turtles are somehow unique among reptiles. Good, broad, hypothesis-based research.

Warning: DON'T B.S. Reviewers see right through that. Don't dig up some random feature of the species your studying and try to make it sound like a broad question, as it will only annoy them. Indeed, if you can't think of a broader significance to your study, you may want to re-evaluate the direction you are pursuing, as you will encounter the same problem later as well.

For systematics/ evolution, the level of significance should extend AT LEAST to the class level, if not higher (phylum/ kingdom/ all species). If your project will explain a phenomenon seen in most mammalian species, that's great, but if it's something specific to a group of canids, that may not be good enough.

Have a clear hypothesis you are testing, and make sure it is broadly significant. 'Nuff said.

**Methods**

It's important that you say how you'll figure these things out, too. Be as specific as you can given the space limitation, including sample size and all required primary methods. If you're doing systematics on a particular gene, mention that you have the primers isolated and will be sequencing the Xxx gene on an ABI 377. If it's a nuclear gene, mention if you plan to clone it to sequence possible heterozygotes. Why did you pick this gene?

Make sure that your methods are the best way to address your question, or if not, mention why you can't do it the "right" way. If the reviewer can come up with a better way to address your question and you don't say it, your grant will be rejected.

Also, be very careful to avoid any errors. Errors in methods are the second-most common reason for rejection. These errors can come from failing to mention something or saying something incorrect. Similarly, if your sample size is too small, reviewers balk at that. Think of sample size in the relevant scale: if you're comparing trees in 2 populations that have an ecological difference, and you're surveying 10 trees in each population, your relevant sample size is 2 (or 1 each), not 20.

Mention how you might avoid confounding factors, if appropriate. If you're studying 10 populations to examine the effects of local temperature differences on age structure, address other potential confounding variables. Are they at the same latitude? Do they have the same species present (the ones you're studying and all others)? Etc.

**Independence**
Again, this will come up a lot in the future, so you should consider it all around. The reviewers try to determine if you're doing a piece of your advisor's project, or if you're really an independent student who came up with their own project and direction. It's good if the letters address this specifically as well.

**Familiarity with literature**

**BE SURE TO CITE MAJOR RELEVANT PAPERS.** To save space, you can cite them using superscripted numbers and list the papers separately. If you fail to cite a major paper in your area, it makes you look bad. Keep in mind that you should also be reading and citing papers that study similar topics but in different species groups. For example, if you want to examine the effects of different parts of a calling song in sparrows, you really should cite the seminal work by Mike Ryan on that subject in frogs.

**Letters**

Make sure to talk about the content of the letters with your advisor and second recommender. Here are the relevant parts:

1) Familiarity with project. The letter should include a detailed description of your project and an evaluation of its impact/significance.
2) Familiarity with student. Does the student have the necessary background/skills for the methods and analysis required. It helps if the letters mention that the student has successfully done parts of this project, indicating which parts.
3) Overall student evaluation. Does the student work hard and get good grades? Does the student know the scientific literature in his/ her area?

Again, these are in order of importance. Many recommenders limit their letters to the third part, and that greatly hurts the application. Discuss your project extensively with your letter-writers, and ask them to specifically discuss it in their letters.

**Common pitfall statements**

"This research will aid in conservation efforts of …" -- Sigma Xi funds BASIC SCIENCE, not applied science (such as conservation, crop science, etc.) generally. Conservation is not sufficient justification for the study.

"This species is endangered/ threatened." -- Doesn't help. Don't research it just because it's endangered, or if you do, don't look to Sigma Xi to help you.

"This project will yield basic/ background information needed for [later interesting study]." -- You should be proposing the later interesting study. As they see it, you may only get this far and then stop.

"This project will help us to understand [something really ambiguous/obvious/basic]." It should help you to really understand something, and if you put in an answer like that, you're BS'ing. For example, studying how the reduction of a population to 1/10 its original size affects genetic variability is a no-brainer. Also, studying something to "see how natural selection affects variation in a species" is meaningless.
"This project will develop a novel method for X." -- Develop the method, then propose the project. They want hypothesis-based research.

**Some potentially favored projects**

You might be wondering- what DO they like? Here are some that might be favored.

"This project will help to explain the origin of introns." This was one in the 5/200 batch, and people jumped on it. Great, broad significance, and it seemed like it really would do that.

"This project will assess the impact of interspecific competition on speciation." This is something that has been done a few times, but it's an interesting area where results can be easily generalized.

"This project may help to explain why Allen's Rule is not observed in X group." Again, neat because it addresses a broader issue.

Alright, that's it. You're on your own. Go out and write that application, and read the final checklist below before you click the "Send" button. Remember, you can only get 2 Sigma Xi grants in your career (and only while you're a student), and you MUST turn in a report one year after the first grant to be eligible for a second.

**Final checklist**

1) Do you frame your goal in the form of a major research question for which the answer is not already known?
2) Do you justify the need for your study in the broader sense of the field (and not limited to your organism/group)?
3) Do you state explicit hypotheses that are to be tested?
4) Do you state why your system is appropriate (and not extravagant) to test these hypotheses? [Note- all applications to travel abroad are looked upon with some degree of skepticism, as many students "just want to go to the tropics."]
5) Are you explicit in your description of methods?
6) Do your methods clearly address your hypotheses and relate well to the major research question?
7) Is your budget justification listing the items that you need and that can be funded by this grant? Note- listing $10,000 in expenses is more likely to work against you than for you.
8) Is it clear that a grant from Sigma Xi will play a significant role in determining whether this research can be done?
9) Are your letters from people who are familiar with your research competence and who know exactly what you propose to do, how you propose to do it, and the significance of the research?
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TOTAL NUMBER OF STUDENTS AWARDED FUNDING IN FISCAL YEAR 2004: 290
Speciation by reinforcement predicts that females of a particular species that occur in the same region with heterospecifics (sympatry) should exhibit higher species mating discrimination than females derived from areas where only one species is present (allopatry)[1]. This difference between sympatry and allopatry results from the strengthening of mating discrimination by natural selection to avoid maladaptive hybridization[2]. Gene flow among discriminating and non-discriminating conspecific populations could obscure the pattern predicted by reinforcement, though, as the alleles conferring higher discrimination may spread across all populations. However, the pattern predicted by reinforcement is commonly observed, even in species which have high levels of gene flow between discriminating and non-discriminating populations. This paradox suggests that some mechanism is generally preventing the spread of the high discrimination phenotype out of sympathy.

This paradox could be explained by one or both of two following hypotheses: (a) natural selection favors less discriminating females in populations allopatric to other species, perhaps because these females do not needlessly postpone mating[3] and/or (b) mating discrimination differences found among sympatric and allopatric populations are maintained by asymmetrical gene flow among populations, with most migration occurring from allopatric to sympatric populations. The first hypothesis predicts that conspecific mating should occur faster in individuals derived from allopatric populations than those from sympatric populations, thus increasing the number of potential offspring. The second hypothesis predicts that levels of genetic diversity should be higher in populations sympatric to heterospecifics than in allopatric populations. This will result in a significant genetic structure between allopatry and sympatry. I propose to test these hypotheses in the sibling species Drosophila pseudoobscura and Drosophila persimilis, which have been suggested to have speciated by reinforcement[4] in the presence of extensive intraspecific gene flow[5] and minimal genetic structure[6].

I will collect flies from six D. pseudoobscura populations: 3 sympatric to D. persimilis and three allopatric to D. persimilis. I will evaluate the time to copulation in flies derived from these populations using a no-choice mating design to determine whether the higher discrimination exercised by D. pseudoobscura females in sympatry increases mating latency in conspecific pairings. Likewise, I will examine the numbers of alleles and average heterozygosity of 15 microsatellite markers[6] in flies collected in these populations to evaluate the level of structure between sympatric and allopatric populations and whether migration may be asymmetric between these populations.

The results of this investigation will shed light on the historical aspects and mechanisms that might be contributing to the sexual isolation of species and thus, to the origin of species.
On Running a Faculty Search: Doing the Job Right

During the course of the past year, one of us (Bigelow) was an applicant for a number of faculty positions in ecology, including one at Kenyon College, where the other authors (Itagaki, Heithaus) are on the Biology faculty. As the searches progressed, Bigelow had the opportunity to note the quality and the tone of the communications sent by the various search committees.

We write this out of the common belief that the process of applying for positions can be made more humane than is usually the case. Indeed, many search committees fail to communicate with the bulk of their applicants beyond an initial acknowledgment of the receipt of application and a brief rejection letter, often posted many months after the closing date, if at all. Clearly, this procedure does not acknowledge the importance of the nonselected applicants to the application process. Although a large pool of applicants can be onerous to deal with, it improves the search by allowing a wider choice, and may also increase the professional self-esteem of the person who is ultimately selected. We recount our recent search experiences from both sides of the fence, in the hope of improving the professionalism with which faculty searches are conducted, and enhancing the appreciation of the role that nonselected applicants play.

We believe that prompt, courteous, and honest communication at all phases of the search enhances the professionalism of the process. In the Kenyon search, notification of receipt of application was sent promptly to each of 163 applicants for an Ecologist position, using personalized, not form, letters. Within 1 month of the closing date, a nonform letter of rejection was sent to those who did not receive on-campus interviews, detailing the number of applications received; the average date the Ph.D. was received; average numbers of grants and fellowships received; and the average number of peer-reviewed publications. The letter also provided the qualitative criteria by which applicants were judged. Once an acceptance was received from the selected candidate, personally addressed letters were sent to applicants, informing them of the choice for the position, and thanking them for their part in making the applicant pool such a deep and talented one.

We feel that professionalism and clear communication make a brutal process more humane. There is no easy way to say “no thank you” to 162 out of 163 applicants, but being truthful and direct, being prompt, and giving some idea of the competition and our criteria for selection were critical to this search. It required more organization, an office manager willing to print out various different letters (there were four different rejection letters out of the first round, for candidates on the long list; the short list; the phone interview list; or none of the lists), and a search chair willing to sign nearly 500 letters, including the various mailings. As for the compilation of the qualifications of the various candidates, the search chair simply noted the numbers as the files were read, and the data entry and analysis took just an hour or two. Indeed, it was useful to the department to see numerical indices of the candidates’ qualifications.

After an offer was made, we informed the other interviewed candidates of how they stood instead of letting them wait. By promptly letting people know that the search had been closed and who was hired, candidates were provided information that allowed them to plan, as well as to satisfy their curiosity. All of this meant more work and postage, and required making some difficult phone calls, but we feel that the candidates appreciated the candor and transparency of such a process. We also feel that treating people with professionalism may have dividends later in unexpected ways: a particularly good student is sent our way; a good candidate takes us more seriously, etc. Also, if people are treated professionally, they may not mind if they get the job as the second (or lower) ranked candidate. Indeed, at Kenyon, we have not had a chance to test this idea in recent years, because we have hired our top-ranked candidate in the last five biology tenure-track searches, and in eight out of the last nine hires over the past 13 years. The primary reward in taking the extra time and effort, though, is in knowing that things were done right, and that the candidates were treated with respect.

Seth Bigelow
Institute of Ecosystem Studies
Box AB
Millbrook, NY 12545

Haruhiko Itagaki and
E. Raymond Heithaus
Department of Biology
Kenyon College
Gambier, OH 43022

Tips on Increasing Your Funding Success Rate, from an Ex-National Science Foundation Program Director

The National Science Foundation (NSF), whose mission is to fund basic research and training in the sciences, uses merit review to evaluate proposals submitted for funding at every career level: graduate student to post-doc to senior investigator. In the Division of Environmental Biology (DEB) in the Directorate of Biological Sciences, where the vast majority of NSF awards in ecology and evolutionary biology are made, merit review is achieved through a combination of mail reviews and advisory panels that convene to discuss the merits of proposals. The outcome of panel discussion is a set of funding recommendations made to the Program Director.

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Directors chairing these panel discussions. Most other programs within the Biology Directorate use similar protocols.

After listening, as an Ecology Program Director, to many debates (hundreds) on the merits and flaws of individual proposals, I have observed that, in the vast majority of cases, the reasons for declining a proposal for funding can be classified into four major categories. In order to aid the community of investigators (hereafter referred to as Principal Investigators, or PIs) seeking funding, I will outline the big four—typically “fatal”—flaws of proposals. I present them in order of both importance and commonness. I also include some additional tips that may make a proposal more likely to be recommended for funding.

Major Problem 1: The proposal lacks a strong conceptual basis.

Proposals that suffer from this flaw are often narrowly focused on a particular system or problem. In these proposals, the PI often does not present hypotheses, or does not place the stated hypotheses within a broader framework of existing ecological theory (verbal or mathematical). This problem can be especially gnarly for proposals with a more applied or conservation focus, since the proposed research in these cases is often not easily generalizable across systems. As a corollary, PIs should not sacrifice the conceptual aspects of the proposal for more experimental detail. The conceptual framework is the hook on which the whole proposal must hang, and therefore is of utmost importance.

Major Problem 2. The proposed experiments do not adequately test the stated hypotheses.

Proposals suffering from this flaw have avoided flaw number one and have set the proposed work within a broad ecological context. The PI has not, however, carefully thought out whether the proposed experiments adequately address the hypotheses presented. Typically, the planned experi-

ments either do not directly address the hypotheses, or the outcomes of the proposed experiments do not adequately distinguish among various competing hypotheses. Proposals that focus on historical or biogeographical approaches can be especially vulnerable to this problem, as many non-mutually exclusive hypotheses may explain a particular pattern. Designing appropriate tests to distinguish among hypotheses can be difficult.

Major Problem 3. The proposal lacks preliminary data in a critical area.

In this case, a proposal may be artfully written, but the PI has neglected to collect or present key preliminary data that will convince reviewers that the work is important or feasible. For example, a proposal might be focused on examining several aspects of predation in a particular system, but the PI has neglected to show that predation is an important force in this system. Alternatively, the proposal may contain a particular technique without documentation that the technique works in the system, or that it is feasible. In the latter case, a PI may overcome this problem if s/he allots a certain amount of space in the proposal to convincing the reviewers that others have used the technique successfully in the same or similar systems. However, for specialized methodology or an unusual system, reviewers will almost always expect good documentation that a technique works, and/or documentation that the phenomenon under study is ecologically important. This problem may constrain the stage at which a PI can successfully gain NSF funding.

Major Problem 4. The PI has not adequately justified why a particular system or species has been selected for study, or why particular response variables have been measured.

This problem is related to the previous one, but is a bit subtler. Often, the PI has not adequately justified the selection of the species or the phenomenon under study. For example, many field experiments occur in settings with hundreds of species or more. Especially in manipulative experiments, the PI must often choose to study only a subset of those species. Whenever the PI selects a subset of available species for experimental manipulation, the investigator must document why those particular species were chosen, and why they are good representatives of the community as a whole, or good objects of study for that particular question. If a study species is not native, the PI must generally document why understanding the attributes of this non-native system will be applicable to native settings, or to ecological theory. Similarly, PIs must usually also select a subset of response variables to measure, and these variables must be justified as well.

Practices that may increase the likelihood of funding success

1) Complete the proposal sufficiently ahead of time to get comments from a colleague prior to submission. This practice will increase the likelihood that some of the above-mentioned errors are caught. Preferably, this critic will have sat on an NSF panel before.

2) If the proposal is a resubmission, the PI should state this fact in the newest version of the proposal. In addition, the PI should carefully address the comments of the previous reviewers (using the previous panel or program summary as a guide), either in a single block of text at the beginning of the proposal, or intermittently in the appropriate sections of the text. Even if the PI does not agree with the prior criticisms, the investigator should be sure to address why s/he thinks the previous comments were unjustified. Be aware that panelists have access to prior submissions and reviewers’ comments when they evaluate the current version of the proposal.

3) Take the time to justify the budget request thoroughly; this practice will reduce the likelihood of getting big budget cuts. The budget justi-
fication is also a good section in which to include details on the training components for undergraduates, graduates, post-docs, etc., since PIs get up to three pages for the justification.

4) DO NOT ANNOY PANELISTS AND REVIEWERS. Always comply with the grant proposal guidelines for submission, and try to make the proposal layout easy on the eye. This comment pertains especially to font sizes; adhere strictly to the 15 character per inch limit, and recognize that different fonts have different character widths. EVERY-ONE gets annoyed at people who stretch the limits to squeeze in more text. Panelists who are reading 20-plus proposals react very poorly to noncompliant proposals.

This commentary is not meant to provide a foolproof formula for NSF funding; obviously, other key aspects enter into funding recommendations, most importantly, the originality of the ideas in the proposal. The aim of this commentary is to make PIs aware that there are, to some degree, stereotypical flaws in many of the proposals that are submitted to the NSF.

I want to observe that, from the perspective of a PI, I have been impressed with the overall effort that NSF puts into these programs to achieve maximum fairness in the funding process. The community of scientists must also play its part in order to attain a maximally fair process. Active researchers are asked twice a year by each NSF Program’s Directors to provide (E-)mail reviews (via Fastlane) of proposals. These reviews are solicited from experts in the area of the proposal, and are very important to the panel for reaching a funding decision. DEB panels are typically about 20 people, and while the Program Directors try very hard to match the expertise of the panel to the assortment of areas covered by the approximately 130 proposals received for each panel, it is often not possible to cover every area in every panel. Mail reviews serve a vital role in providing expert opinion on the quality of the research and methods, and in providing essential feedback to the PI on the proposed work. Unfortunately, all of the programs in DEB have been experiencing a dwindling response rate for the mail reviews. Some PIs with a 20-year record of NSF funding have not returned a mail review for the last 15 years. NSF keeps extremely accurate records of the review history of every scientist asked to review a proposal. The lack of participation by mail reviewers not only hurts the PI whose proposal goes unread, but also hurts the fairness of the evaluation process.

By the time you read this note, I will no longer be a Program Director. However, I am contributing the note to provide concrete, helpful suggestions to the community of PIs wishing to get funded. I am also hoping to increase the level of conscientiousness in this same community to ensure an enduring and fair decision-making process.

DISCLAIMER: Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

Acknowledgments

Thanks to fellow Program Officers Scott Collins, Mark Courtney, and Saran Twombley for valuable comments on a draft. Mark Schwartz, always a colleague, provided extremely useful examples for some of the flaws. Finally, a panelist who quietly joked to me during panel about “Fatal Flaw Number 4” inspired this piece.

Sharon Strauss, ex-Program Director,
Division of Environmental Biology,
National Science Foundation

Present address:
Associate Professor
Section of Evolution and Ecology
UC Davis
Davis, CA 95616
E-mail: systrauss@ucdavis.edu

Ecological Resource Management: A Call to Action

As the human population enlarges, it becomes increasingly difficult to sustain valued ecological resources. Human use of resources, whether it is the harvest of ocean fisheries, logging of forests, or farming of arable lands, has resulted in significant population declines in many wildlife species. The growth of urban areas and the expansion of impermeable surfaces alter landscape diversity and modify hydrologic patterns in ways that decrease habitat quality for many desired plant, fish, and wildlife species. Impaired water, air, and soil quality related to industrial, municipal, and agricultural activities have altered the composition of aquatic and terrestrial communities.

Since the passage of seminal environmental legislation in the 1970s, large numbers of ecologists have found gainful employment in government agencies and consultancies, working on a vast array of projects in pollution assessment and prevention, mitigation, cleanup, restoration, and wildlife habitat enhancement. Often, the specific demands of projects limit the breadth and depth of ecological information brought to table. Too many times, however, opportunities to improve the ecological focus of projects are squandered, largely because specific expertise is lacking, or the will to tackle a thorny topic is not there. Unfortunately, we are in this situation largely because the distance between academic ecologists and applied ecologists seems to have grown. Some academicians hold little respect for their colleagues in the applied fields; some consultants or resource managers wonder aloud if academicians study anything relevant. This rift is occurring at the worst of times, for it is now more than ever that we need each others’ insights and knowledge in order to achieve shared goals. One area that begs for substantial advances in both scientific understanding and the application of such knowledge is population ecology.
FINISHING GRAD

SCHOOL AND

SUCCEEDING
Keys to Being a “Good Grad Student”

IN THE LAB
2) Think hard. Too many people propose an experiment and then just plug at it without thinking while doing it if there might be a better way, what the results mean, etc. Your dissertation should continually evolve. You may come up with a great idea in your 3rd year that should prompt you to drop the projects you proposed for other, more fruitful ones (assuming your advisor & committee agree). Think constantly about what you’re doing and what you’ve found thus far.
3) Analyze your data while you go. The more you have updated numbers/ sequences/ whatever, the more you can do #2 above. Analyze monthly or more often.

OUTSIDE THE LAB
*4) Take initiative! NOW IS THE TIME TO BEGIN TO BUILD YOUR CV.
   a) If your advisor is writing a literature review or other literature-based paper, ask to actively participate in exchange for coauthorship.
   b) If you know someone who is an associate editor for a journal, volunteer your services as a reviewer.
   c) Make contact with people who you think could be potential postdoc advisors. Write to people whose papers you’ve read and ask them interested questions. The importance of this cannot be overstated!
   d) Think about collaborative projects with other students, but don’t let yourself get too distracted from your dissertation work, which is priority #1.
5) Read the literature!!! This is absolutely necessary! It is NOT the job of your advisor or your committee members to point out new relevant papers to you, and they will expect you to know such papers in your General Exam. You should be regularly reading the journals in your area of specialty. Your advisor should give you a list of journals you should peruse as each issue comes out.
6) Present at meetings! You’ll need practice speaking, so go present your data at the big national meetings, and don’t stick with your labmates or buddies while there. Talk with the movers and shakers in your subdiscipline at these meetings.

SOCIAL/ INTERACTIONS STUFF
7) Very regularly update your advisor and your committee members. Your advisor should have updates AT LEAST monthly, and your committee members at least every 6 months. These are REAL updates, not just descriptive- give them numbers, statistics, analyses, etc. Talk with them about stumbling blocks, including nonscientific ones. It’s THEIR JOB to help you, and you can make it easy for them to do it.
8) Keep a thick skin. We are taught to criticize more than compliment. Take criticisms of your projects/ papers/ proposals/ etc. as help, not insults or personal attacks.
9) Be nice. No one likes a jerk. Don’t insult people- be kind but assertive. If you disagree with something, say so, but be judicious in your words. Also, be careful about bad-mouthing people (especially ones in your department), as it may get back to them, and there may be consequences.
10) Participate! Go to biology grad student functions. Go to seminars and lab meetings. Don’t squirrel yourself away or stick exclusively with an outside social group.
RECRUITERS & ACADEMIA

What makes a good PhD student?

Doing a PhD should be fun and rewarding, because you can spend all your working time discovering things and pursuing ideas — and getting paid for it, without any administrative responsibilities. Those who stick with a career in science do so because, despite the relatively poor pay, long hours and lack of security, it is all we want to do.

Unfortunately most new PhD students are ill-prepared, and as a consequence very few will fulfill their aspirations to be independent scientists. The main reasons for this are the ‘grade creep’ inherent at most universities, making it difficult to identify the really talented first-class graduates from the rest, and the pressure on universities to graduate as many PhD students as possible. The consequence is that we enrol far too many of them without telling them clearly what doing a doctorate should entail. We therefore set ourselves, and the students, on a path of frustration and disappointment.

So what should we be telling prospective PhD students?

● Choose a supervisor whose work you admire and who is well supported by grants and departmental infrastructure.
● Take responsibility for your project.
● Work hard — long days all week and part of most weekends. If research is your passion this should be easy, and if it isn’t, you are probably in the wrong field. Note who goes home with a full briefcase to work on at the end of the day. This is a cause of success, not a consequence.
● Take some weekends off, and decent holidays, so you don’t burn out.
● Read the literature in your immediate area, both current and past, and around it. You can’t possibly make an original contribution to the literature unless you know what is already there.
● Plan your days and weeks carefully to dovetail experiments so that you have a minimum amount of downtime.
● Keep a good lab book and write it up every day.
● Be creative. Think about what you are doing and why, and look for better ways to go. Don’t see your PhD as just a road map laid out by your supervisor.
● Develop good writing skills: they will make your scientific career immeasurably easier.
● To be successful you must be at least four of the following: smart, motivated, creative, hard-working, skilful and lucky. You can’t depend on luck, so you had better focus on the others!

Georgia Chenevix-Trench is principal research fellow at the Queensland Institute of Medical Research, Royal Brisbane Hospital, Herston, Australia. ©www.qimr.edu.au/research/labs/georgiat/Guidetopdhs.doc

GRADUATE JOURNAL

Valuable diversions

Passion for science can make it hard to stop thinking about work outside office hours. One solution is to engage in hobbies that force you to switch off from thoughts of work, such as sports, crafts or, in my case, music. At choir rehearsals, I effortlessly shift my focus off small black ants onto the small black notes on the sheet music.

Choirs, teams or dance groups can offer a welcome break from the scientific world, where social gatherings inevitably lead to talking shop. In the choir, I meet people in different professions and life situations. While I may tell the occasional ant story, pub discussions are as likely to revolve around life as a casino dealer, teacher or full-time mother.

But perhaps most importantly, performing in a concert or learning a new piece of music gives me a feeling of instant gratification that research sometimes lacks. The average biological project can take years from planning to writing up, and when your inbox finally delivers that longed-for letter of acceptance, you’re already deep into the next project. Short-term successes outside science — learning a new language, competing in a race or performing in a play — can boost your morale, giving you strength to continue in the marathon run towards graduation.

Katja Bargum is a graduate student in the Department of Biological and Environmental Sciences at the University of Helsinki, Finland.
One year before PhD checklist

Read this 2+ years before intended PhD, so you can prepare accordingly.

Short answer: Don't ride on inertia. TAKE INITIATIVE.

O Am I realistically going to finish my work in the coming year?

O Does my advisor think I am realistically going to finish my work in the coming year? If you & your advisor disagree, confer on this topic explicitly NOW before problems arise. If you don't know, TALK TO HIM/HER.

O Do I have any idea at all what I want to do following graduation?

At this point, you have to have made some (at least tentative) decisions. You will prepare your CV differently and do different things depending on your choice of direction, and you really have to choose something now. If it doesn't work out, you can always change later, but you can't just postpone a decision any longer.

O Have I begun to seriously contact potential postdoctoral advisors, industries, or have I prepared myself for a teaching position? "Seriously contact" involves explicitly stating some interest in obtaining a position there and specifying the timeframe.

O If going for postdoc, have I begun to formulate ideas that I can put into a postdoctoral fellowship application? If no, consult with both your current advisor and prospective postdoc advisor(s) immediately to get started.

O Have I published any papers yet? If not, you must submit NOW.
CURRICULUM VITAE

JOHN K. STUDENT

Biology Department
Box 90338, Duke University
Durham, NC 27708 USA
PHONE: (919) 660-0000
E-MAIL: jkstudent@duke.edu

I. EDUCATION

2000-2005 (anticipated) Ph.D. Biology Department
Duke University
Durham, North Carolina USA

1993-1998 BS Department of Biology, Highest Honors
University of Springfield
Springfield, XX USA

1999 Summer Institute in Statistical Ecology
South Carolina State University
Columbia, South Carolina USA

II. CURRENT RESEARCH INTERESTS

Community ecology, tropical ecology, species richness, ecology of disturbance using Cecropia

III. PUBLICATIONS

A. Refereed Publications


B. Unrefereed Publications and Abstracts

C. Publications in Review


IV. HONORS AND AWARDS

2000 Sigma-Xi grant-in-aid of research program. "On the spread of *Cecropia". Sigma Xi, The Scientific Research Society Research Triangle Park NC, USA. $750


V. TEACHING EXPERIENCE

2000-2001 Teaching Assistant, BIOL 20L Introductory Biology Laboratory.

VI. PRESENTATIONS AT SCIENTIFIC MEETINGS

Student, J. K. and S. Advisor. 2001. Spread of *Cecropia* into disturbed habitats in Panama: A whole different story. Ecological Society of America meeting, Madison, WI, USA.

VII. PROFESSIONAL ACTIVITIES

A. Reviewer For


B. Professional Memberships

*Association of Tropical Biologists*
Advice to Grad Students About Choosing a Postdoc Advisor

Figure out an area of interest (e.g. academic research, teaching, biotech research, law, etc.) then look at their record of training for you chosen career.
Do your research: talk to previous postdocs from the lab as well as postdocs currently there.

1) How available/approachable is the PI?

"Available" doesn't necessarily mean always around. It means can you talk to them when you want to? Can you talk to them about both good and bad data? About problems in the lab?

2) How do they facilitate your research?

Do they provide the resources to get your experiments done?
Are you given lots of outside responsibilities (i.e. lab jobs, training techs, TAing)?
How is your work facilitated in terms of collaborations?
Look at the lab environment-- are people generally happy? Does PI create internal competition?
Play favorites? What is the tone of lab meetings: supportive or combative?

3) How do they disseminate your research?

Are you encouraged to give posters/talks? Are you sent to meetings?
Are you encouraged to write up your work for publication? Do you write your own papers? Are you given guidance in these areas?
Provided with opportunities for public communication of your own work? (local and national)
The PIs should talk up the research and accomplishments of the people in his or her lab. Is everyone represented in advisor's presentations? Fairly?

4) How do they train you for your future career?

For PI skills-you need to get experience/advice on grant writing, reviewing papers, letters of recommendation, interacting with people in a department.

Excerpted from:
Mentoring Session Synopsis
ASCB National Meeting
Tuesday Dec. 7, 2004
Sponsored by SubCommittee on Postdoctoral Training (SCOPT)
How to approach a potential postdoctoral mentor

As a faculty member, there's nothing more important than carefully selecting your employees: both for high potential productivity and for good interactions. To some extent, this is more true for hiring postdocs or technicians than for taking on graduate students. The reason for this is that most universities will not let you easily "fire" an employee without extensive documentation and a waiting period, while it's often technically easier to get rid of a troublesome or unproductive student. Hence, it is crucial that you put your best foot forward in applying for postdoctoral positions.

Now, most faculty will be far less "choosy" for someone who is applying for a postdoctoral fellowship to come to their lab than for someone who is coming in on their grant. The reason is simple: the faculty member's reputation and likelihood of future funding rests on the success of their funded proposals: they want to ensure that they hire someone who does the work right. In contrast, if you apply for a fellowship and get it, the faculty member is paying you close to nothing in salary, and all your productivity is a "bonus."

As such, it's an excellent idea to immediately suggest applying for a postdoctoral fellowship from NIH or NSF or whoever when contacting a prospective employer. They may make your appointment conditional on getting the fellowship. However, if they have funding, and you do a good job interacting with them in preparing the proposal, they may decide you're worth the risk. That said, here are my suggestions. Talk with your graduate advisor and committee about them and about their thoughts.

1) **Make it clear to your prospective mentor that you know their research.** Make explicit statements about why you are interested in their lab, and cite relevant work. Try not to butt-kiss too heavily, though.

2) **Note your own qualifications/record.** If you work with someone who that person knows, definitely say-so. Immediately send them a list of your publications, and let them know briefly what your dissertation work was about.

3) **Tell them what you have to offer.** If you have some skills, techniques, or ideas that haven't been used often in that lab, let them know.

4) **Offer to write a fellowship application to come work with them.** See above.

5) **Spell and grammar check your letter before sending!!! Let your advisor read it, too.**

6) **Keep your initial contact brief.** You can give them more details when they reply.
Sample contact e-mail

Dear Dr. Conant:

Greetings. I am a 5th year ecology graduate student studying short-distance dispersal of *Drosophila cantigua* with Chuck Sanders at the University of Guadeloupe. My research has focused on the effects of patch quality on the dispersal of this species, and I have observed that, consistent with the predictions of the marginal value theorem, flies tend to disperse more quickly from poor-quality patches than from high-quality patches, and their residence time is inversely related to the distances between patches. This work was just published in *Evolutionary Ecology* in the July issue. I have also participated in other projects related to dispersal behavior in insects (see publication list below).

I was impressed with your study that demonstrated the effect of matrices on dispersal patterns of planthoppers in the latest issue of *Ecology*, and I am writing to inquire about possibilities of joining your lab as a postdoctoral research associate. I am skilled at mathematically modeling ecological processes, and I would be very interested in applying this skill to your planthopper/parasitoid wasp system, and then empirically testing the resultant predictions. Your previous paper in *Ecological Monographs* noted that patch distance played a lesser role in mediating dispersal than matrix composition. I was thinking that it might be interesting to explore this further using molecular genetic data: do your patches fit an isolation-by-distance model, and if so, does the slope of the distance effect change with matrix composition? I previously worked in a molecular genetics laboratory isolating microsatellites, and I could easily apply these tools to your system, if you're not already doing so.

If you would be interested in my joining your group, I would be happy to prepare an NSF/NATO postdoctoral fellowship application. The deadline is in about 3 months, so we would have time to bounce ideas between now and then. I anticipate completing my dissertation in about a year, so the timing would be perfect, if you agree.

Please let me know if I can provide you with any more information, or if you'd like references (beyond Dr. Sanders). I hope to have the opportunity to work with you and your group.

Sincerely,

Madeup Smith

PUBLICATIONS:

...
MOVERS

Craig Hogan, director, Center for Particle Astrophysics, Fermi National Accelerator Laboratory and professor of astronomy and astrophysics, University of Chicago, Illinois

1993–2008 Professor, astronomy and physics departments, University of Washington, Seattle, Washington
2002–05 Vice-provost for research, University of Washington, Seattle
1995–2001 Chair, astronomy department, University of Washington, Seattle

Craig Hogan was hooked on astrophysics the minute he learned that remnant heat from the Big Bang was still detectable. His wide-ranging contributions to the field include the co-discovery of ‘dark energy’ — the mysterious force behind the acceleration of the expanding Universe. But he hopes that future experiments will reveal an as-yet undetected dimension of the Universe.

“Craig has forged unusually original and versatile theoretical insights into astrophysics,” says Martin Rees, Hogan’s PhD adviser at the University of Cambridge, UK. “If you look at any number of subjects — from dark energy to how the Universe began — you’ll find the earliest papers are from Craig.”

After postdocs at the universities of Cambridge and Chicago and at the California Institute of Technology in Pasadena, Hogan helped to build the first theoretical group at the University of Arizona’s Steward Observatory. There, he learned the inner workings of telescope-based experiments as they applied to theory projects. Hogan eventually joined the physics and astronomy department at the University of Washington in Seattle, where it was easier to bridge his interest in those two fields. Despite the clouds and mountains, Washington had a telescope large enough to survey supernovae, key to detecting dark energy. Hogan played down the discovery.

“The tension between the age of the Universe and the velocity of the galaxies had suggested a cosmological constant for a long time,” he says. The real surprise, he adds, was how well the experiment actually worked.

Hogan’s research focus now includes proposed space-based experiments such as the Laser Interferometer Space Antenna (LISA), designed to detect gravitational waves in space. “So far we’ve turned snapshots of the Universe into a silent movie,” says Hogan. “Detecting gravitational waves would be like adding a soundtrack — and that is potentially much more transformative to science as a whole than discovering dark energy.”

As director of Fermilab’s Center for Particle Astrophysics, Hogan will push for LISA as well as for other new ways to explore the physics of gravity and space-time. Fermilab will need a new focus once the Large Hadron Collider in Switzerland makes the lab’s Tevatron particle collider obsolete. “Fermilab is the premier high-energy physics lab in the United States,” says Hogan, “and gravity is the one force of nature it hasn’t yet studied.”

Virginia Gewin

The postdoc interview

The following questions should help you get the most out of your postdoc interview and, with luck, out of your postdoc experience as well.

• If the project is independent, will you be able to take it with you when the fellowship ends? Be wary of a ‘conditional project’ — if you take on project X first, you will get project Y.
• Will you be granted time to participate in a postdoc council, take courses, learn new technologies, improve communication skills, and so on? Does the mentor/principal investigator (PI) have funds for attending scientific meetings?
• How is authorship handled? How often and where does the lab publish?
• Where is the mentor along the tenure-track timeline? Senior PIs with productive track records are safer. But junior faculty members may be more eager to get more publications out.
• Will the mentor help you apply for small grants or fellowships? How stable is the current funding?
• Is your potential mentor receptive to collaborations with other labs?
• How are research supplies acquired and financed?
• Will you be able to meet lab members to talk freely about the lab and the mentor? A PI’s pledges in the courtship phase might change once a commitment is made.
• Can you contact lab alumni? If so, ask them for the five best and five worst things about working with the mentor.
• Is productivity more important than the number of hours you work?
• What is the vacation schedule? Is there sick time? Is there a maternity/ paternity policy or leave?
• Does the mentor hold regular lab or individual meetings? An individual development plan helps answer these questions in a written, contractual format.
• Does the institution have a postdoc policy? If so, read it in detail. Are there postdoc term limits?
• Does the institution have a postdoc office or association? If so, does it review all the offer letters to ensure the terms and stipend levels are fair?

If you walk away thinking, “If I could change one or two major things, it would be great”, then keep on walking. Reflect on the interview, talk to your mentors, and trust your gut.

Kryste Ferguson is an academic coordinator at the University of Pennsylvania’s Office of Biomedical Postdoctoral Programs. Ivonne Vidal Pizarro is a programme administrator at the American Association for Cancer Research. Reprinted by permission of the Society for Advancement of Chicanos and Native Americans in Science.

Judging me, judging you

“Good morning,” I begin. “It’s great to be here presenting my latest research.” And it is good to be in front of faculty members and students, despite my sickening nerves. This is judgement day for getting a permanent faculty position. Someone rustles my handout as I unveil my work, ‘Invasions in heterogeneous environments’. Maybe handouts weren’t such a good idea after all. Can I convey my interest, inspire people? Much as in a student lecture, I scan faces for some feedback. Nothing. So I catapult everyone into my favourite results.

The interview gets altogether more personal. How would I teach ecological theory? With whom would I collaborate? What resources would I require? Now, I’ve done my homework. I’ve spent evenings reading the department’s website. I know their research, their courses, their ‘future strategic plan’, the funding opportunities, and even some of their hobbies. It helps me answer their questions, but it also helps me judge the department. I figure that this could be a long-term partnership, so I’d better know the place.

The implications are huge. For one, my partner and I finally could live in the same country if I get the position. I try and keep a grip on my nerves by judging the department while they are judging me. I pose a final question in my head.

What will you do to help me be successful? I’ve always wanted to work with them, so I think they have a vested interest in my success.

Instead, the department head asks me a question. I’m thrown off guard, but I answer. And the interview continues.

POSTDOC JOURNAL

Jon Yeatsley is a senior postdoc in evolutionary genetics at the University of Lausanne in Switzerland.

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The Association of American Medical Colleges last month approved a document that, if it becomes more widely adopted, could revolutionize postdoctoral training. The association’s Compact Between Postdoctoral Appointees and Their Mentors (www.aamc.org/postdoccompact) is powerful because it gives both parties clear responsibilities and sets clear expectations for each side.

It tells postdocs to take primary responsibility for their career development. It states that their research project should be developed with their mentor, and that this should have clearly defined goals and timelines, all of which, ideally, should be agreed at the time the postdoc appointment is made. It asks postdocs to follow good research practices, to adhere to ethical standards and to treat their colleagues with respect. It also challenges them to assume more responsibility as their project progresses and puts the onus on them to request formal performance reviews. And, finally, it charges them to seek professional development activities outside the lab, both in terms of scientific and career development.

On the flip side, mentors are instructed to recognize that postdoctoral fellowships are a training period — not an opportunity to obtain and exploit inexpensive labour. Mentors, too, should establish timelines for research as well as career development goals with their fellows, the compact says. They should base their relationship with fellows on mutual trust and respect. And they should ensure that postdocs have the opportunity to obtain the skills they need — whether on or off the bench.

These guidelines, although challenging, seem to be mutually beneficial. But the compact ups the ante for mentors by asking them to help postdocs explore career options outside academia and to commit to helping their mentees succeed on whatever path they choose. If both postdocs and mentors sign up to this compact it will require a lot of work and commitment from both sides. But it could also help end many of the complaints that each side has about postdoctoral training arrangements.

Paul Smaglik, Naturejobs editor
Compact Between Postdoctoral Appointees and Their Mentors

December 2006
The Compact Between Postdoctoral Appointees and Their Mentors is intended to initiate discussions at the local and national levels about the postdoctoral appointee-mentor relationship and the commitments necessary for a high quality postdoctoral training experience.

The Compact was drafted by the AAMC Group on Graduate, Research, Education, and Training (GREAT) and its Postdoctorate Committee. It is modeled on the AAMC Compact Between Resident Physicians and Their Teachers, available at www.aamc.org/residentcompact. Input on the document was received from the GREAT Group Representatives, members of the AAMC governance, and other members of the postdoctoral community, including the National Postdoctoral Association. At its October 8, 2006, annual business meeting, the GREAT Group unanimously endorsed the document. The document was subsequently endorsed by the AAMC Executive Committee on October 20, 2006.

The Compact is available on the AAMC Web site at www.aamc.org/postdoccompact
Compact Between Postdoctoral Appointees and Their Mentors

Postdoctoral training is an integral component of the preparation of scientists for career advancement as scientific professionals. Postdoctoral appointees typically join an institution to further their training in a chosen discipline after recently obtaining their terminal degree (e.g., Ph.D., M.D., D.V.M.). This training is conducted in an apprenticeship mode where she/he works under the supervision of an investigator who is qualified to fulfill the responsibilities of a mentor. The postdoctoral appointee may undertake scholarship, research, service, and teaching activities that together provide a training experience essential for career advancement.

Core Tenets of Postdoctoral Training

Institutional Commitment

Institutions that train postdoctoral appointees must be committed to maintaining the highest standards of training and to providing a program sufficient to ensure, that when completed, the trainee can function independently as a scientific professional. Institutional oversight must be provided for terms of appointment, salary, benefits, grievance procedures, and other matters relevant to the support of postdoctoral appointees. A responsible institutional official must be designated to provide this oversight, and a suitable office should be available for the administrative support of postdoctoral affairs.

Quality Postdoctoral Training

Individuals should be trained to independently formulate meaningful hypotheses, design and conduct interpretable experiments, adhere to good laboratory practices, analyze results critically, understand the broad significance of their research findings, and uphold the highest ethical standards in research. The development of additional skills—including oral and written communication, grant writing, and laboratory management—are considered integral to this training.

Importance of Mentoring in Postdoctoral Training

Effective mentoring is critical for postdoctoral training and requires that the primary mentor dedicate substantial time to ensure personal and professional development. A good mentor builds a relationship with the trainee that is characterized by mutual respect and understanding. Attributes of a good mentor include being approachable, available, and willing to share his/her knowledge; listening effectively; providing encouragement and constructive criticism; and offering expertise and guidance.

Foster Breadth and Flexibility in Career Choices

Postdoctoral appointees must have training experiences of sufficient breadth to ensure that they are prepared to pursue a wide range of professional career options. Effective and regular career guidance is essential and should be provided by the mentor and the institution.
Commitments of Postdoctoral Appointees

- I acknowledge that I have the primary responsibility for the development of my own career. I recognize that I must take a realistic look at career opportunities and follow a path that matches my individual skills, values, and interests.

- I will develop a mutually defined research project with my mentor that includes well-defined goals and timelines. Ideally, this project should be outlined and agreed upon at the time of the initial appointment.

- I will perform my research activities conscientiously, maintain good research records, and catalog and maintain all tangible research materials that result from the research project.

- I will respect all ethical standards when conducting my research including compliance with all institutional and federal regulations as they relate to responsible conduct in research, privacy and human subjects research, animal care and use, laboratory safety, and use of radioisotopes. I recognize that this commitment includes asking for guidance when presented with ethical or compliance uncertainties and reporting on breeches of ethical or compliance standards by me and/or others.

- I will show respect for and will work collegially with my coworkers, support staff, and other individuals with whom I interact.

- I will endeavor to assume progressive responsibility and management of my research project(s) as it matures. I recognize that assuming responsibility for the conduct of research projects is a critical step on the path to independence.

- I will seek regular feedback on my performance and ask for a formal evaluation at least annually.

- I will have open and timely discussions with my mentor concerning the dissemination of research findings and the distribution of research materials to third parties.

- I recognize that I have embarked on a career requiring “lifelong learning.” To meet this obligation I must stay abreast of the latest developments in my specialized field through reading the literature, regular attendance at relevant seminar series, and attendance at scientific meetings.

- I will actively seek opportunities outside the laboratory (e.g. professional development seminars and workshops in oral communication, scientific writing, and teaching) to develop the full set of professional skills necessary to be successful for my chosen career.

- At the end of my appointment, in accordance with institutional policy, I will leave behind all original notebooks, computerized files, and tangible research materials so that other individuals can carry on related research. I will also work with my mentor to submit the research results for publication in a timely manner. I can make copies of my notebooks and computerized files, and have access to tangible research materials which I helped to generate during my postdoctoral appointment according to institutional policy.
Commitments of Mentors

• I acknowledge that the postdoctoral period is a time of advanced training intended to develop the skills needed to promote the career of the postdoctoral appointee.

• I will ensure that a mutually agreed upon set of expectations and goals are in place at the outset of the postdoctoral training period, and I will work with the postdoctoral appointee to create an individual career development plan.

• I will strive to maintain a relationship with the postdoctoral appointee that is based on trust and mutual respect. I acknowledge that open communication and periodic formal performance reviews, conducted at least annually, will help ensure that the expectations of both parties are met.

• I will promote all ethical standards for conducting research including compliance with all institutional and federal regulations as they relate to responsible conduct in research, privacy and human subjects research, animal care and use, laboratory safety, and use of radioisotopes. I will clearly define expectations for conduct of research in my lab and make myself available to discuss ethical concerns as they arise.

• I will ensure that the postdoctoral appointee has sufficient opportunities to acquire the skills necessary to become an expert in an agreed upon area of investigation.

• I will provide the appointee with the required guidance and mentoring, and will seek the assistance of other faculty and departmental/institutional resources when necessary. Although I am expected to provide guidance and education in technical areas, I recognize that I must also educate the postdoctoral appointee by example and by providing access to formal opportunities/programs in complementary areas necessary for a successful career.

• I will provide a training environment that is suited to the individual needs of the postdoctoral appointee in order to ensure his/her personal and professional growth. I will encourage a progressive increase in the level of responsibility and independence to facilitate the transition to a fully independent career.

• I will encourage the interaction of the postdoctoral appointee with fellow scientists both intra- and extramurally and encourage the appointee’s attendance at professional meetings to network and present research findings.

• I will ensure that the research performed by a postdoctoral appointee is submitted for publication in a timely manner and that she/he receives appropriate credit for the work she/he performs. I will acknowledge her/his contribution to the development of any intellectual property and will clearly define future access to tangible research materials according to institutional policy.
• I recognize that there are multiple career options available for a postdoctoral appointee and will provide assistance in exploring appropriate options. I recognize that not all postdoctoral appointees will become academic faculty. To prepare a postdoctoral appointee for other career paths, I will direct her/him to the resources that explore non-academic careers, and discuss these options.

• I will commit to being a supportive colleague to postdoctoral appointees as they transition the next stage of their career and to the extent possible, throughout their professional life. I recognize that the role of a mentor continues after the formal training period.

This compact serves both as a pledge and a reminder to mentors and their postdoctoral appointees that their conduct in fulfilling their commitments to one another should reflect the highest professional standards and mutual respect.


ALTERNATIVES TO

ACADEMIA
More biologists but tenure stays static

It’s official: biology postgraduates in the United States face greater competition for tenure than ever before. A wealth of data released this month will reopen discussions about employment and training in the US biomedical system.

The data, compiled by the Federation of American Societies for Experimental Biology (FASEB) (opa.faseb.org/pages/PolicyIssues/American Societies for Experimental Biology), are from many sources, including the US National Science Foundation (NSF), the Council of Graduate Schools and the National Institutes of Health (NIH). And one message is clear: increasing numbers of bright young students are eager for a career in biology and biomedicine, but fewer than before will gain the coveted tenured academic positions.

NSF data show that the number of students in US graduate programmes in the biological sciences has increased steadily since 1966. In 2005, around 7,000 graduates earned a doctorate. But the number of biomedical PhDs with academic tenure has remained steady since 1981, at just over 20,000. During that period the percentage of US biomedical PhDs with tenure or tenure-track jobs dropped from nearly 45% to just below 30%.

So where do all the graduate students end up?

The percentage of biomedical PhDs going into industry has tripled, from 10% to 30%, since the 1970s, the NSF reports. But those who stay on the academic track face a more arduous slog than before.

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So where do all the graduate students end up?

The percentage of biomedical PhDs going into industry has tripled, from 10% to 30%, since the 1970s, the NSF reports. But those who stay on the academic track face a more arduous slog than their mentors. Although numbers of applicants for postdoctoral fellowships awarded by the NIH increased between 2002 and 2006, the percentage who were successful dropped sharply (see graphic above). And the average age of scientists earning their first R01 grant — the NIH’s bread-

Is baby DVD research Mickey Mouse science?

The Walt Disney Company is going toe-to-toe with the University of Washington in Seattle after a study by the university’s researchers suggested that exposure to DVDs and videos for babies, including Disney’s Baby Einstein, could be associated with poorer language development.

One of the team, professor of paediatrics Dimitri Christakis, was widely quoted as saying “I would rather babies watch American Idol than these videos.”

Robert Iger, Disney’s chief executive, says the study’s “methodology is doubtful, its data seem anomalous and the inferences it posits unreliable”. In a letter to the university, he accused it of issuing a “deliberately misleading, irresponsible and derogatory” press release. “Whether your university is comfortable associating its name with analysis of this quality is, of course, your decision,” he wrote. “And I would not be reaching out to you if all that was at stake was a poorly done academic study.”

What is at stake is a million-dollar industry in such products for babies. A full set of Baby Einstein DVDs costs US$369.99. Baby Einstein packaging says it “is not designed to make babies smarter”, but detractors claim such products are marketed as educational.

“Disney is expecting the brand to bring in $1 billion by 2010,” says psychologist Susan Linn of Harvard Medical School in Boston, Massachusetts, and a founder of the Boston-based Campaign for a Commercial-Free Childhood, a group opposed to marketing to children. In May 2006 the campaign asked the US Federal Trade Commission (FTC) to investigate Baby Einstein and Brainy Baby of Alpharetta, Georgia, another leading manufacturer of baby videos, for “engaging in deceptive acts and practices”. They were backed by the American Academy of Pediatrics and the American Academy of Child and Adolescent Psychiatry. The complaint is still being considered.

Linn sees the entire ‘baby industry’ becoming more litigious. “We can expect more of this kind of corporate intimidation,” she warns. “Disney is on the defensive and they’re going to come out swinging.”

The study, published online earlier this month (F. Zimmerman et al. J. Pediatr. doi:10.1016/j.jpeds.2007.04.071; 2007), found that babies aged 8 to 16 months who watched such videos scored lower than other babies on the Communicative Development Inventory (CDI), a standard tool used to gauge language development in infants. Babies that watched an hour a day scored 17 points lower on the CDI scale — corresponding to knowing seven fewer words than a typical baby in the study who did not watch the videos, the researchers say.

Lead author Frederick Zimmerman suggests several explanations for their findings, including the fact that parents worried about their child’s language development might turn to the videos. But “it is possible that heavy viewing of baby DVDs/videos has a deleterious effect on early language development,” he says.

The study was press-released by his university under the headline “Baby DVDs, videos may hinder, not help, infants’ language development”. University president
and-butter grant to an independent researcher — has risen from 34 in 1970 to 42 now.

The percentage of PhDs still in a postdoctoral fellowship three or four years after their doctorate has declined since 1997, from 45% to 30%, although the total number of postdocs grew from about 25,000 to 33,000 in the same period.

What does this mean for biology and biomedicine as a career option? It's more than an abstract question to Howard Garrison, director of FASEB's office of public affairs, who has a college-bound daughter. "She's thinking of biology and biological sciences, so I tell her don't give up, but..."

Garrison says. "People are drawn to the biological sciences, so I tell her don't give up, but..."

"You're thinking about 'alternative careers' before ever setting foot in graduate school, then you're being foolish," says Jodi Lubetsky of the Association of American Medical Colleges.

Norka Ruiz Bravo, deputy director for extra-mural research at the NIH, says the agency welcomes the FASEB report: "FASEB has performed a very useful and timely service for the biomedical research community in highlighting this important issue. It is a matter of great interest and concern for NIH." The NIH recently instituted the Pathways to Independence awards, which help postdocs set up their own labs.

A posting to an online careers discussion group puts the matter bluntly: "If you aren't thinking about 'alternative careers' before ever setting foot in graduate school, then you're being foolish."

Erika Check
See Editorial, page 839.

Let down by the statistics

Most claims that men and women are affected differently by disease-associated gene variations are poorly founded. A team of researchers has found that the data supporting such claims are often poorly analysed statistically or come from studies that were not adequately designed to show these links.

"The abysmal standard of statistical analysis in much of genetic epidemiology is little short of scandalous," says David Balding, professor of statistical genetics at Imperial College London, UK, who was not involved in the study. "This paper reveals an entire industry of prominently reported results that are largely unjustified and probably mostly false."

John Ioannidis and his colleagues at the University of Ioannina School of Medicine in Greece evaluated 432 claims in 77 research papers (N. Patsopoulos et al. J. Am. Med. Assoc. 298, 880–893; 2007). The team applied a set of criteria to determine whether the papers' authors had performed the correct analysis, such as comparing like with like, and had taken steps to show that the association was not due to chance. Worryingly, only 12.7% of claims satisfied these criteria. "There is quite a gap between what should have been done and what the journals and reviewers should have asked for, compared with what the authors did," says Ioannidis.

Many studies were not designed to test for a link between sex and gene variants, with researchers trying to extract associations from their data after the fact. Sample sizes were at least ten times smaller than they needed to be to yield statistically robust results, Ioannidis adds.

"This paper tells us that we don't have a clue whether gender is a real biomarker for any of the clinical areas assessed," says Howard McLeod, director of the UNC Institute for Pharmacogenomics and Individualized Therapy in Chapel Hill, North Carolina. "Gender, as well as age and race, are crude ways of understanding the complex factors regulating clinical effect," he adds.

Claire Ainsworth

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Salaries in Industry (2008)
from respondents to surveys in Genome Technology

Median salaries in pharma and biotech, separated by company size.
Small company: <500 employees
   VP, director, senior manager   $125K-$150K
   Senior scientist/ researcher/ technologist $85K-$100K
   Staff scientist/ researcher/ programmer $60K-$75K

Midsize company: 500-4999 employees
   VP, director, senior manager   $175K-$200K
   Senior scientist/ researcher/ technologist $100K-$110K
   Staff scientist/ researcher/ programmer $100K-$110K

Large company: 5000+ employees
   VP, director, senior manager   $175K-$200K
   Senior scientist/ researcher/ technologist $110K-$125K
   Staff scientist/ researcher/ programmer $75K-$85K

Government agency:
   VP, director, senior manager   $125K-$150K
   Senior scientist/ researcher/ technologist $100K
   Staff scientist/ researcher/ programmer $85K-$100K

Raises/ Paycuts. First number is fraction that got a raise in the past year, second is last raise was 6% or more, and third number is fraction that had a pay cut in the past year
   Pharma/ biotech     83%, 31%, 2%
   Academic           75%, 24%, 4%
   Government         82%, 19%, 2%

Layoffs. The following is percent respondents who said their company had layoffs in the past year.
   Pharma/ biotech     42%
   Academic           25%
   Government         29%

Movin' out. The following is percent respondents who said their last employer is no longer in business (first number), expect to leave their organization to find a new job in the next 1 year (second number).
   Pharma/ biotech     12%, 24%
   Academic           8%, 24%
   Government         8%, 19%
   (Note- this would include postdocs and technicians, too)
Becoming a scientist isn’t easy. Earning a Ph.D. is just one step in the long journey to professional fulfillment. Then comes a postdoc or three, and maybe a multiyear probationary period. Most scientists are in their mid-30s by the time their real careers get under way. And the payoff—the opportunity to spend the rest of your life working really hard on interesting projects—brings with it a decent, but usually not great, salary.

Fortunately for the profession, most scientists seem willing to put up with those challenges. Those who responded to the third salary and employment survey by AAAS report job satisfaction at just a shade below “very good.” “I can’t believe I’m getting paid for this!” says Bonny Dickinson, an assistant professor at the Research Hospital for Children at the Louisiana State University Health Sciences Center in New Orleans. And in a year when most workers saw their real incomes fall or stagnate, life scientists report receiving modest but significant salary gains. “I think my compensation is good,” says Linval DePass, executive director of nonclinical safety at Durect Corp., a Cupertino, California, specialty pharmaceuticals company. “I think salaries are increasing, particularly in the area where I work.”

For life scientists, 2005 was a pretty good year. Full-time academic life scientists—the largest group in our survey—reported earning 5.4% more this year, on average, than they did the previous year. That’s well above the 3.4% rate of inflation. Full-time scientists in industry did quite a bit better, earning a boost of nearly 10%. To no one’s surprise, the salaries of industrial scientists with doctorate degrees far outpace those of their academic colleagues, with means of $116,000 and $78,000 respectively. That difference, coincidentally, nearly matches the $40,000 average salary being collected by academic postdocs in 2006.

Still, even those academic workhorses are doing a little better than in the past. Salaries for postdocs—17% of respondents—rose by an average of 8.1%, more than double the inflation rate. Postdocs in industry had a blockbuster year, earning 19% more. (One caveat to the postdoc numbers: Some of the respondents may be first-year postdocs, meaning the comparison may be to what they were earning as graduate students.)

Despite the rising tide, large disparities remain. Even excluding industrial scientists, scientists in certain disciplines earned far less than their colleagues did. Developmental biologists with doctoral degrees who work in academia, for example, earned a median salary of just $45,000, whereas Ph.D. pharmacologists earned $99,000. Academic developmental biologists gained some ground, however, earning 7% more than last year, compared to a 2% average raise for Ph.D. toxicologists.

How the survey was conducted
The survey targeted U.S.-based life scientists. We sent e-mail invitations to 41,000 AAAS members and 12,000 free registrants on the Science magazine Web site. Kelly Scientific Resources
also participated in the survey by polling some 12,000 of their employees, whose responses were combined with the rest of the survey data.

The overall response rate was 7%—just over 4500 scientists—of whom 62% are employed in academia. Some 35% work in industry, government, or the nonprofit sector, and 3% are self-employed. Some 43% of survey respondents are women, three-quarters hold doctoral-level degrees, and 22% are nonwhite. Nearly 9 in 10 are U.S. citizens or permanent residents.

The information collected goes well beyond their paychecks. They were asked where they work and for how long, what they do, and how satisfied they are. (Of the 12% working on temporary visas, for example, half report that their immigration status has caused “job security/pay issues,” and 23% said that they faced “challenges obtaining grants.”) We also invited them to make comments and interviewed several people who agreed to be quoted.

Despite the considerable challenges of a scientific career—relatively low pay, long hours, a very long training phase, and a tight job market—scientists say they enjoy the work. Survey respondents rated their job satisfaction as 3.7 on a 5-point scale, between “good” and “very good.” The finding is similar to those of the two previous surveys (Science, 18 June 2004, p. 1829, and 12 October 2001, p. 395), suggesting that scientists’ happiness is not a new phenomenon.

You might think that postdocs, with their low salaries, poor job security, and often-poor working conditions, would be less happy than most other scientists. They were—but not by much. Postdocs rated their job satisfaction at 3.5, midway between “good” and “very good.”

So what makes scientists happy? Surely it’s not simply how much they’re paid; compared to the earnings of those in other professions requiring similar training, scientists’ salaries remain quite low. But our survey showed that salary is one of many factors determining job satisfaction. People who rated their salary “excellent”—a 5—were also more than three times as likely as the average survey respondent to rate their overall job satisfaction as “excellent.”

But a closer look at the connection between salary and job satisfaction shows that the correlation really isn’t all that strong. A linear regression analysis of job-satisfaction versus salary shows that whereas scientists who earned $150,000 rated their job satisfaction as “very good,” scientists earning barely one-fifth as much were only slightly less satisfied. Furthermore, scientists who

Look who’s talking. Survey respondents are well-distributed by age and most likely to be white male Ph.D.s working at an academic institution.
work in industry report exactly the same level of job satisfaction as their lower-paid colleagues in academia.

What else affects scientists’ job satisfaction? Among the most important factors are promotion opportunities, job security, and intellectual challenge. Our follow-up interviews identified still other factors and gave a more nuanced view of scientists’ deepest professional desires.

Moving ahead
Traditionally, Harvard University has been notoriously stingy with tenure. But neuroscientist Florian Engert says times have changed, at least in his corner of the Yard. “I can think of five people who have gotten tenure in the last few years,” he says, “and only one who hasn’t.” (A Harvard administrator told Science, “We have not released tenure numbers in the past and would not do so at this time.”) Accordingly, Engert, who comes up for tenure in 2 years, rates his job satisfaction as “excellent.”

Engert, an associate professor in Harvard’s Department of Molecular and Cellular Biology, studies vision and cognition by monitoring brain activity in zebrafish. Engert’s “excellent” job-satisfaction rating is consistent with the fact that people who rated their promotion opportunities as “excellent” were four times more likely than average to rate their job satisfaction as “excellent,” too.

Likewise, immunologist Kathleen Hoag of Michigan State University in East Lansing loves her job despite the long hours—“It’s fun! Intellectually challenging! Tiring!”—and rates her chances of getting tenure this year as “almost certain.”

The correlation is even stronger in the other direction. Those who rate their promotion opportunities “very poor” are seven times more likely than average to register low job satisfaction. Many postdocs and soft-money researchers find themselves in precisely that position.

“To start a scientific career is very challenging, and the returns are not very good,” says Rahul Sharma, a research instructor at the University of Virginia in Charlottesville, who sees his promotion opportunities and job satisfaction as “very poor.” Likewise, immunologist Kathleen Hoag of Michigan State University in East Lansing loves her job despite the long hours—“It’s fun! Intellectually challenging! Tiring!”—and rates her chances of getting tenure this year as “almost certain.”

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Campus costs. Postdocs in academia earn less than do their colleagues at other sites.
doc,” he says. Besides paying him better, such a job would give him the chance to write his own grant proposals and leverage any funding into a position with greater stability. “Until you are a tenured faculty member, the career doesn’t really start,” says Sharma, who plans to reassess his situation in a couple of years if his prospects haven’t improved.

The right fit
Whereas job security boosts professional satisfaction, our survey found, there’s no sure path to fulfillment. Ken Nussbaum, a veterinary epidemiologist at Auburn University in Alabama, sees a “burgeoning need” for animal experts in public health, and he wants to help fill that need. Nussbaum has tenure. But he gives himself a 1 for job satisfaction, and he’s in the job market.

“I seem to have plateaued academically,” Nussbaum says. “I don’t wish to continue highly technical lab work, yet I have training that I hope will be transferable to the field of public health. I’d like to spend a couple of years working in public health or step back into more concentrated classroom teaching.” Although his efforts to enter the public-health field are going well—he has had a paper accepted at an important meeting—he hasn’t yet succeeded in finding a new job.

Steve Verhey has also struggled to mesh his work with his values and ambitions. When he completed the survey, Verhey was a self-described “lame-duck” assistant professor of cell biology at Central Washington University in Ellensburg, where he had just been denied tenure. His frustration at not being recognized for focusing on teaching at the predominantly undergraduate institution was reflected in his self-rating of 1 for job satisfaction.

But concentrating on research wasn’t a viable option, either, he says, because of the lack of resources—such as lab space—and a balky infrastructure. “The thing that got me the most was the purchasing system,” he says. “Suppliers are set up so that you can call, and they’ll ship it the next day.” But at Central Washington, he says, orders might languish for a week. “Not conducive to doing real research,” he says.

So Verhey went out and founded his own biodiesel company. In the process, he raised his job satisfaction to a 5. “I’m having more fun that I ever did in 20 years in academia,” he says. “I’m using things I’ve learned and learning new things—in the real world.”

Although some people may be happy to labor in obscurity, our survey identified “recognition and prestige” as one of the most important factors in determining job satisfaction. People who gave the top mark to the “recognition and prestige” of their jobs were 3.5 times more likely than average to rate their overall job satisfaction just as high. On the other end, those who gave “recognition and prestige” a 1 were four times more likely than average to give their overall job satisfaction the same poor rating.

In interviews, individual scientists are loath to cite recognition and prestige as keys to professional happiness. But Peter Koulen, a tenured full professor at the University of North Texas Health Science Center in Fort Worth, readily admits that prestige—including institutional prestige—has important practical consequences. “A lot of professional success critically depends on the name of your institution, which, if peer review works the way we think it works,
should not be the case,” says Koulen, who has also worked at Yale University and at the Marine Biological Laboratory in Woods Hole, Massachusetts. “I think the quality of my science has not changed, but the work that I have to do to get my science published or funded is multiple times harder here.”

Carol Sibley, a full professor in the recently created genome sciences department at the University of Washington, Seattle, says she enjoys “excellent” job satisfaction but is considering a change nonetheless. “I’m 62, [and I] still have lots of energy and interest. But at some point you think, ‘I’ve been a prof all this time; maybe there are other ways to apply my skills.’ ”

Sibley, who studies the two malaria parasites, would like her work to have more direct relevance to public health. “I study drug resistance. As you work on that at the basic-science level, you get more and more interested in how we can slow this [disease] down.” Living in the city that’s home to the Bill and Melinda Gates Foundation and other organizations focused on world health, she acknowledges that she has many opportunities. But she wants one with modest travel requirements. “One of the minuses is that the folks I know travel a huge amount—more than I want to,” she says.

The right location
Geography, too, can have a big impact on scientists’ job satisfaction. Scientists who rated their geographic location “not satisfactory” were three-and-a-half times more likely than other respondents to suffer from low job satisfaction. Christopher Dougherty, a soft-money research professor at Florida Atlantic University (FAU) in Boca Raton, studies the genetics of age-related macular degeneration. His goal is something more remunerative and secure.

But he and his wife prefer to stay in town so their 6-month-old son can get to know his grandparents, who live nearby.

Dougherty’s solution is to wait for the jobs to come to him. Scripps Research Institute has just committed to opening a new research facility—with a research agenda that matches up well with Dougherty’s focus on the genetics of geriatric diseases—on FAU’s other campus in nearby Jupiter. Scripps is expected to attract a cluster of new biotech companies to the area.
But just as some scientists are limited by geography, others are aided by it. “I’ve worked in the [San Francisco] Bay area, which is a very strong area for biotech,” for 22 years, says Durect’s DePass. “Because of that, there is considerable competition for good people,” which contributes to an increase in salaries.”

The satisfaction of older scientists
Conventional wisdom and at least a few scholarly articles suggest that scientists do their most creative work when they’re still young. Our survey indicates, however, that it’s older scientists who find their work most satisfying. The upward trend in job satisfaction begins at 35, but our survey found the biggest jump at 55.

So why are older scientists happier? One reason may be that they get paid a lot more than their junior colleagues do. Everyone knows that older workers earn more than younger ones, but our survey showed that in the life sciences the trend is stronger and continues longer than in the general population. Academic life scientists above 65 reported mean salaries of $133,000, more than three times as large as those in the youngest (25 to 34) age group, who earn a mean of $41,000. For the general population, the ratio of peak earnings to early-career earnings is only 1.24, according to the Bureau of Labor Statistics. BLS data also show that workers in the general population achieve peak earnings between 45 and 54, whereas in our survey, the very oldest science workers also report the very highest salaries.

So although young life scientists earn only a little more than the typical American worker, their salaries increase much more steeply, and the increases persist. That pattern makes sense to David Inouye, a 56-year-old ecologist and conservation biologist at the University of Maryland, College Park. He says his job satisfaction “stems in part from the success of a graduate program that I started 18 years ago.” On the research side, the full payoff was also slow in coming.

“In terms of research, much of what I do now builds upon work that I started as a graduate student in 1973,” he says. “So part of the age-satisfaction correlation, at least in my own case, comes from having laid the groundwork decades ago for work that is still ongoing and being very fruitful now.”

For Ananda Lugade of Luminex Corp. in Austin, Texas, the correlation has a simpler explanation: She just didn’t find the right job until she was older. “I could not get satisfaction at an early age,” she wrote in an e-mail. “I got an opportunity to make some good contributions,” she says—but only after she reached 45.

Mentorship and guidance
So what about younger scientists? Our survey did not address directly the issue of mentorship, but almost all the young scientists we interviewed call this an important factor. Michigan State’s Hoag is grateful that her department has faculty mentoring committees, which are available to advise all probationary faculty members. Hoag’s department offers all faculty members an annual review, which allowed Hoag to be clear on what was expected of her and how well she was meeting those expectations. That knowledge has been an important element of her professional contentment.

Kathryn Shows, a postdoc at Virginia Commonwealth University in Richmond who studies the genetic disorder Treacher Collins syndrome, credits her postdoctoral adviser and mentor for helping her return to science after leaving to start a family: “She encouraged me to come back, and she’s been like a cheerleader for me, understanding that I have a life outside the lab.” Shows also feels she’s getting the kind of training she needs to develop into an independent academic scientist. “I’ve always been interested in genetics and cannot imagine studying anything else. I [also] cannot imagine being anywhere else than at a university.”

Dickinson—the Louisiana State immunologist who said she couldn’t believe she’s getting paid for the interesting work she’s doing on the mechanism of cholera, among other things—credits her mentor, Seth Pincus, for making a big difference in her professional life. “I’m happy to be a part of a team working under his leadership,” she says. She especially admires how Pincus got the lab back up and running 6 weeks after Hurricane Katrina devastated New Orleans.

Despite her overall satisfaction, she admits the fit isn’t perfect. Her institution isn’t large, and compared to Harvard, where she did a postdoc, its approach to science is a bit low-key, she says. “It’s a little bit isolating,” she confesses. “I gave a seminar yesterday, but there were so few people there. I spent so much time preparing, and nobody gave me any feedback. Sometimes I really miss Harvard, where people are very excited. It’s not like that here; come 5 o’clock, it’s hard to find people.”

Salary matters for Dickinson. But what matters most is the peace of mind it buys. “I make $84K,” Dickinson says. “I would still do it at $65K, [but] I’d be spending more time worrying about finances and so on.” In the meantime, she says, her life is good. “My experiments are going well. I feel blessed.”

Another factor our survey didn’t address directly—but that came up repeatedly in comments and interviews—is the importance of good colleagues. And Michigan State, with the sixth largest student body in the United States and a faculty to match, offers Hoag plenty of those. “I can pretty much know that I can get advice or expertise, or even a new collaborator, in just about any new direction my research might move in,” she says.

Also important, says Hoag, is “the demeanor of the individuals that I work with. My office, my main colleagues in the diagnostics program faculty—we’re a team. Everyone is a team player, very entrepreneurial, always looking for new ways to reach the public. It’s so exciting,” she adds. “Nobody could possibly become deadwood.”

Jim Austin is the editor of ScienceCareers.org.

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Golden years. Scientists’ salaries keep rising throughout their careers.

“It’s more than 7 years since I got my Ph.D., and I’m still struggling to start my career.”

Rahul Sharma
Crossing Over

From Genome Technology, October 2005 issue

By Meredith W. Salisbury

In generations of scientists past, there was a clear distinction between those who worked in industry (that is, big pharma) and those whose careers played out from start to finish in academic labs. Today, with small biotechs thrown into the mix and a growing breed known as 'scientist-entrepreneurs,' the lines between public and private sector are increasingly blurred.

While it’s much less unusual these days for scientists to go back and forth between academia and industry, it’s still not common practice. Curiosity abounds with researchers on both sides of the divide: what’s it like on the other side? And, more importantly, if I try it out and don’t like it, can I come back?

Genome Technology interviewed a number of scientists who have done just that. They’ve crossed the fence and, in many cases, crossed back over — usually with no permanent damage done to their careers, and more often than not to greater opportunities than they likely would have had without the job zigzag. In remarkably candid discussions, these people offer their experiences and advice to help you determine whether a career shift is in order, and what it will take to accomplish the jump. (Hint: If you’re looking to make a decision based purely on salary, don’t waste your time reading ahead. Proceed directly to industry. What have you been waiting for?)

Similarities and Stereotypes

Let’s get the basics out of the way first: what do industry and academia have in common, and just how different are they?

It’s no secret that some academics tend to imagine their private-sector counterparts as researchers clad in expensive suits who have sold — well, not their soul, but certainly that part of the brain from which interesting and biologically relevant scientific questions spring. These are people who ignore the greater questions of science in their pursuit of a magical product that goes “cha-ching!” Conversely, of course, there’s no shortage of industry researchers who look at their academic peers as mad-scientist types who chase down answers to impossibly huge (and sometimes useless) questions at the expense of coming up with meaningful results that could have an impact today. These people wouldn’t know a bottom line if it bit them on their Birkenstock-clad toe.

As with all stereotypes, there’s a grain of truth lurking somewhere in there; fortunately, as these worlds come closer and closer, scientists can see for themselves that those grains of truth are awfully small parts of the story.

Finance is one of those grains of truth, and the need for private-sector scientists to think in commercial terms is simply undeniable. “In industry the metrics for success or failure are very clear,” says Steve Lincoln, vice president of informatics at Affymetrix, who spent seven years at the Whitehead Institute and had a stint at the Cold Spring Harbor Laboratory before heading to what he jokingly refers to as “the dark side.” “In the end, did you bring in more money than you spent?” Because of the company’s fundamental need to turn a profit, industry scientists might have to abandon certain projects or work on projects that they otherwise wouldn’t have chosen to work on, points out David Ginzinger, director of scientific operations at Applied Biosystems, who spent the first eight years of his career at the University of California, San Francisco. Academics,
of course, can afford to be more dedicated to their projects — often even after grant funding has run out.

Of course, the focus on the bottom line means that scientists at commercial enterprises might not have as much freedom to delve to the bottom of a biological problem for the sake of knowledge. “They [don't] necessarily have to, in their minds, completely identify and solve the problem to convert it to a commercial opportunity,” says Michael Liebman, director of the Windber Institute and former pharma scientist.

“Pharma, I would have to say, doesn’t invest in really understanding the disease from the clinical perspective to come up with a solution that’s commercially viable.”

Still, having that finance metric means that success can be easier to pin down in industry, points out Brian Gilman, a former team leader at what is now the Broad Institute who has since started up his own consulting firm, Panther Informatics. In the corporate environment, he says, “you’re praised for what do you, how well you do it, and how well you manage it. In academia that’s not always the case. Sometimes in academia it doesn’t matter how well you do it; it only matters where you came from, whose lab you came out of.”

Lincoln notes that the proxy measure of success that academia has adopted — the peer review process — is hardly objective. Even if it were, it would still be difficult to truly appraise someone’s work: “In academia, in many cases, how important your research is might not become clearly understood for perhaps a decade,” Lincoln says.

Another difference between academia and industry is how team-oriented people tend to be, Liebman says. “Academia tends to polarize people, each [creating] their own individual research empire,” he says. Industry researchers probably have more incentive to work together in team environments.

ABI’s Ginzinger notes yet another distinction: “The pace of change here is considerably different” than what he was used to in academia. “You have to turn on a dime sometimes, and you have to be prepared for that.” Many of the experts GT interviewed underlined the differences between pharma and biotech, and this element is probably one that’s affected by that. Pharmas, with their thousands-strong staff rosters, are considered slow-moving and are more comparable to academia; smaller biotechs, on the other hand, are known for their nimble dynamics and rapidly shifting environments. “My [academic] friends who go into discovery research in pharma say it’s almost the same,” says Gilman of Panther Informatics.

All that said, however, there are still similarities between academic and corporate organizations. Ginzinger says that contrary to the academic prejudice that industry is where science goes to die, “There’s still a lot of science on the industry side … [and] a lot of publication from industry.” He adds, “I think that’s a fear people have, that it’s impossible to publish [in a corporate setting]. In some companies, it’s actively encouraged.”

Also, the basic means of getting science done and getting ahead are essentially the same on both sides of the fence, according to Steve Lincoln at Affymetrix, who says, “They’re all about networking in both cases. Opportunities are things that happen for you by and large because of people you know.”

**Perks and Pay**

Getting down to brass tacks, the most obvious and tangible distinction between academia and industry is the salary. “Look, salaries in academia are not as good,” says Jill Mesirov, CIO of the
Broad Institute, who has in the past worked for IBM among other places. She says the difference is “at least on the order of 25 percent or more less pay” for academics.

Postdocs taking on a staff scientist position in industry stand to double their pay, according to Ginzinger. “If you’re in a higher level position, it might increase by 50 percent.” Gilman says that when he went from a startup to a public-sector research institute, he took a 50 percent pay cut for the move.

The annual Genome Technology salary survey bears out these claims. On average, a pharma or biotech staff scientist made between $75,000 and $100,000, whereas the same position in academia commanded between $50,000 and $75,000, according to data from this year’s survey. Senior academic scientists fell into the same range as the academic staff scientists, while in industry a senior scientist position went up to between $100,000 and $125,000 for people in large pharma or biotechs. Lab techs made between $30,000 and $50,000 in academia, while their industry counterparts took in between $50,000 and $75,000.

But Lincoln says that recent trends have served to boost academic salaries to some extent. “In the area of bioinformatics and some of the fields that were trendy for a while, the academic salaries for staff members have gone up considerably,” he says. “I think that’s in part a reaction to needing to be at least somewhat competitive with industry … to retain high-quality talent.”

Salary, of course, is only part of the compensation package story. When it comes to other benefits — such as health insurance — scientists agree that academic and industry scientists are on much more even ground. Both sides have retirement plans, although Ginzinger says universities “typically don’t have a matching component” to their plans. (Of course, plenty of startups don’t, either.) Stock options are a notable perk unique to industry, but after the rocky rides of so many biotechs in the past several years, “the attraction of stock options has reached perhaps a more reasonable level,” Lincoln says.

One area where public-sector institutions may have an advantage is in IP rights, according to Michael Liebman at Windber. There’s an opportunity now “to share in ownership of intellectual property and things of that nature … because of the way universities are valuing this in their long-term planning,” he says. In industry, typically anything you create is by default the property of your company.

**Academia to Industry**

The longstanding tradition of moving from academia to industry means that most public-sector scientists aren’t too worried about being able to jump the fence, at least in this direction. In 1987, Michael Liebman made the leap from Mount Sinai Hospital in New York to Amoco because his research was happening “at the very earliest time in bioinformatics, and the problem was that it was very interdisciplinary and academics in 1987 was not interdisciplinary at all. So the opportunity to look at industry, which was interdisciplinary, was very attractive.”

Ginzinger, who was working at the Comprehensive Cancer Center Genome Analysis Facility at UCSF, was looking for more “growth potential” than life at a core lab offered. ABI beckoned, and off he went.

Gene Myers famously made the leap to industry from the University of Arizona, where he had developed a bioinformatics tool that looked like it could be quite useful for the human genome. Myers says despite his concerns about leaving academia, he couldn’t turn down the opportunity to go work on the landmark project, so he joined Celera.
For years, academic scientists — often postdocs — have moved to industry seeking better-paying pastures. For most people, it will be a “fairly seamless” transition, says Myers, “in the sense that when you go to a company you’re usually hired into a specific position with a specific mandate and budget.” Myers adds that he took into consideration the other people who would be working at the company when he was trying to make his decision.

Still, there can be wrinkles. Industry work tends to demands a set of skills — financial and managerial, in particular — that are usually not a part of the academic scientist’s repertoire. “The primary limitation to getting into industry is that you are not a person, if you are from academia, that understands certain standard operating procedures,” says David O’Hagan, who has bridged the academia-industry gap more than once and currently works for the Burnham Institute while starting up his own company called Ampliprot. Plus, academics have to get used to having much less freedom to carve out their own research goals in a corporate setting. It can be “a rude awakening when somebody says no, you can’t do that experiment,” Gilman says.

But there are plenty of ways to leap the fence, no matter what level your career is. Find an opportunity to run a project, advises Ginzinger, who says that project management is a rare skill among academics and one that is highly valued in industry. That will help translate to a private-sector job by giving you an edge over the throngs of academics also sending out their résumés.

Steve Lincoln found his path to industry through a collaboration he was already part of in his academic job; the company got to know him as an academic and was comfortable enough with him that he had no trouble getting hired on. Such collaborations, increasingly common in this field, are particularly good places to make contacts in the private sector that can help when trying to land a job.

Industry to Academia

This career move is decidedly less common than the other way around, but it’s far from unusual. “One of the great attractions to me of coming back into an academic setting was [that] I could focus on the scientific results and a little less on the marketing and revenue-driven stuff,” says Mesirov, whose career path took her from academia to industry and back again. “What really motivates me is the science and the results.”

Myers also left industry when Celera changed direction, and he headed out for a position at the University of California, Berkeley. He says it was the right move for him, but that the transition wasn’t as easy as it had been on the way out. At Berkeley, he says, “I felt a little bit like I was starting over as an assistant professor. I got an office and a startup package, but the students don’t necessarily know who you are.” It takes time to attract students and grants — a couple of years. “At a university, you’re an independent entrepreneur, and it takes time to build your group,” he cautions. (Myers has left Berkeley but is remaining in the public sector; he will be one of the first scientists at HHMI’s new Janelia Farm research institute.)

Crossing back to academia is more challenging than going to industry in the first place, experts agree. “There are some people whose names allow them to be able to cross back and forth anytime they want, as many times as they want,” says Linda Kirsch, who runs her own recruiting firm for the life sciences field. “When it comes to people going back into the academic world, it comes down to who can get funding” — and that’s certainly not everyone.

“I think that if you go into industry and you keep up a really strong research profile, then you probably can come back,” says Mesirov. “But if you go into industry and you start doing marketing and sales or something like that, it’s going to be harder.” She recommends that anyone interested in returning to academia maintain “a really strong, current research portfolio.”
It can also just be a matter of time to get back to the public sector. “I know a number of people who have gone back. It certainly can be done,” says Steve Lincoln. “In some cases it involved maybe a step backwards, [or they] had to rebuild some street cred — some publication trail.” He points out that as academic projects get bigger, thanks to models like the Human Genome Project, the need for project management and organizational skills in academia may pave the way for easier transitions for industry folks to cross over.

Ginzinger at ABI notes that moving back and forth can be easier between academia and biotechs than academia and pharma. “We collaborate all the time with academia,” he says, so it’s more likely that a corporate scientist’s name will be known and respected by his or her academic counterparts.

David O’Hagan says that as the public/private-sector divide gets blurrier, a new model is coming into focus — that of the ‘scientist-entrepreneur’ who makes a career of straddling the fence. O’Hagan says he’s done it more than once: while he was working on his PhD at Wayne State University in Michigan, he was recruited by Genomic Solutions to develop its microarray technology. He continued pursuing his degree full-time while also doing technology development as a company employee. Currently, he’s a full-time employee at the Burnham Institute, and is simultaneously starting up a company based on proteomics technology with a fellow Burnham scientist. The startup was part of the condition of working there, he says, so he can split his time between the endeavors. In the future, he predicts, this model of doing both together will become increasingly common in the field.

Which is right for you?

Managing your career means doing more than waiting for opportunities to come knocking, says Linda Kirsch, who has built a career around finding the right person for the right job in the systems biology field. With that in mind, one way to set the goal of your next job — make the leap or stay in your sector — is to consider which side is better suited to your personality.

Entrepreneurial people will do well on either side of the fence, says Jill Mesirov at the Broad. But there are “some people who will get more satisfaction by building and driving a company, by building that revenue stream,” she says. “You just have to understand what drives you.”

Are you willing to move around? Relocating is more often required in a private-sector career, says Michael Liebman at the Windber Research Institute. He says another distinction is whether you get more out of working on a project or building a tool. “If your motivation is solving problems — a practical application of the solution — then I would say industry could be appropriate.” But if you’d rather focus on a research project to really understand a biological problem, for instance, academia might be a better place for you. “They have to know … if they like things versus principles,” he adds.

Brian Gilman, who left academia to run his own startup, says, “You should really think about your adversity to risk.” While this will be less of a factor for academics going to pharma, entry to biotech certainly means taking on an added risk load. “Think about how well you do with high-risk, high-reward type things.” He also says considering your reaction to failure could help. “When you fail, do you sit there and beat yourself up for months on end? Or is it just, ‘OK, I failed, next thing’?” Being able to shake off problems and regroup quickly is a skill you’ll need to work in biotech, he says.

Gilman also says that people who worry they won’t be able to publish in a corporate environment have really answered their own question. “If you feel that way, that publications are your lifeblood,” he says, “you weren’t cut out to [go to industry] in the first place.”
Testing out the other side

There are a number of ways to get your feet wet without leaving the island.

Corporate postdoc or internship. “You specifically look for an opportunity to postdoc in the kind of environment that you think you might have an interest in,” says Linda Kirsch. “They’re shorter commitments. People do multiple postdocs, and you get a sense of the kind of projects you like, the size group you like.”

Take a leave of absence. “If you have a faculty job, you can take a sabbatical … and check out what it’s like in an industrial lab,” says Jill Mesirov. Gene Myers, who used this means when he left for Celera, adds, “At least a one-year leave of absence is pro forma. … If you go to industry, a year will be long enough to tell whether you like it or not.” Myers says this can be a good safety net, too: he negotiated a three-year leave when he left for Celera, with a guaranteed return option in case he didn’t like the private sector.

Try an adjunct position. Many universities offer adjunct faculty positions to industry scientists, Mesirov points out. It’s a good way see what academia’s like. If you’re an academic going to industry, hold on to an adjunct position as a safety net — that’s what Michael Liebman did through his corporate career.

Think of the core lab as middle ground. When David Ginzinger was considering heading to industry from academia, he just wasn’t sure — so he went to a core lab to get more business-type experience without leaving the safety of his university environment. It requires fiscal responsibility and managerial skills, he says, but keeps members in touch with the scientific research. He thinks of it as a solution that didn’t close any doors while he figured out his next step.
The Other Side of Publishing

You've gotten your PhD, slogged through a postdoc, and realized that the bench just isn't for you. Maybe you'd be better suited to life at a scientific journal.

By Meredith Salisbury

It's no secret that the bench is not for everyone. But while most people think that leaving the lab means heading straight for sales or marketing in industry, there's another career path that some researchers find more appealing: being an editor at a scientific journal.

It's a job that keeps you engaged in cutting-edge science and puts you in touch with some of the best researchers of the field. Step one toward editorial happiness? Put aside any bias you have that leaving the bench is a cop out, says Chris Gunter, senior editor at Nature. "Don't let anyone tell you that you're a failure because you're not an academic PI."

Gunter, who earned her PhD studying Fragile X syndrome and completed a traditional postdoc, knew early on that academia wasn't going to be the place for her. "I didn't have a burning passion to take one question and follow it through for the next 30 years," she says. During her postdoc, she worked with her PI, Hunt Willard, to arrange a schedule that would let her work both in the lab and at the journal he edited. That training made it possible to get her first job at Science; soon after, she was recruited by Nature, where she now handles all genetics papers.

The most important characteristic of a good editor is "having a very broad interest in research topics," says Jami Milton Dantzker, associate editor at PLoS Biology. She says that people who "really like to focus on the big picture" will find journal work most fulfilling. Dantzker, whose background is in studying neural activity, adds that it helps to be someone who enjoys an intense environment with lots of responsibility. Good editors make time for as many as six conferences a year, she says, in addition to the regular work of juggling authors and reviewers, meeting strict deadlines, and keeping up with the scientific field.

Publishing can also be a path to a range of other careers. "You build a huge network" as an editor, says Gunter, and that can pave the way for jobs in teaching or scientific administration (such as being a grant advisor at NIH). Gunter, for instance, has an adjunct faculty position at the University of Pennsylvania.

So You Want to Be an Editor? Start with These Practical Tips

Ask your advisor for a chance to review. This is good practice even if you aren't considering a career in journal publishing. "I think all advisors should give students chances to review papers," says Gunter. "That's how you learn what is a good paper and what isn't."

Pursue a postdoc, but choose a PI with editorial ties. When Gunter was ready for her postdoc, she decided to join Hunt Willard, who was editor of the journal Human Molecular Genetics. She worked with him on a part-bench, part-journal schedule that gave her a chance to look at papers, suggest reviewers, and even plan and execute two review issues of the publication. "That was great training," she says. Dantzker notes that editors who haven't completed a postdoc tend to start at a lower level.

If possible, write some general science articles. "If you can find some time to write general articles, accessible articles about research, that would definitely be helpful," Dantzker says. This step gives you writing samples to send to journals with job openings, and also lets you see how you fare writing about other people's research.

Try to set up an internship at a journal. Even a short-term stint as an intern will give you a better sense of whether you'll really like life at a journal, says Dantzker. "It's the kind of job where you have to be on every day. A person has to like that intensity."
You can search federal job postings at:
http://jobsearch.usajobs.opm.gov/

and can see current pay tables by clicking "Salaries and Wages" at:
http://www.opm.gov/oca/

States often have their own government job lists: e.g.,
http://www.osp.state.nc.us/jobs/

And there are other government job search engines, such as this:
http://www.jobbankinfo.org/
Research Fishery Biologist, ZP-0482-3

SALARY RANGE: $54,494.00 - 84,913.00 USD per year
OPEN PERIOD: Monday, July 07, 2008 to Friday, August 01, 2008
SERIES & GRADE: ZP-0482-3/3
POSITION INFORMATION: Competitive Service: Career or Career Conditional Full-time Permanent
PROMOTION POTENTIAL: 4 DUTY LOCATIONS: 1 vacancy - Beaufort, NC

JOB SUMMARY:
NMFS is dedicated to stewardship of our nation's living marine resources, and the habitat on which they depend, through scientific research, management, and enforcement. NMFS provides effective stewardship of these resources to benefit the nation, through domestic and international programs supporting coastal communities that depend upon them, while providing safe and healthy seafood to consumers and recreational opportunities for the public.

The incumbent will be working for the NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, at the NOAA Laboratory located in Beaufort, N.C.

The incumbent conducts independent research in fisheries, ecology, or related topics using manipulative experiments or other suitable techniques; determines appropriate quantitative methods for application to various types of field data by using classic parametric and non-parametric statistics, multivariate and spatial statistics, and other analytical techniques such as modeling.

QUALIFICATIONS REQUIRED:

Successful completion of a full 4-year course of study in an accredited college or university leading to a bachelor's or higher degree with major study in biology, zoology, or biological oceanography that included at least 30 semester hours in biological and aquatic science and 15 semester hours in the physical and mathematical sciences.

In addition to meeting the basic entry qualification requirements, applicants must have specialized experience as listed below.

For ZP-III: one full year of specialized experience equivalent to at least ZP-II/GS-9 level in the Federal service which is directly related to the position described under the Major Duties paragraph, -OR-Master's or equivalent graduate degree.
Specialized experience is defined as the following: Professional experience that reflects the ability to design and conduct independent research focusing on fisheries or related living marine resources in an ecosystem context; experience with mathematical modeling applied to natural population, particularly with reference to fisheries ecosystems such as spatial modeling, species interaction modeling, or trophic dynamics modeling. Experience writing proposals for external funding for research on fisheries ecology that were successfully funded.
Notes from Nov. 8, 2002, talk by a former Louisiana State Univ. professor who got a job in the USDA Forest Service

Differences from academia:
- Freedom to explore is more limited, must fulfill mission of the agency
- Can rise (salary and position) faster than in academia
- Promotions determined by a national committee- less direct impact of your own department, which allows for more objective evaluations
- Research funding already built into the job. Allows continuity for long-term projects
- Can implement actions that need to be taken rather than merely writing about them
- More control over time than standard academic position

Similarities to academia:
- Can still advise graduate students (through adjunct appointments) and postdocs
- Promotion determined by research productivity, primarily publications
- Can and encouraged to apply for grants, though NSF and some foundations won't fund government

Application (see www.usajobs.gov):
Personnel office makes the first cut. Determine if you meet the knowledge, skills and abilities required for the job. Important to be explicit in addressing the job ad. Also, make sure that you write such that a non-scientist can understand you. Starting salary in 2002 for a GS-12 (after 2-year postdoc) is $45,000.

Hires begin with a 1-year probation, where it is easy to get rid of people who do not perform well. Subsequent to this is a 3-year probation where it is somewhat more difficult to get rid of people who do not perform well. After that, it is more difficult to fire employees. You can always be fired for "reduction of force" decisions resulting from federal budget cuts.

There are also government non-professional lines, such as technicians. Their GS levels are often based on the job opening rather than the applicant's qualifications. Within each GS grade, there are 10 "steps" that can raise one's salary.
United States Department of Agriculture
Research, Education and Economics
Agricultural Research Service

October 22, 2002

Mohamed Noor
Biology

Dear Dr. Mohamed Noor and 101 Grad Students,

I will gladly share with you and your students my experiences and insights regarding graduate school and seeking employment afterwards.

I have now been on both sides of the fence since obtaining my Ph.D. from New Mexico State University – the academic side as a postdoc, visiting professor and an assistant professor, and recently the government side with the USDA-ARS (United States Department of Agriculture-Agricultural Research Services).

My experience as an Assistant Professor at a small University in Alabama was not satisfying. Though they claimed research was important they provided no setup funds and poor laboratory facilities, yet expected me to write and secure grant funding. Teaching was presumably the main mission of the university however I was not encouraged to expect my students to actually learn anything. All I heard from administrators is that “most of our students are the first generation to attend college”. We had to make special concessions for our students. What it boiled down to is the number of students enrolled meant more money from the state and in tuition. Though my experience with a small university was not palatable I do know that there no doubt is a small university that I could have been satisfied at, but due to my experiences with academe I decided to jump the fence and pursue a career in the government.

I am finding my current position as a molecular biologist studying genetics and marker assisted breeding of honeybees to be quite rewarding. I don’t have whining students to listen to or lectures to write. I go to work and put in 8-12 hours a day then come home to my pets and enjoy my evening. I don’t have to worry about writing a grant to secure tenure. I am expected to write two peer-reviewed journal articles a year. Research is a little bit constrained in that we are mission oriented. We have to keep in mind who we are working for – the people – particularly honey producers, bee breeders and bee keepers specializing in moving colonies to crops for pollination. We need to be able to address problems involving the honeybee industry. Currently we are selecting strains of bees resistant to the varroa mite (the mite that has pushed the bee industry to the brink of extinction). We are also developing strains resistant to the tracheal mite and the bacterium which causes American foulbrood.
Since graduating with my Ph.D. each position I have held I found the advertisement on the internet and I sent my application via e-mail with appropriate attachments (cover letter, CV and any other material requested). Here are the primary web pages I use when looking for positions to apply for:

http://chronicle.merit.edu/
http://www.colostate.edu/Depts/Entomology/jobs/jobs.html
http://www.sciencemag.org/
http://www.ars.usda.gov/
Evoldir http://life.biology.mcmaster.ca/~brian/evoldir.html or contact Golding@McMaster.CA

It is never too soon to begin looking at job advertisements. This is a good exercise that may help direct you in focusing your interests and informing you how many jobs in your area are being advertised.

Also while a graduate student write as many proposals as possible. Sigma Xi awards small grants. Pre-doctoral fellowships are excellent opportunities for beginning grad students. The government has opportunities too. If you are interested in a career in the government sometimes it’s best to enter those positions after obtaining a masters degree because there are more tech jobs available than scientist positions. Often times once you get your Ph.D. you’re over qualified for many positions.

It is very important to have a well-defined and doable research project. Be sure you are not on a fishing expedition. Make sure you can get at least two publications from your dissertation (of course more is better). Start planning for your life after graduation now. Know your options.

I hope this has been helpful. Please let me know if I can be of further assistance.

Sincerely,

Pamela G. Gregory
I am the Chief Editor of Nature Reviews Genetics – monthly reviews’ journal. I joined the journal as an Associate Editor straight from the lab and became the Chief Editor almost two years later. As an Associate Editor my duties included commissioning articles, editing them and managing their peer review, writing short 300-600 word long pieces on recently published primary papers as well as travelling to meetings and doing lab visits. In addition to these duties, as a Chief Editor I have additional responsibilities that extend to the editorial direction of the journal, as well as management and business aspects of the journal.

No specific training or preparation is required for a job of an editor. My first degree is in Genetics, I have a PhD in developmental genetics from Cambridge and two years of postdoctoral research, also in developmental genetics but working on a different problem and in different model organisms. Generally speaking, my background is fairly typical of editors who work on Nature reviews titles. Having worked in more than one lab is an advantage since as editors we tend to work with a broad spectrum of topics. We do a lot of writing and editing – much more than the editors who handle primary manuscripts do. Although we do not require any formal training in science writing, we do require our candidates to write well and have a good appreciation of what makes a good story (and how one should develop). Suitable candidates who apply to work with us are given written tests, which include writing, editing and commissioning, before they are invited for an interview. Although the test is designed for us, it is also a good indicator for the candidate whether he/she would enjoy the job.

Working on a monthly journal requires an ability to deal with tight publishing deadlines (which are immovable) but gives one the satisfaction of seeing the result of ones work every month, in the form of the new issue. The fact that we cover such broad topics means that we often lose touch with experimental nuances, however, we gain the overview that can rarely be attained while working on one’s own project in the lab. Work in our editorial offices is tremendous fun; there is much interaction with our colleagues within and between the journal teams. A good editor would be anyone who is passionate about science, has good literary skills and attention to detail, and won’t mind not being THE first person to make a scientific discovery. Keen interest in science beyond one’s own field is essential. It is also useful to read journals in a critical manner, always looking out for what they provide versus what the readers might want.

Magdalena Skipper
Chief Editor
Nature Reviews Genetics
www.nature.com/nrg
There are many differences between working in academia and working in industry. What will appeal to you will depend on your personality and what you want from your work-day.

Advantages to working in industry:
- You can make more money.
- You don’t have to write grant applications.
- You will, most of the time, have 40/hr work-weeks.
- You will likely expand your horizons, both personally and professionally, by working with different sorts of people and experiencing different types of jobs and career options.
- You can get a decent job with a Master’s degree. PhD’s can get you into more senior positions more quickly, but are usually not required for advancement.

Disadvantages to working in industry:
- You don’t have as much independence as to what topics you research.
- You can be susceptible to lay-offs and other market forces, which usually don’t jeopardize academic jobs.
- Academia certainly has its share of bureaucracy and politics, and you can expect the same thing in industry. Lots of administrative tasks and red tape.
- Unless you’re a lab tech, you’ll likely have to develop some level of business and communication skills. If this appeals to you, you won’t consider it a disadvantage!
- You have to be willing to learn new techniques and procedures, even ones that may be far outside your original education. Unless you’re a QC technician, you can’t take one single area of lab-expertise and do just that one procedure all day.

“Industry” can be split, at its most basic level, into two types of companies: research and manufacturing. Of course every company will have a different business structure and atmosphere, and will treat its employees in different ways, so I don’t want to over-generalize too much.

Research Companies
I’ve never worked for a research company, so I cannot say too much about them here. From what I know, research companies, such as Abbott and Baxter, need a lot of lab technicians. Lab techs may work in primary research labs or in QC labs. Lab tech jobs are well suited to people who like being “lab rats”, doing their benchwork and largely being left alone, with no big administrative responsibilities. From a position like this you can work your way up to lab manager, but generally need a PhD to move farther up the management chain (for example overseeing a research division). These types of companies also have sales and marketing positions; their customers are hospitals and doctors who buy their medical devices and drugs.

Manufacturing Companies
I work for a manufacturer. We make instruments and consumables for chemical separations, so most of our scientific employees are chemists. There are many different positions for scientists in companies like mine, positions that will suit different personalities. Each type of job requires different skills, different levels of scientific knowledge, and has different potential for salary and
advancement. All of these jobs at my company require at least a Bachelor’s degree; many require at least a Master’s. The jobs my company has for scientists include:

Applications scientists typically write technical presentations and generate data to be used in marketing materials, to convince customers to buy the product. You have to have the tenacity to optimize an experiment and keep current on trends and popular methods in the market. It’s not enough to just get results -- you have to get good-looking results, because the results are going to be used as sales tools.

R&D scientists develop and test new product concepts. R&D jobs can be a lot of fun, but, like a lab tech job, you don’t have much say about what research you do. Industry is profit-oriented – if a line of research is really cool, but won’t result in a product that can be sold, you won’t be allowed to pursue it. Although you don’t need marketing experience for a job like this, you need a marketing mentality – you are creating products that your company will have to successfully sell to customers. R&D work can be very rewarding for people who like constantly working on new projects, and have the imagination and scientific talent to come up with a new idea and troubleshoot it until it works. You also have to be able to let something go, even if it was your “baby”, if it isn’t working out.

Sales reps handle customer accounts directly, using face-to-face techniques to sell products. Not every scientific manufacturer requires their sales reps to be degreed scientists, but many do. You need the technical competence to understand the products, how the customers use them, and make product recommendations. Being a sales rep can be difficult, requiring lots of travel and lots of effort to make your quota each month. If you love talking to people and hate being at a desk all day, you might enjoy being a scientific sales rep. If you’re good at it, you can make a lot of money.

Technical support scientists take phone calls from customers and try to solve their technical problems with our products. Depending on the company, this may or may not require you to spend much time in the lab. You have to be comfortable talking on the phone and be diplomatic and friendly to be successful at a job like this.

Product Managers (my job). Depending on the company, these people will be more on the business end of things, and may not spend much time in the lab. I have a group of products I manage, and am responsible for every aspect of their success. I write our advertisements and sales flyers, think up new promotions and ways to reach new customers, train our Technical Support and Sales employees, guide the marketing scientists on the data I need them to generate, and work with the R&D group on developing new products. I also negotiate pricing with suppliers, analyze sales patterns, and write User Manuals and technical literature. I need to stay very current with our competition, their new products, prices, and more. While this type of job requires a scientific background to understand the products and properly market them, the day-to-day job is more like an MBA. It suits my personality – I was never very happy spending my days at the bench running experiments.
What do I love about my job? I’ve developed new skills and found hidden talents, for example it turns out I’m very good at crisis resolution – keeping a cool head while finding a solution -- an ability I never would have suspected I had. I’m also good at digging up competitive intelligence and finding information our competitors probably wish we didn’t know. I’ve developed a lot of people skills and communication skills (both verbal and written) that I would have never developed in academia. It has given me a level of confidence that has spilled over to my personal life. Also, I’ve learned a lot of new science. My primary area of expertise is still the biological sciences, but through this job I’ve also learned about chemical, environmental, and drug discovery techniques. Finally, I see real, concrete results of my work every day -- I walked on air when we sold the first box of a product that I had conceived, developed, and brought to market.

What do I hate about my job? It can be quite draining sometimes, dealing with the same problems, the same obstacles, the same administrative baloney every day. I’m expected to grow sales for my products, but am not always given the resources I need to do so. Some days the problems and annoyances pile up and seem overwhelming. I enjoy handling large projects, and get frustrated with small, tedious tasks. I often compare my job to the circus performer who runs around the stage, trying to keep all the plates spinning on the poles.

But, after 6 years, I still love my job and am extremely happy I chose the path of industry over academia. Although I probably won’t stay at this company for too long, I will almost certainly look for the same job position with another manufacturer. Going into industry was a good choice for me – it won’t be a good choice for everyone.

I’m happy to offer follow-up thoughts to anyone who wants to talk more or has questions. Dr. Noor will give my email address upon request.

Sarah T.
7 November, 2002
Postgraduate Options in Scientific Administration

Office of Personnel Management - Presidential Management Fellows Program

http://www.pmi.opm.gov/

Online in first week of September, applications due in October for next summer, but MUST be submitted through LSU itself- cannot be submitted of exclusive of the school, so check on this soon.

Department of Health and Human Services- Emerging Leaders Program

http://www.hhs.gov/jobs/elp/

Career path choice in "administrative". Next set has job start-date of July 1, 2005.

USDA Career Intern Program


For all of these, a few business classes are recommended...
APPLYING FOR JOBS IN
AND SUCCEEDING IN
ACADEMIA
Improving Visibility
ASCB National Meeting-Saturday Session Dec. 4, 2004
Sponsored by Sub-Committee on Postdoctoral Training (SCOPT)

Panel:
Mary Beckerle (Professor and Deputy Director, Huntsman Cancer Institute, University of Utah)

Clare Waterman-Storer (Associate Professor, The Scripps Research Institute)

Daphne Preuss (Professor, University of Chicago, and Principal Investigator, Howard Hughes Medical Institute)

Jeffrey Mervis (Deputy News Editor, Science Magazine)

Why is Visibility Important?
Letters of recommendation-want to build up a relationship over time. Don't want to try to cozy up to someone a few months before you need letters. You should identify potential mentors and advisors at the beginning and start building relationships very early. Then those letters will be very powerful and informed, rather than shallow and cursory.

Important to have an inside advocate in the department when applying for an academic job.

Local Visibility:
Get known at your institution and department.
Seek out and create opportunities to interact w/ other faculty and postdocs
Volunteer to give a research seminar
Be proactive and go out and make people aware of you and your work
Collaborate w/ others in your dept. and in other depts.
  Figure out if someone else can help you
  Stop by their office/send them an email saying you want to run some data by them
  Tell them your story and maybe your idea for a collaborative project
Organize a research interest group (discuss papers and present work on a common theme)
Organize a journal club
Make the emphasis on the science—the best way to start an interaction is through talking about science

National/International Visibility:
Never pass up an opportunity to present your work or put yourself in a situation where you can interact

Go to meetings and present posters/give talks
Volunteer to give talks
Volunteer to host a seminar speaker or meet with a seminar speaker

Choose sessions at meetings wisely (aim for cross-fertilization; be in a related session where you don't already know everyone)

Contact folks in semi-related fields and talk about science/ask questions/seek advice

Go to small conferences (i.e. Gordon conferences), where it is easier to meet people. Small conferences also have activities (tours, hiking, canoeing, etc.) Sign up for one and go out and meet people that way.

Approach people and ask questions at meetings--go to their posters.

Science Writing and Journalism:
If you are interested in science writing, start writing. You need to practice, practice, and practice. Set yourself assignments. Take your last paper and write a mini-article for a lay audience. Practice communicating science.
Find opportunities to write (newsletter, institutional magazine or website, pamphlet). Your first writing jobs will probably not be paying you--that's okay--it is better to get practice and exposure. Get your writing out there, in whatever form.

Don't assume you know more; don't assume you know less. Be aware that academic writing does not automatically translate into science journalism.

Check out AAAS Mass media fellowships (grad student & postdocs--10 weeks paid fellowship where you get placed at a major media outlet).

Check out the national association of science writers website (www.nasw.org).

Writing programs (i.e. at UC Santa Cruz)--they are fine if you want to go that way; but they are not an absolute requirement. It is more about actually writing and refining your skills and talent, than it is about having a paper certificate. If you do want to do a program-look for one that includes internships involving actual journalistic experience.

**Supplementing your education:**
Not all the education or mentoring you require will be available at your home institution or within your own lab. Go out and seek the training, experience, advice you need.

Suggestion for Jr. faculty to take a night class in business management--learn about budgets, project management, timelines, goal setting, people management.

Volunteer to review grants. Call Scientific Review Officer at NIH or at NSF. Offer your reviewing services. Great way to learn how to write grants and what works/what doesn't. Creates a good relationship with the Review officers at the granting institutions, who can then be a good source of advice and guidance on areas of interests, initiatives, and possible study sections for your research.

**Other thoughts:**
Conquer your shyness, or learn to deal with it--just remember, many senior scientists are also shy, so don't be afraid to approach them. Start out by making it about the science.

You don't have to have that significant of an interaction. If you went canoeing with someone at a Gordon Conference, and you want to email that person later about something, just write, "A few years back, we met at the XYZ Gordon Conference on the canoe trip. I was curious if you might want to meet on the phone to discuss XYZ data of mine. I think it might relate to your stuff on ABC." In other words, mention the connection, if there is an amusing story, add that too. Then get to the point about why you are contacting them.

Think strategically when you think about networking and building your visibility--who do you want to be visible to? Traditional research academia? Industry? Teaching institutions? Patent lawyers? Science writers? Then find ways to interact with those folks.

Put yourself in the mind of someone hiring you--look at yourself through his or her point of view. When you talk to people, ask them what they look for in a hire or in a potential colleague.

Good place to network with biotech people is BIO, a big biotech meeting. Most companies have people there giving seminars and presenting posters. Also, most big cities have a regional biotech network or association. Go to one of their meetings and talk to people.

Patent lawyers also have an association w/ meetings. Go to one of these if you are interested in patent law or intellectual property.
For networking with people from primarily undergraduate research institutions, check out the National Council on Undergraduate Research, scan through ASCB’s journal Cell Biology Education, read the Chronicle of Higher Education.

Make yourself some business cards, either through your institution or through a vendor (i.e. www.iprint.com). Hand them out to everyone you meet and ask for theirs.

Maintain contact with the people you have met—send them a pre-print of an upcoming paper, or an email about some recent data. Let them know when you are looking for jobs, or thinking about this or that career.
How to Get a Teaching Job at a Primarily Undergraduate Institution

A. Malcolm Campbell
Biology Department
Davidson College
How to Get a Teaching Job at a Primarily Undergraduate Institution

Introduction

Recently, I was hired as a tenure-track faculty member in the biology department of an undergraduate institution. Previously, while seeking a site for the second year of a Pew Teacher-Scholar Postdoctoral Fellowship, I had the rare opportunity to visit and interview at eight colleges in the Midwest. Since I was not being considered for a tenure-track position at the time, I was able to get a feel for the interview process without all the pressures of a real job interview. This experience gave me a feel for the interview process and insights into the special qualities sought by undergraduate institutions. To share what I learned during my time on these campuses, I published an article in the Council on Undergraduate Research (CUR) Newsletter (1). There have been several publications written for candidates interviewing at research institutions (2, 3, 4), but none for prospective faculty members at primarily undergraduate institutions (PUIs). Unfortunately, most PhD candidates and postdocs are chastised for any interest they have in teaching (sometimes referred to as the “T-word”), and we get little support from research mentors for our career choice. There has been increasing awareness, however, that not everyone who gets a PhD wants to establish a research lab at a university. In an attempt to assist those seeking “alternative” careers, I have expanded my original CUR Newsletter article to give some suggestions that may be helpful for those wishing to get a job at a PUI.

Career Tracks

If you know that teaching at a PUI is why you are getting a PhD in the first place, then you want to think about the implications of choosing a particular lab for your thesis work. If you choose a lab that does only one technique and your project requires you to work with live Ebola virus, then you are not setting yourself up for a teaching job. Most PUIs want a person who is versatile and can conduct student-based research. Proficiency with a single technique is too limited a repertoire, and Ebola is not conducive to inexpensive and short-term research projects. If you are still keen to choose this project, then accept the reality of a postdoctoral fellowship in order to add breadth to your training.

The big question in the minds of most who want to teach is, “Do I have to do a postdoc?”. The answer is yes and no. I have met several recent hires who had no postdoctoral training but in today’s tight market (at least 100 applicants for each advertised job), they are the exception. Postdoctoral training will be beneficial for several reasons: 1) since so many applicants have postdoc experience, those without it might be at a disadvantage; 2) this additional training allows you to learn more techniques and a different system which should provide sufficient experience to teach at least one more course; 3) as a postdoc you should gain more experience with writing grants and increase your publication record; and 4) you will develop a degree of maturity that comes from having to adapt to a new area of research. With a few Nobel Prize winning exceptions, the name recognition aspect of your postdoctoral mentor selection is negated by the fact that most faculty members only recognize the names within their field and will not recognize your mentor’s name. However, you might find that the name of the institution where you postdoc has a greater impact. This does not mean that your quality of training will be better at a name brand institution, but some people will find this attractive which may, in some small way, help you get an interview. A very important consideration is whether or not you will be able to take your research with you. Some PIs do not let go of their projects for any postdocs, or maybe your research is too difficult to conduct at a PUI with its limited resources. For example, if your research requires a P4 biohazard lab, you will never get a teaching job where you are expected to maintain a research program. The ideal project for a PUI is one that is cheap, easy to learn, and not subject to intense competition. If you are wanting to teach molecular biology and use this in your research, it is understood that this is an expensive discipline but you might want to work with an inexpensive system like Chlamydomonas or Drosophila instead of more expensive ones like mammals or tissue culture.
Another question that people often wonder is whether they should tell a mentor that teaching is their long-term interest. It is a good idea to be honest up front because in the end, you will want a letter of recommendation from the PI so he or she will find out eventually. If you are considering a lab where the PI is hostile to teaching as a successful career for PhDs, it is better to find this out before you commit yourself to this lab. Do not subject yourself to a lab where the PI resents his or her “wasting time” on someone who will “just wind up teaching anyway.” There are plenty of PIs who do view teaching as an acceptable career since there is a growing perception at the highest levels of science that “alternative careers” must be pursued, though “alternative” is still seen by most as a step down.

One aspect that is often overlooked is teaching experience. Most PhD candidates have to teach for at least two semesters. Often, the courses are huge and allow little room for personal input and control of the course. If you know that teaching at a PUI is your objective, try to teach more than the bare minimum. Offer to guest lecture for your mentor (very few mentors object to this). You might be able to teach a course for someone on sabbatical at a local college (either a 2-year or 4-year institution). As you gain more teaching experience, ask yourself again if you enjoyed the process. Is this what you want to do for the next 30 years?

Finally, where are teaching jobs advertised? This is easiest part of the entire process; all jobs are listed either in Science or in The Chronicle of Higher Education. In Science, most jobs appear between late August and early January but some gems can be found outside this peak time due to unexpected changes in faculty because of death, retirement, or relocation. Searching weekly issues of The Chronicle has gotten infinitely easier now that it is available on gopher. The paper edition is cumbersome to plod through while the electronic version will provide all the biology related jobs in a single list. To access The Chronicle’s job listing by gopher, select: North America; USA; General; ACADEME THIS WEEK (The Chronicle); JOBS; SEARCH using The Chronicle’s list; Faculty and Research; Science and Technology; Biological Sciences. There will be some overlap between this listing and those found in Science, but The Chronicle’s listing is a week or two ahead of Science which can make the deadlines more user friendly. An even better development has been Science On-Line, the world wide web (WWW) home page for Science. If you have not tried “the web” it is easy and now you have a good reason to try it out. The WWW address is: http://science-mag.aaas.org/science/ which is easily accessed by Netscape or other browser. (See your local computer guru to find out how to get your computer system to access WWW.) Once you have gotten to this home page, you will have several options. Click on the arrow-head next to “Career Opportunities.” On this page, you can either choose to browse all of the advertisements as you would for the paper version, or you can conduct a keyword search. Try words like ‘cell’, ‘undergraduate’, ‘teaching’, or ‘college’. You could search for a particular state, or the word ‘tenure-track’. Unfortunately, you cannot search back issues through this medium.

Things to do Before Applying

There are a number of things any candidate should do before applying for a position. Contact local colleges or your alma mater and offer to present a seminar of your work—then make the time to do it. There is never a good time in your schedule to do this, but the practice is invaluable and most colleges would be happy to have a free seminar speaker. While there, show them your CV, teaching philosophy, and research interests (see below) and ask for constructive criticism and suggestions for your job search.

• Once you have seen an ad that is tempting, do a little homework and soul searching. Ask yourself how far you really want to stretch yourself. For example, if the ad is for a geneticist and you are a biochemist who happens to use Drosophila tissue.... could you really teach genetics?

• Consult Science Citation Index’s year-end report, the geographical listing, which has a state-by-state listing of that year’s publications from each department of every institution in the country. Compare the school in question to others with which you are familiar. This will give you an idea of the level of research at the school in question.

• Use the Council on Undergraduate Research’s Directory of Biology Departments. It is a very impressive list of most of the top PUIs in the country and it gives a great deal of information about the available equipment and research interests of the faculty.
• Use Peterson’s Guide to Four Year Colleges to learn about their students in areas such as geographic and ethnic diversity, average SAT scores, etc. This Guide also lists the school’s endowment which will give you a feeling for how deep the school’s pockets may be when it come time for negotiations of salary and set-up money.

• Call the chair of the department, or the chair of the search committee, to ask some general questions. The fact that you called will probably be recorded in your file. You can try to get a better understanding of the job: which courses you would teach; how many contact hours you would be expected to maintain; whether there is a research lab available or in the planning stage; whether there is any set-up money; how many majors the department has, etc.

• Surprisingly, most college and university libraries have a microfiche collection of catalogs from every school in the country. Catalogs allow you to find out who teaches which courses, what courses are offered, who teaches them, and how often. You can also get a feeling for the history of the college, any areas of special pride, and read the school’s mission statement. Increasingly, PUIs are presenting information on WWW home pages which is an easy format to utilize. All of this information comes in handy when you are writing your cover letter.

The Application

You will need to submit four documents for any teaching position where there is an interest in research-active faculty: 1) a cover letter; 2) your CV; 3) a statement of your teaching philosophy; and 4) a description of your research interests. Even if the ad does not ask for them all, you should send them. If they really don’t want one of the documents you send, they will not read it. However, some institutions will not list all four required documents to save space (i.e. money) or as a quick way to eliminate those “who don’t know better.” Some PUIs ask for transcripts which you might want to have in your files so you can send them copies directly, if this is acceptable. Of the four standard documents, I would rank the four documents in the following order of importance: 1) cover letter, 2) cover letter, 3) cover letter, 4) cover letter. Although your CV, teaching statement, and research interests/plan are very important documents for a job that expects both teaching and research, the first round of cuts will be heavily influenced by your cover letter. The cover letter is incredibly important for the following reasons. There is no one in the department who does what you do (if they did, they wouldn’t want to hire another one), so no one will understand fully your research or appreciate who has written your letters of recommendation. You are writing to an audience of administrators and a collection of biologists from every sub-discipline, so your cover letter should be general in nature in order to appeal to everyone while sufficiently distinct and not generic. At some institutions, the older faculty may not conduct research at all, and will not be familiar with the latest techniques. They may have as many as 150 applications to read, so everyone is looking initially for those that can be eliminated easily rather than trying to identify the best applicant. With this in mind, the first document most faculty read is the cover letter, so yours should not contain any reasons to justify putting it in the stack of excluded applications.

Now that you know which document needs to be perfect, what should it look like? It should be about 1.5 pages long, explain why you are interested in teaching as a primary focus, indicate clearly that you are familiar with this particular school, and make it clear that you want to work with their undergraduates. (Make sure you use that word, some applicants send the same cover letter to graduate programs and PUIs - a guaranteed way to be excluded from the search.) If you determined from your phone call that there is an interest in hiring a research-active faculty member, you want to describe your intention to conduct student-based research. The cover letter should be well written, easy to read, and maybe reveal enough of your personality that your application stands out from the others. Once you have a document in a presentable format, have several colleagues critically read your cover letter in order to see how you look on paper.

Your CV should be written as if you were trolling for fish—put out as many hooks as possible to snag as many fish along the way as possible. Sure, you need all the basic facts, but they should be presented in the best possible light. For example, lets say your Ph.D. thesis is on a molecule in the right ear of the tsetse fly and you got your degree with Dr. X at University Y. You could list yourself as:

Ph.D., 1995, University Y.
Or you could say:

Ph.D., 1995, University Y.
Thesis title: “A big and novel molecule in the right ear of the tsetse fly”
Thesis advisor: Dr. X.
Comprehensive exams in Entomology and Neurobiology

By listing all this information, you have put out four hooks instead of one. You never know who is interested in some obscure aspect of your research and by providing the thesis title, you have allowed one more person to get hooked. Or maybe, there is someone who actually knows your former thesis advisor, likes insects, our likes the idea of hiring an insect neurobiologist. The date may indicate your “scientific age” and the university may also carry some implications.

At the top of your CV, you may want to put some biographical information, but then you may not. Your name will probably indicate your gender so that is not an issue. But do you want to give your birth date? your place of origin? marital status? These are issues that should not be factored into a hiring decision but frequently are (at least subconsciously) by some faculty. So if you think it might help, add it; but when in doubt, leave it out. If you decide to include personal information, do not give names or ages of family members.

You might want to include some of the following sections in your CV. I have suggested some entries for each heading:

**Education**

List your degrees (with as many hooks as possible) beginning with the most recent. Some people like to include post-doctoral training under education. Also, non-degree experiences could be added here (e.g., Cold Spring Harbor courses).

**Academic Appointments**

You can list any temporary teaching positions, postdocs, research associates, etc.

**Honors**

Cum laude, Phi Beta Kappa, undergraduate scholarships, fellowships, awards (especially “TA of the year” or other teaching awards), etc.

**Teaching Experience**

Beginning with the most recent, list any teaching experiences you’ve had, even if you did volunteer teaching for public school kids, a single guest lecture for undergrads or grad students, as well as all TA positions. You might want to de-emphasize research assistantships that relieved you of teaching duties. The point here is to establish a long-term interest in teaching. You do not want to appear as a postdoc who could not find “a real job” and has reluctantly decided to settle for a teaching position. Likewise, you do not want to appear to be running from the demands of research in search of an “easy” teaching job.

**Professional Activities**

List your memberships in professional societies (give dates of membership), editorial consulting for X journals or funding agency (you reviewed a paper or grant proposal for them, including those your mentor farmed out to you), committee memberships at the university or professional society level, any invited talks (e.g., your alma mater practice talk), and funded grants.
Publications ( * denotes undergraduates as co-authors)

If you have any undergraduates as coauthors, set another hook by drawing attention to this fact.

Articles

Begin with the most recent including those in press. If you have both research and review papers, you might want to list them under separate headings to enhance your professional appearance. If you need to, you can add manuscripts in progress but this should probably be done if you have only two or fewer publications. It tends to draw attention to a weak publication record.

Abstracts

Begin with the most recent, and give where the abstract was published or where you presented the work. You may want to distinguish between oral and poster presentations, if you are keen to do so. Presentations at “in-house” formats should not be included in this list.

References

These are the people who will write your letters of recommendation. You should have their title, name, full address, and phone number; a fax number and an email address might not be a bad idea. Choose people who each have different perspectives of you, especially if they can comment on your teaching ability and/or your desire to teach. One of your undergraduate teachers might be appropriate if you were close to this person and have maintained contact. To facilitate the process for your references, notify them well in advance and mail them a list of addresses and brief descriptions of the positions.

Writing a teaching philosophy is like trying to photograph a dense fog, but at least you have to write only a maximum of 1.5 pages. (With 150 applications to read, no one wants to read epic statements.) You might explain more about the basis for your desire to teach; what courses you could teach in addition to the ones advertised (based on what you learned from reading the catalog, although this could be a touchy subject if someone on the search committee feels threatened, so use the phone call to help figure this one out); what teaching goals you might have; any basic beliefs about what constitutes good teaching; what you might do in the lab sections that deserves special mention. A good definition of a teaching philosophy is up for grabs, so ask faculty at nearby colleges to critique your statement in exchange for a free seminar. I have found that even faculty I had never met were willing to help out a budding young teacher.

The research statement should also be about 1.5 pages and should be in balance with your teaching philosophy; do not present a lopsided picture of yourself. You cannot go into too much detail since there is not enough room and no one will really understand it anyway. Make sure to cover three areas of particular importance: the nature of your research, undergraduate student involvement, and the potential of funding your research. If you want to brag a bit, you can add appendices under the appropriate area. Appendices are great devices because you are setting more hooks but the material is optional reading. The 1.5 pages or your research statement should stand alone, but if the committee gets serious about you, you have provided more material for them in an appendix to help the committee make a more informed decision. You might want to show off your publications so you can squeeze a few reprints into an appendix under the section describing your project. You may have submitted a grant or had one funded which you can tout in another appendix under the fundability section.

The Phone Call

If you get a call from a school requesting an interview, ask about the seminar audience, length of the talk, the presentation format (2x2 slides etc.), and whether a completed story (your thesis) or ongoing and future work is preferred. Ask
to meet with students without any faculty present, perhaps over a meal. Some schools do not automatically schedule this, which might imply what they think about their students. Meeting biology majors is very important since they will be your source of research colleagues and the people with whom you will work the most. Many PUIs will ask you to present a lecture to a class in addition to your research seminar. If this is not required, you may want to volunteer to give a lecture. This may give you better insight into the caliber of students and enable the faculty to evaluate you more completely.

From this point on, think of yourself not so much as competing against two or three other candidates but as a prospective employee looking for the best fit. You want to find your niche in the broad spectrum of approaches to answering the question, “How do we teach biology?” Some schools have created “research colleges” where most of the faculty receive extramural funding and have large research labs but do not stress curriculum innovations. Others send their students away for summer research experiences and put most of their resources into the curriculum and intensive student contact. These dichotomous models, and all those in between, can be successful only with the right combination of faculty members.

Now it is time to get more serious about your homework. Familiarize yourself with the department members and the courses offered. Look in the most recent March issue of a journal called *Academe*, which lists the average salaries for assistant, associate and full professor for almost every school in the country. The salary listed for an assistant professor includes those with 6 years of teaching experience, but keep in mind that science faculty often get higher salaries. This information will tell you what to expect as a reasonable salary offer. Read all the papers published by department members during the last five years as listed in Science Citation Index. Prepare a five-year research plan with an explanation of how it involves students. Also compile a list of equipment (with prices) that you will need to teach and conduct research.

### The Interview

The average interview has the following basic format. You’ll meet students, faculty, the dean (and maybe the president), give a seminar, go out to eat (and drink, but watch yourself), and generally be kept very, very busy. This process can be exhausting so don’t let down your guard; mind what you say to everyone from the time you arrive until after you have left, including those delegated to transport you to and from the airport.

The interview provides your best chance to get answers to all your questions, so make the most of your visit. During your time on campus, there are a few things you should try to do. Go to the department and the library after hours to see who and how many are working. While in the library, look for the journals you will need. Ask to look at some housing, and get a feel for the quality and cost of living in the area. Make sure you get a good tour of all the facilities and equipment in the department, as well as the rest of the campus. Other points to keep in mind during your stay: note any differences between responses of tenured and non-tenured faculty; try to detect if this is an embattled department (e.g. animal vs. plant, molecular/cell vs. organismal/field, research active vs. non-active); make sure that you meet everyone in the department and there are no hidden skeletons; bring a small notebook and take notes during your meetings with everyone - faculty and administration - because by the end, it will be hard to remember all the details; and if the occasion presents itself, casually mention the other schools considering you, because this makes you appear more attractive. If no one in the department conducts research, beware of the potential for unrealistic expectations of your research from both the department and the administration. Ask about the possibility of a reduced teaching load in exchange for student-based research or extramurally funded grants. Find out how reappointments and tenure decisions are made, who is involved in these decisions, and what percentage of faculty are denied tenure. Be prepared to be asked illegal questions concerning age, sexual preference, marital status, and children. (Questions concerning religion are legal at church related schools which advertised as such.) You have three options in response to illegal questions: 1) refuse to answer, 2) note the impropriety (either overtly or subtly) of the questions but answer them anyway, 3) anticipate the questions by inquiring about schools, benefits plans, or job opportunities for significant others.

### The Dean

Some questions are best asked of the dean. Ask him or her: the salary range offered for this position (this may not be their final offer, but negotiations should wait until after you have been offered the job); set-up funds; and the benefits package including annuity, health insurance, moving expenses, occasional free classes for family members, tuition
remission for your children. Sometimes you will be asked open-ended questions concerning set-up money. Dean: “How much were you thinking?” Candidate: “That depends on the institution’s commitment to research.” This is where your ability to bargain will be useful. Remind the dean that 1X funding gets 1X results and 10X funding gets 10X results. However, this kind of hardballing puts reasonable expectations on you to perform. Ask the dean to define “scholarly activity” in regards to tenure. It is a good idea to present the dean with a list of equipment which should be prioritized as equipment needed versus wanted, with potential funding sources for the latter. This list should include everything you can justify since you can look very generous as you compromise during the negotiations. It might be worth pointing out that time spent on applications for funds to purchase essential equipment is time not spent on teaching or research. Again, the final negotiations will come later, after the job offer is made.

The Chair

The chair has information and/or control over certain aspects of the department. Ask the chair how long he or she has held this position and whether this is a rotating position or an open-ended one. Have “scholarly activity” defined in the chair’s own words and compare this with the dean’s response. Does the definition include: attending national meetings (with or without posters and/or students), publications (is there any weight given to one article in Nature vs. three in obscure journals), publication of textbooks and lab manuals, national society committee participation, grants applied for versus funded, research with students (with or without resulting publications)? Find out who in the department has received grants lately and from which agencies. Ask to see your potential office and research space in addition to the teaching labs. Beware of vague responses and promises of a newly renovated lab space that seems too good to be true. If they do discuss a space that is not currently available, ask about the budget for renovations and to see the blueprints.

Questions for Every Faculty Member

It might prove informative to ask these questions of each member in the department. You might uncover some facts within the department that you might not notice otherwise. What percent time does he or she spend on teaching, research, and service? Compare their responses to what you know about their publications and when they were hired, since expectations at most schools have changed in recent years. What is the average size of classes, labs and overall workload? How does each member see the new position? The new physiologist position, for example, is it for a plant physiologist, human physiologist/anatomist, or someone who does patch clamping? Is everyone in agreement, or are there opposing ideas being presented?

Questions for Any Faculty Member

Here are some general questions you can ask any department member. Would you have access to email in your office? Does the department use IBM or Mac? Is there a policy concerning sabbaticals for both tenured and non-tenured faculty? Does the department use TAs and work-study students? If so, how are they funded and how are they assigned? Who is responsible for setting up equipment and washing glassware used for teaching labs? Does the college have a license to work with radioactive isotopes? Are biology majors required to do research? Do they have to submit a thesis? Are there any curriculum changes in the works? Are there any collaborations currently underway within the department, with other departments, or other schools? Are the sciences coordinated and unified, or split and possibly hostile? Who pays for photocopying, phone calls, interlibrary loans, faxes? Does the administration support travel to scientific meetings? Is there financial support for research expenses or sabbaticals? How can subscriptions to vital journals be requested? Is there access to MEDline or other online source for journal articles? Do you have access to the nearest large university research library? Is there a formal speakers series, and who is responsible for inviting the speakers?

Questions for Students

Often, students will tell you the way they see their school and department without “politically-correct” filters. Ask them: what courses they like and hate, do they read journal articles, what are the strengths and weaknesses of the depart-
ment and school, do all the faculty get along, with hindsight would they choose the same school again, do they control any aspect of the department (speakers, clubs), have any alumni returned to talk with them about life after graduation, do they have any future plans? Invite some students for a more informal discussion over coffee or soda, if there is time during the evening.

The Job Offer

If you have asked all these questions and they still want to hire you, don’t jump at the offer right away. Tell the caller you would like a few days to consider the offer and ask to come visit again in order to finalize details and let your significant other see the area, though you may have to pay for this trip yourself. You might want to call other places you are considering and apprise them of the offer and see if they can match it. Once you have signed the contract, never again will you have the ability to directly affect your salary. After you sign the contract, your annual wage increases will be percentages of your starting salary. It is worth reminding yourself that you have been selected with much pain and expense and that the first offer may not be as high as they are willing to go. It’s like buying a car; some places offer fixed prices while others like to haggle. You will have to deduce this distinction on a case-by-case basis. One cautionary note: most PUIs are not accustomed to hardball tactics so be firm but not pushy. You do not want to spend all of your political capital with the dean during the negotiations because the dean may extract his or her revenge by providing a smaller percentage salary increase for the second year in order to recoup the PUI’s losses in your high starting salary.

After you have the final offer, write down what you understand to be the complete package (e.g., teaching load, set-up money, lab space, salary, and benefits) and send two copies to the dean with one to be signed and returned to you. Explain to the dean that this unwieldy procedure is designed so that neither you nor the college will be surprised later and no one will feel misled.

References


Acknowledgments

I would like to thank the The Council on Undergraduate Research for allowing me to use portions of my Newsletter article, The Pew Charitable Trusts and the Pew Midstates Mathematics and Science Consortium for their support, Drs. David Kirk, Mary Lee Ledbetter, and Chris Watters for their helpful comments, and the biology departments of the consortium member colleges which kindly hosted my visits.
Dr. David Cody  
Chair, Evolutionary Biology Search Committee  
Department of Biology  
University of South Carolina  
Columbia, SC 27599 USA  

November 10, 2002

Dear Dr. Cody:

I am writing to request consideration for one of your advertised positions in evolutionary biology. I am currently an NSF-Bioinformatics postdoctoral fellow at Duke University in Biology. I have asked Jerry Coyne (U. Chicago), Chip Aquadro (Cornell U.), Dan Greenblatt (Montana State U.), and William Platt (Louisiana State U.) to write reference letters for me. I am excited about the opportunity to apply for this position, and I believe that my research and teaching interests are complementary to those of the faculty in your EEOB and MCDB groups.

My research focus is on the processes causing and patterns associated with speciation, and I have taken an interdisciplinary approach to addressing these problems. While my primary study organisms are Drosophila species, I am willing and open to studying speciation in several vertebrate and invertebrate species. I would like the opportunity to benefit from direct interactions and collaborations with your outstanding evolutionary biologists, behavioral ecologists, and molecular geneticists, as well as researchers at other nearby universities.

I have TA'ed several courses in the general areas of evolution, animal behavior, and the use of molecular genetic methods in evolutionary and ecological research. I would be interested in teaching courses in these general areas at USC, if awarded a position. In addition, my research projects have benefited from the assistance of a large number of undergraduate student researchers. I would strive to incorporate undergraduate students into the research programs that I develop there. My research is very amenable to such undergraduate help. Of course, I would also actively pursue assistance from outstanding graduate students and postdoctoral researchers as well.

Thank you for your consideration of my application for this position. I look forward to hearing from you at your earliest convenience.

Sincerely,

Michael Smith, m1smith@lsu.edu  
225-578-0000

(Underlining added for class, NOT for what would have been submitted!!")
Mohamed A. F. Noor - Current Research Interests (2003)

One of the greatest unsolved questions in biology is how continuous processes of evolutionary change produce the discontinuous groups known as species. My research has focused on understanding the processes that cause the evolution of barriers to gene flow between incipient species. I have taken an interdisciplinary approach to understanding these processes, incorporating genomic, classical genetic, molecular genetic, and behavioral analyses.

Genomic approach to studying hybrid sterility

Hybrid sterility involves failed (or inappropriate) interactions between alleles at different genes that halt gametogenesis. However, progress in identifying the genes causing sterility and their mode of interaction (protein-protein, transcription factor-binding site, etc) has been extremely limited. Thus far, four genes causing hybrid sterility or inviability have been isolated using standard QTL mapping approaches (see Noor 2003), and three of these are transcription factors, suggesting failures in gene expression may be a major cause of hybrid dysfunctions.

My laboratory undertook a series of parallel experiments to evaluate this hypothesis and to identify 1) genes misexpressed in hybrids, 2) whether misexpression is directly associated with hybrid sterility, and 3) upstream genetic regulators of the misexpressed genes. In the Drosophila simulans clade, we used microarrays and real-time quantitative PCR to identify genes underepressed or overexpressed in sterile hybrid males relative to fertile pure-species males. We found that transcripts with male-specific patterns of expression, including many involved in spermatogenesis, are disproportionately underexpressed in hybrids (Michalak and Noor 2003). This misexpression is not a simple consequence of their sterility, as Drosophila transcription is premeiotic while the disruptions in spermatogenesis in sterile hybrids are postmeiotic (coinciding with translation). However, these disruptions in expression may cause hybrid sterility.

Continuing this work, we produced fifth generation backcross hybrids between these species, of which about half are sterile and half are fertile. These five generations of backcrossing allowed recombination to separate factors causing sterility from those causing misexpression if they result from distinct hybrid disruptions. We then assayed expression and fertility in the resultant males, and we found an almost perfect correspondence: all backcross hybrids bearing anomalously low levels of the transcripts identified previously were sterile, while those bearing pure-species levels of these transcripts were fertile. This observation strongly suggests that the disruptions in expression observed in the F1 hybrids may directly cause sterility. We also identified strongly correlated expression among many of the misexpressed transcripts, suggesting they lie along the same regulatory pathway. Finally, we genotyped the backcross hybrids for a panel of microsatellites to map the upstream regulators of the misexpressed transcripts, and we were able to map one to a region of the X-chromosome previously shown to bear factors causing hybrid sterility (Michalak and Noor 2004).

In all, my laboratory took a reverse genetics approach to significantly enhance our understanding of the nature of hybrid sterility in this species group. We also examined the generality of our observations by studying disruptions in expression in hybrids of the Drosophila pseudoobscura species group using differential display. We identified several transcripts disrupted in these hybrids, and characterized some as also male-specific (Reiland and Noor 2002). Further, we characterized one of these misexpressed transcripts as a long, antisense RNA
to a component of the transcriptional mediator complex (Noor et al 2003), further suggesting a general role of disruptions in expression causing hybrid dysfunctions.

Genetics of behavioral species discrimination, and speciation by reinforcement

One of the most contentious issues in speciation has been the role of natural selection in driving species formation. In particular, can the process of speciation be driven directly by natural selection? Females could experience direct selection for mating discrimination if they produce hybrids of low fitness, a process now called "reinforcement." Previously, I sought evidence of speciation by reinforcement in *Drosophila pseudoobscura* and *D. persimilis*, two species that hybridize in nature and produce fertile hybrid females but sterile hybrid males. Through behavioral observations, I found that females derived from sympatric populations were consistently more discriminating against mating with heterospecifics than females derived from allopatric populations: direct evidence for speciation by reinforcement (Noor 1995).

My laboratory has produced the genome-wide recombinational linkage map associated with the upcoming publication of the *D. pseudoobscura* genome sequence (Richards et al 2004). Using a large (>150 marker) panel of microsatellites from this database, we fine-mapped the genetic basis of this difference in behavioral discrimination exercised by *D. pseudoobscura* females. We found that there is variation both within and among populations in which loci are associated with heightened mating discrimination. However, several candidate genes were highlighted by our mapping study. For example, on the 4th chromosome, one QTL conferring high discrimination is directly associated with some UDP-glycosyltransferases, which are involved in olfaction, providing a behavioral justification for the result and means for further pursuing the specific effect of this QTL. These results are currently being prepared for publication.

This is the first study to look at the genetic basis of a barrier to gene exchange that may have evolved for that role. Thus, this study may help us understand the genetic basis of the last phase of the speciation process itself. Understanding the genetic basis of reinforcement will also be useful for testing numerous recent hypotheses regarding the genetics of adaptation.

Genetics of barriers to gene flow between species, and a model for the speciation of *Drosophila pseudoobscura* and *D. persimilis*

Although species are often perceived to be distinct units, genetic introgression from closely related species does sometimes occur. Such introgression is not typically homogeneous across the genome, and regions of the genome that contribute to reproductive isolation (e.g., hybrid sterility) are less prone to introgression than unlinked regions. However, an integrated historical portrait of introgression and the genetics of reproductive isolation has not been developed in most hybridizing species.

*Drosophila pseudoobscura* and *D. persimilis* are reproductively isolated by strong species mating discrimination exercised by females, F₁ male hybrid sterility, weak hybrid female sterility, a hybrid male courtship dysfunction, and hybrid breakdown, but they do occasionally hybridize in nature. Previous studies of the genetic basis of these isolating mechanisms have yielded only limited information about how much and what areas of the genome are susceptible to interspecies introgression. My laboratory mapped the genetics of each of these barriers to gene exchange. We found that all are strongly associated with the inversions on the two arms of
the X-chromosome and the inversion that differentiates these species at the center of the second chromosome (Noor et al., 2001 Evolution; Noor et al., 2002 PNAS).

Concurrently, Jody Hey (Rutgers University) and his laboratory have tested for interspecies introgression at these same genomic regions by documenting the presence of fixed sequence differences between these species. He has found that those regions of the genome linked to known barriers to gene exchange had numerous fixed sequence differences between these species, while other regions of the genome had few or no fixed sequence differences (Machado and Hey, 2003).

Combining this data with our laboratory’s findings, we have developed a model for the speciation of *D. pseudoobscura* and *D. persimilis* (Ortiz-Barrientos et al, 2002). These species may have once had alleles conferring mating discrimination and/or hybrid sterility at loci across their genome. Historically, these two species became sympatric and began to hybridize. In regions of the genome not bearing inversions that differentiated the two species, recombination allowed for the loss of alleles contributing to barriers to gene exchange. However, in the regions inverted between the species, where recombination was effectively inhibited, the association between prezygotic and postzygotic isolating mechanisms allowed for these barriers to persist, and the two species were prevented from fusing into one.

Consistent with this model, we have shown that barriers to gene exchange are commonly associated with fixed inversion differences between species in sympatric species pairs, and that closely related sympatric species should commonly have fixed inversion differences. We recently received a new NSF grant to further test this hypothesis using another subspecies of *D. pseudoobscura* that does not coexist with *D. persimilis*. We are finding that hybrid sterility maps both outside and inside the inverted regions in the allopatric pair but only inside the inverted regions in the hybridizing pair, strongly supporting our model.

**Other research projects**

Students (undergraduate and graduate) and postdocs in my laboratory have also participated in a wide range of other projects, including, but not limited to:

- Genome-wide study of relative evolutionary rates of X-linked vs autosomal genes (Counterman et al 2004)
- The effects of polyploidy on hylid (frog) population genetics (Espinoza & Noor 2002)
- The effects of recombination rate variation on QTL mapping studies (Noor et al 2001)
- Population genetic consequences of founder effects in *Drosophila* species (Reiland et al 2002; Noor et al 2000)

**Literature Cited**


Statement of Teaching Interests - Mohamed Noor (1997)

My overall teaching experience is both extensive and diverse. I have also supervised students in the laboratory and in the field. I am confident in such settings, and I believe that my students learn a lot from our interactions.

My teaching style employs three fundamental aspects. First, I ask my students to design experiments that test the principles they learned in the lectures and labs. Students do not carry out these proposed studies, but developing the ability to design experiments is fundamental to the research process and to critically evaluating the scientific literature. Second, I use computer simulations to illustrate the points made in lecture. I have developed many such computer simulations of ecological and evolutionary processes that I can use. Finally, I assign readings in the primary literature so that students can see how scientific writing is done. Students submit their laboratory reports in scientific paper format, as though to a journal or granting agency.

Aside from these basic aspects, students in my courses will also take advantage of supplementary resources that I will make available on the World Wide Web. Outlines of the topics discussed in each class will be maintained and updated weekly. Additionally, students will be able to submit questions anonymously through a class webpage. Answers to questions will then be both posted on the class webpage (along with the questions) for the duration of the semester and also read at the beginning of the next class. This feature will supplement asking questions in class, by appointment, or via e-mail, not be an exclusive alternative. Finally, old or sample tests will be available on the webpage a few weeks prior to testing. Review questions for the course material will be distributed in class as handouts, and duplicates will be available on the web.

Courses:

If awarded the position at the U. Kentucky, I would be willing teach a variety of courses, including the introductory Evolution course for undergraduates, as well as advanced classes such as Speciation & Cladogenesis and Ecological & behavioral genetics.

My Evolution class would cover the basics of the field, stemming from its Darwinian roots all the way to current debates on Wright's shifting balance theory, punctuated equilibrium, and the relative roles of genetic drift and natural selection in maintaining genetic variation within species and causing speciation. If I teach the entire class, I will use the latest edition of the evolution textbook by Ridley, but the scope of the material covered will extend beyond this text. This class will also use computer simulations of various evolutionary processes (see above).

In my Speciation & Cladogenesis class, I will lecture once a week, and the other meeting day will consist of student discussion (assuming this is a TuTh class). Students will be assigned to present and critically evaluate papers they have read, while I guide the subject of discussion and correct errors. The students will consider such questions as: Do these experiments prove what they claim to prove? How else could the experiments have been done? Students will be encouraged to debate the theories and to get more information to prove their points. This class would be most suitable for either highly advanced undergraduates with a special interest in the topic or graduate students.

Speciation can complement existing courses in population genetics and evolution. I will emphasize how processes within species are thought to result in speciation. This area is ripe with controversy, and I will discuss the changes in opinion with respect to the various proposed modes of speciation, such as sympatric speciation, speciation by reinforcement, founder effect
speciation, chromosomal speciation, and "punctuated equilibrium." Finally, each student will be assigned to develop a "research proposal", investigating some fundamental question in speciation or cladogenesis. This project will be presented in the last week as though it was a short thesis proposal.

Ecological and behavioral genetics would operate in the same manner as Speciation and cladogenesis. We would cover classic work in the area, starting with Ford and Darlington, and continue through current topics in ecological genetics, such as the work of Slatkin, Antonovics, and Travis. In addition, we would discuss the transition of ecological genetics from documenting and measuring selection in natural populations to current emphases on the genetic basis of natural adaptations and life history traits. Quantitative genetic studies of ecological and behavioral traits would be discussed in some detail.

Research student supervision:

Undergraduate and graduate students are welcome to join my laboratory and participate in my research or, preferably, design their own projects under my supervision. I will meet with all of my students individually each week to assist in developing their ideas they are interested in researching and to monitor their progress. I will also hold weekly lab meetings to foster communication and scientific interaction within the laboratory. Student projects need not supplement my research or even be on the same organism, though the questions must be related to speciation or population, ecological, or behavioral genetics. Finally, I will encourage all students, in my lab or otherwise, to apply for research grants. As president of the Cornell chapter of Sigma Xi, the Scientific Research Society, I know of many such funds that are available.
Applications for ecology position at Mythical Univ.

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<th>Name</th>
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Questions to ask (and be prepared to answer) at academic job interviews, collected from diverse sources
Kathryn L. Cottingham, Dartmouth College Dept. of Biological Science

Dean

Big Picture
- What is the long term plan for this school/institution?
- How does this department fit into the long-term plan?
- What is the outside perception of this department? Strong? Unified? Interactive?
- Admissions profiles:
  - Undergraduates: who applies? who is accepted? who comes here? Where do they go after graduation?
  - Graduates: who applies? who is accepted? who comes here? Where do they go after graduation?

New Faculty Assimilation/Success
- What sorts of programs are available for new faculty members?
  - Formal mentoring?
  - Orientation?
  - Written faculty handbook?

Research
- What resources are available to initiate student research?
- Is there support for summer research by undergraduates?
- Are competitive, within-institution seed grants available?
- What are the indirect costs of grants? (Noor doesn't recommend this question)
- What are the expectations for the summer? On campus or is field work ok?

Teaching
- What are typical teaching opportunities, across the college?
- How much variation is there across departments?
- Are teaching training opportunities available? What kinds? How often?
- Can one buy out of teaching obligations with grant support?

Faculty Review/Tenure
- What is the schedule and mechanism of faculty review?
- How much of the department is already tenured? Is there a quota?
- Who decides tenure and how?

Sabbatical Policies
- Are sabbaticals available?
- If so, how do they work?
- Do benefits continue?
Dean, continued

Details
• What salary range (within assistant, associate, and full professors)?
• How paid?
• Can grants be used to supplement summer salary?
• How do raises work?
• What are the benefits?
• What retirement plan(s) would be available?
• What type of health plans are available?
• Any benefits for tuition for family members?
• Will they pay moving expenses?
• Are there resources available to assist spouses in locating jobs?
• Who insures equipment?
• Who would I be negotiating with?
• What is the time frame for making a decision?

Department Chair

Big picture
• What is your vision for the department/school? Where is it going in the next 5-10 years?
• When was the last planning exercise? Can I get a copy?
• How does this position fit in to that vision?
• Is the department growing or shrinking?
  • Which subfields?
  • Are there tensions among the subdisciplines?
  • What are current plans for future hires?

New Faculty Assimilation/Success
• What sorts of programs are available for new faculty members?
  • Formal mentoring?
  • Written faculty handbook?

Department Administration
• How big is the department?
• Is it unified, or split along disciplinary lines?
• How often does the department meet to discuss departmental business?
• How are decisions made?
• How is chairmanship determined? How long is the term? (Noor doesn't recommend this to ask the chair- save for a senior faculty member. Sounds rather confrontational.)
Students
- What kind of graduate students do you attract (both areas and backgrounds)?
- Where do they go once they finish their degrees?
- Who pays for graduate students? Are there any training grants?
- Do students have a say in search decisions?
- Do students have a say in department administration?
- What interdisciplinary collaborations are already in place? (Are there any training grants, for example)
- How many undergraduate majors come through the program each year?

Research
- What is available as "set up" money?
- Is there department research support available? Of what kinds?
- Are there vehicles available for field trips/research use?

Teaching
- What secretarial help is available for working with courses? With grants/papers?
- What is the teaching expectation through time? How many courses?
- Which courses?
- What would this person teach over the next 3 years?
- How much flexibility in what an individual teaches?
- How much flexibility in when courses are scheduled (within a week, within a year)?
- How big are classes? Are teaching loads weighted by the number of students in the classes?
- Is there time to prepare the first course?
- Can I teach a seminar the first semester/quarter?
- Are TAs available? For what courses?
- How much funding is there for courses, particularly new ones?
- How do ideas for new courses get processed?
- What are the teaching labs like?
- Are there computer teaching labs? Software? Support personnel?

Service
- What non-teaching expectations are there?
- What are the “standing” department committees?
- How do undergraduate and graduate advising work?

Promotion & Tenure
- Are there annual reviews before tenure?
- Who decides on tenure?
• On what criteria are decisions made?
• Are the criteria written down and handed out to new faculty?
• What are the unwritten criteria?
• What percent succeed?
• Is there a “tenuring up” policy?
• schedule -when do people come up for tenure?
• What are the criteria for promotion to full professor?

Details
• Can I see the space for this person?
• How much office space, lab space, offices for graduate students?
• How long to remodel? Who pays?
• Ethernet? Networks? Email? Who pays?
• Reprints? Page charges?

IMPORTANT FOR YOUR SANITY: When will a decision be made? When might I be notified?

Faculty Members

Big Picture
• What do you like best about this place?
• What do you like least about this place?
• What are you looking for in this new position?
  (want to know: is there agreement? Or are there opposing ideas?)
• What are hiring priorities for the future?
• What else does a newcomer need to know?

New Faculty Assimilation/Success
• What sorts of programs are available for new faculty members?
  • when you started
  • now
  • what do you wish you’d known?

Higher Administration
• How is the [higher] administration? Rigid? Flexible?
• Are they fair?

Department Administration
• How often does the department meet?
• How are decisions made?
• Do you feel that faculty have an adequate say in day-to-day operations?
  • In major decisions?

Graduate & Undergraduate Students
• How about the students? Are they motivated? What do they do after graduation?

• What support is available for graduate student research? Enough computers?
• What support is available for undergrad research?
• Are work-study students available from time to time?
• Is there travel support? How often? How much?

• Do all biology majors do research?
• Do they have to submit a thesis?
• Are there any curriculum changes in the works?

• Do grad students with TA’s have time to get their own research done?
• How are most grad students funded?

Faculty, continued

Research
• What support is available for research?
• How’s the library? Journal availability? Where do you go for the obscure stuff?
• Does the administration support travel to scientific meetings? How often? How much?
• How much equipment sharing is there?
• Do you feel like this is a congenial environment?
• How much collaboration is there within the department or college?
• How much external collaboration is there? Is this supported by the administration?
• Who does grant book-keeping?
• Is there access to mainframe or UNIX-based computers?
• How much technical support is there for computing?

Teaching
• What do you teach?
• What is the general teaching expectation through time? How many courses?
• What would you like this person to teach over the next 3 years?
• How much flexibility in what an individual teaches?
• How much flexibility in when courses are scheduled (within a week, within a year)?
• How big are classes? Are teaching loads weighted by the number of students in the classes?
• Can I teach a seminar the first semester/quarter?
• Are TAs available? For what courses?
• How are TAs trained?
• How much funding is there for courses, particularly new ones? Can you buy what you need?
• How do ideas for new courses get processed?
• What secretarial help is available for working with courses? With grants/papers?
• Is this a Mac based or PC based department? What are the student computer labs like?
• Who sets up equipment and washes glassware for teaching labs?

Responsibilities/Loads
• How are administrative committee responsibilities?
• How about advising?
• How many minor committees for graduate students?
• What percent of your time is spent on teaching, research and service?
• What is the average class size?
• What is the average lab size?
• What is your overall work load?

Sabbaticals
• What is the policy on sabbaticals? Do they have them? When? Are they automatic? How much?

Faculty, continued

Promotion & Tenure
• Are there annual reviews before tenure?
• Who decides on tenure?
• On what criteria are decisions made?
• Are the criteria written down and handed out to new faculty?
• What are the unwritten criteria?
• What percent succeed?
• Is there a “tenuring up” policy?
• schedule -when do people come up?
• What are the criteria for promotion to full professor?

Details
• How's the salary?
• How do raises work?
• Are the benefits any good? Are they transferable to other schools?
• What are housing costs?
• Is good housing available?
• What's it like to live here? Where do most people live? In town? Elsewhere?
• Schools?
• Crime rate?
• Cultural events on campus? Locally?
• Tuition assistance?
• Opportunities for spouse/partner?
• How’s the parking?
• Family leave policies? Maternity coverage? Day care?
• Who pays for photocopying, phone calls, interlibrary loans, faxes, page charges, reprints?

Miscellaneous Questions

Salary/Benefits (Ask administration, untenured faculty, or benefits coordinators)
• How much?
• Hard money or soft money?
• What are the fringe benefits like?
  • health insurance. Who pays? What %? How does copay work?
  • maternity coverage/leave. How long a leave is guaranteed?
  • sick leave
  • retirement plans (TIAA-CREF? How do they do it? Matching? Who pays?)
  • any mortgage assistance programs?

Raises (Ask administration & untenured faculty members)
• what are the typical ranges?
• On what criteria are raises granted? Who decides?

Living
• cost of living: high/low?
• housing costs

Start Up
• How much money for equipment, supplies and travel as "set up" money?
• Can the spending be spread over a number of years, say two or three?
• Summer salary included?
• How about summer salary for undergraduate and graduate students until grants?
• Is there seed money available from the college/university?

Tenure
• schedule -when do people come up?
• Are there annual reviews before tenure?
• Who decides on tenure?
• On what criteria?
• Are the criteria written down and handed out to new faculty?
• What percent succeed?
• Is there a “tenuring up” policy?

Graduate Students
**Big Picture**
- What do you do?
- Why did you come here?
- What do you want to do after you finish?
- What's the best thing about this department?
- What could be improved?
- What’s the best thing about this institution?
- What could be improved?
- What do you want from the new person?
- What skills/courses/seminars could I offer that would be especially helpful to you?

**Student Life: What’s it like to be a Ph.D. student here?**
- How much camaraderie is there among the students of different professors?
- How much say do you have in administrative decisions? Job searches?
- Do students worry about support? How are the TAs? RAs?
- How many students have their own grants?
- Do you have enough money to live on?
- Is there a department social life? Within the grads/postdocs?

**Department Politics**
- Do the faculty get along? Are there hierarchies? Clear schisms?
- How do things work day-to-day? Does each professor have their own lab, which works independently of other labs? Or have professors banded together in groups with more shared equipment?
- What do you hear from faculty about:
  - job satisfaction
  - department politics
  - tenure issues
  - salaries
- What do you think about these issues?

**Courses**
- What's a typical junior/senior course like?
- What's a typical grad course like?
- What classes are hard? How much out of class work is there? Is there a lot of variation among different sections of the same course?
- What’s the grad curriculum, beyond the core courses? Do students take many courses?
- How do you like having required core courses?
- What’s this statistics core course like from a student perspective?
- How big are the classes?
Teaching
- Do you have time to do your own research when you’re teaching?
- How much teaching does the average student do?
- Do you get trained?
- If so, how?
- Would there be interest in seminars to improve teaching methods?
- Can you take a more active role in teaching, if you want to?

Research Training
- How many of you had M.S. degrees when you started here?
- How many of you had research experience as undergrads or as technicians?
- Do you feel like you’re exposed to sufficient techniques here?
- Is there support to get training elsewhere if it’s not available here?
- Do you have enough computers/equipment to get your research done?
- What do you need that I could buy with startup funds to help the community?
- Do you have enough time to do your research if you’re also teaching?

Details
- How’s the food? Beer?
- Do alumni come back and tell you about life after graduation?

Questions to be Prepared For

In one of my interviews, I was given these four topics in advance:
- Future research plans: what directions do you see your research taking in the next 5-10 years? What will be the topic of your first major research proposal as a new faculty member, and where will you submit it? What balance do you anticipate between field research and lab/office based research? If field work will be important, what field sites would you want to consider in the first few years?
- Education: Given our curriculum needs within the X group, how will you contribute to the undergraduate and graduate curricula? In particular, what graduate course(s) what you like to teach, and what will be your basic teaching model (e.g. lecture, lecture + lab, discussion, etc)?
- Graduate and undergraduate research: How will you engage graduate and undergraduate students in your research program? That is, what style of advising/mentoring will you use?
- Resources: What critical resources do you need in order to establish a successful research program? What critical resources may already be here? What kind of help would you want from the X group, the Department, and the University for you to achieve your goals?

From Everham & Smallridge, ESA Bulletin Dec 1994
• What is the main point of your dissertation?
• What are your professional goals?
• What is your concept of teaching in a 4-year college as opposed to a research university?
• What specific research will you pursue if you are selected? How do you anticipate funding it?
• How has your experience and training prepared you to teach the courses required?
• What other courses might you teach?
• Why do you want this job?
• Why should they hire YOU?
• What strengths would you bring to the department?
• What would you expect from this department and administration?
• What kind of start-up funds, facilities, and equipment would you need?
• What experiences or interests do you have in college-wide activities and service?

From an underground primer by Peter Kareiva (UW-Seattle) and Dan Doak (UC-Santa Cruz):
• What research will you be doing when you show up here?
• What projects will you start next?
• Why would you want to come here?
• What teaching would you like to do?
• What is your philosophy of grad student training? How will you support students? What types of projects do you expect them to work on?
• What do you contribution to the department that is not already well covered by the faculty?
• What makes you think you could ever get any outside funding?
• What is the best idea you ever had?

Questions to be Prepared For, continued

From an underground list of questions used by graduate students at the University of Arizona
• What do you do? (the 3-5 minute summary of your entire research agenda)
• Where do you see your work going in the next 10-20 years?
• What kinds of tools would be available in your lab for grad student use?
• In what areas do you think your work would uniquely contribute to this department?
• With whom in the department do you envision interacting the most? Outside the department?
• What meetings do you attend? What societies do you belong to?
• What do you envision as your ideal lab: # grads, undergrads, postdocs, techs, participation of grads who are not your own students?
• To what degree do you see integrating grad students into your research program?
• Is their work usually closely related to your research focus or is it fairly independent?
• How do you help grad students get started on a project?
• What’s your perspective on grad student funding?
• How would you respond to a student who is floundering (early vs. late)?
• What types of mentoring have you experienced -- and what would you do similarly or
differently?
• What courses have you taught before?
• What do you see as the major challenges of teaching at a large (small) university?
• What do you want to teach? (grad, undergrad, seminars) Statistics?

Questions Known To Catch People Off Guard

• The illegal questions: spouses, children, etc.
  • For example: will anything need to be done for your spouse/partner (like find them a job)?

• Would you take this job if it were offered to you?

• How would you handle an interpersonal conflict in your lab?
• A break-up between two members of the lab who were involved?
What Colleges and Universities Want in New Faculty

- How well do current graduate programs prepare their students for academic careers?

- Which aspects of the transition from graduate student to faculty member are most difficult for newly hired faculty?

- What changes are needed in graduate programs to address the areas new faculty cite as problematic?

Academia is a major employer of new doctorate recipients (Henderson, Clarke, and Reynolds 1996; Henderson, Clarke, and Woods 1998; Sanderson and Dugoni 1999). While the world of academe has changed dramatically over the last two decades, most graduate programs that prepare new faculty for their first academic positions have not. As the number of people earning doctorates has increased, competition for assistant professor positions is keen, and the number of available positions has not kept pace. Those who mentor and educate most graduate students work in the environment of large research universities that are radically different from the environments where most jobs are available, namely, small public and private colleges, public comprehensive universities, and community colleges. In this context, new faculty are well aware of the shortcomings in their training.

Research has clearly documented the impact of the mismatch between graduate training and the multiple academic responsibilities facing new faculty (Austin 2002, Boice1992, Olsen 1993, Olsen and Crawford 1998, Rice1996, Sorcinelli 1992, Tierney 1997, Tierney and Bensimon 1996, Whitt 1991). On the other hand, graduate faculty have been slow to recognize the discrepancy between the academic environment in which they have succeeded and the environments to be faced by the graduate students they have carefully mentored. At the least, they have not modified their programs to address the responsibilities of the next generation of assistant professors.

This essay provides information to graduate faculty members and others responsible for doctoral education about the new realities affecting the academic job market.
and the working conditions of faculty members. The information is drawn from both research studies and the academic practices of diverse institutions. Our hope is that once graduate faculty members understand the new conditions facing professors, they will use it to adapt their doctoral programs so that they better serve those graduate students aspiring to an academic career.

This paper reviews the research on the preparation needed for graduate students who plan a career in academia for their responsibilities as faculty. The research provides the theoretical and empirical bases for practices that achieve the kind of preparation needed in the current educational context. While practices developed in the Preparing Future Faculty programs (PFF) are not specifically referred to in this review, many of the strategies proposed here have been enacted—mostly successfully—at the universities where PFF programs have been in place. A companion piece to this review is Leigh DeNeef’s Preparing Future Faculty Program: What Difference Does It Make? (AAC&U 2002), which surveys the alumni of PFF programs as to their effectiveness.

This document is a call for graduate faculty and administrators to revise their doctoral programs to a) enable their students to make an informed decision about

How Do Preparing Future Faculty Programs Prepare Students for Faculty Roles?

Although universities are encouraged to design their own PFF programs based on their strengths and the interests of the faculty and students, several common activities help their graduate students to prepare for academic positions in different kinds of institutions.

All PFF programs include preparation for teaching, research, and service, the three aspects of a faculty member's role in most colleges and universities. They do this through courses with such titles as “College Teaching and The Academic Professional,” as well as through workshops and informal brown bag discussions.

PFF programs give graduate students direct personal experience at different types of institutions. For instance, a student may visit a liberal arts college, comprehensive university, or a community college and learn about their different missions, student bodies, and expectations for faculty.

Many PFF students are assigned a faculty mentor at a different type of institution to plan and teach a unit of a course and receive feedback and advice, to attend a department or faculty meeting, and to participate in a faculty development activity.

Often students are encouraged to prepare professional portfolios documenting achievements in teaching, research, and academic citizenship that are useful in the job search.

Typically students receive assistance preparing a résumé, writing an application letter, and doing mock interviewing.

Graduate students tend to be enthusiastic about these opportunities because they learn about the profession they seek to enter, they learn important skills in finding a job and are able to start a new position with greater competence and confidence.
choosing an academic career, b) prepare future faculty members to secure positions in the kinds of institutions where they want to work, and c) help their students develop the skills and capacities they need to survive the first few years of an academic appointment and to meet expectations and tenure requirements at different types of institutions.

A review of the literature and of academic practices regarding graduate students and new faculty suggests five areas that need attention: teaching, research, academic life, job search, and academic options.

1. Teaching

Teaching is the responsibility that demands the most immediate attention and consumes the most time and energy of new faculty (Boice 1992). Hiring institutions desire that applicants be “teaching ready” (Benassi 1999). Yet, the teaching preparation of graduate students is quite varied. Some graduate students have no teaching experience; others have served as a teaching assistant in a couple of different courses; some have taught labs or discussion sections; others have taught a single course; and a few have independently taught several courses. That only a few graduate students have broad experience with teaching suggests that graduate programs are not adequately addressing a major component of faculty work. A national survey of newly hired faculty and their chairpersons agreed that graduate programs did not adequately focus on preparation for college teaching (Seidel, Benassi, and Richards 1998). It is no surprise that the preparation for teaching is inadequate given that graduate students in a recent longitudinal study reported they receive mixed messages regarding the importance of teaching (Austin 2002).

Most new faculty report that they are uneasy with the number of new class preparations and the variety of courses that they are required to teach during their first few years (Boice 1992). Regardless of the type of institution, required liberal and general education courses make up some portion of the curriculum. It follows that most faculty are expected to teach in the general education curriculum that is directed at undergraduates in all disciplines and at varying levels of time to degree. This expectation often comes as a surprise to junior faculty who have just spent several years focused on a narrow niche within one discipline.

In order to best serve the liberal and general curriculum, junior faculty must understand its philosophical importance to the notion of the educated person. In addition, recent curricular changes in undergraduate education include emphasis on multicultural, international, interdisciplinary, and service learning. New faculty may find that they are expected to develop, as part of the general education curriculum, courses that focus on these curricular developments. As an essential component of their courses, they may also be asked to teach writing or integrate the use of computers. Yet, these issues and aspects of teaching are usually ignored in graduate programs.
Most colleges and universities have increased the emphasis placed on the quality of teaching. One result is that well-structured lectures alone no longer meet the criteria for excellent teaching. Faculty are expected to utilize creative techniques that effectively engage students and support learning. Schools expect faculty to embrace new pedagogies including the use of technology, collaborative learning, simulations, and field experiences. Because students come from a variety of backgrounds, demonstrate various levels of motivation and diverse learning styles, and exhibit a wide assortment of career goals, faculty are expected to address their multiple needs, without sacrificing academic rigor. Regardless of the size of the institution or whether its student body includes graduate students as well as undergraduates, teaching often includes the supervision of practicums, internships, independent studies, and theses. Doctoral graduate students, however, are rarely given the opportunity to fine-tune their teaching skills or to mentor students in non-classroom endeavors.

Advising is often part of faculty members’ teaching responsibilities. At many small institutions, this responsibility is not limited to advice about how to complete a major. Faculty are expected to have an “open door policy,” that is, to be available to students on a regular basis and to welcome students seeking consultation on issues ranging from class material to graduate school to home life. Many new faculty are ill at ease with advising students about personal issues, and they struggle with the dilemma of how to limit their time with students so close to their own age who seek extended time with them. Even for seasoned teachers, teaching and advising expectations can be a heavy load demanding extraordinary effort from new faculty who have only a small foundation of experience on which to draw.

Recommendations to Graduate Faculty

Graduate programs must provide their doctoral students with a variety of teaching experiences and successively more independent teaching in order to prepare them for academic careers. These experiences should begin during the first year of graduate school and continue throughout graduate study.

Students need to be introduced to new pedagogies, becoming involved with and knowledgeable about such areas as active learning, field-based learning, diversity, and technology.

Students need more than just the experience of teaching classes. New teachers also should receive constructive feedback about their performance and participate in group discussions about creative teaching possibilities, problem solving, and advising.

The model used for training graduate students in research could be followed in similarly building graduate students’ competence and confidence in teaching and working with students. As a first step, departments or graduate schools could offer seminars on teaching. Later experiences might include supervised teaching, team teaching, summer school teaching, and teaching fellowships, after the more typical experience of teaching assistantships and leading lab or discussion sections.
Faculty identified as outstanding teachers could also mentor individual or small groups of students as part of their teaching load. One particularly underutilized source of expertise in this area is faculty members in other geographically accessible institutions, particularly those who are recognized as successful teachers and who use innovative and engaging approaches to teaching and learning. Many such faculty members do not have the opportunity to work with advanced doctoral students and would welcome the opportunity, if approached in a sensitive way.

2. Research

Although the specific criteria for research vary at different institutions, active scholarship is considered essential to the success of all faculty. Research expectations usually follow from the mission of an institution. At a minimum, institutions require that faculty stay informed about developments in their field. At the other extreme, research expectations are defined by qualitative and quantitative criteria, and publication and grant success define the path to prestige, salary increases, and tenure. Some institutions have expanded their definition of research following the publication of *Scholarship Reconsidered* (Boyer 1990) to include, in addition to the scholarship of discovery, the scholarship of integration, application, and teaching. Today, urban institutions often value practical and applied research that assists their communities, while liberal arts colleges often support interdisciplinary as well as more traditional disciplinary research.

Regardless of the type of institution, faculty are expected to develop a research program that fits with current practice based on the institution’s mission. For most new faculty this means that research plays a different role in their academic life than it played at the research university where they earned their doctorate. They often must disperse their research activities around the primary task of teaching. Since resources are likely to be limited, new faculty may not be able to continue their doctoral line of research. The collaborative research process that seemed so natural in their graduate program may not exist in their new position because they may be the only one in their institution pursuing their particular research area. New faculty may not have graduate research assistants. Many campuses now emphasize undergraduate research, and they may need to learn to include undergraduates in their research. Where do graduate students learn about modifications that will be necessary when they become faculty members at different kinds of institutions?

Recommendations to Graduate Faculty

Graduate faculty must understand that their students’ time and energy in graduate school have been devoted to a task that may not have the same primacy in many new faculty positions. Faculty need to become familiar with the conditions surrounding research activities at different types of institutions. For example, unless graduate students have been hired at a research university, they will not have the same resources available to accomplish their research. Space, money, and assistance may be scarce at their new institution. As new faculty, they may need to consider alternative methods or alternative lines of research.
Faculty should assist their students in preparing for an environment that expects research to be accomplished at the same time that other responsibilities exert more immediate demands (e.g., graduate students could develop projects in their research area that do not require many resources).

Graduate students need an introduction to the growing practice of incorporating undergraduates into their research projects.

Just as new faculty benefit from having previously taught a variety of courses in different settings, they benefit from conducting research under different conditions while still in graduate school. Graduate faculty should consider these needs as they mentor students in developing a research program.

Faculty from a variety of institutions can serve as a valuable resource to doctoral programs by sharing information about the different kinds of research activities at institutions where this responsibility is not the primary focus of faculty.

3. ACADEMIC LIFE

New faculty members must learn and adjust to the unique “academic life” of their institutions. This life is defined by the particular emphasis and expectations that each institution has for teaching, research, and service, in the context of the institution’s overall mission. In the current climate of decreased funding for higher education, downsizing the number of full-time faculty, increased workloads, and reduced availability of funds for research, new faculty consistently report being overwhelmed by the variety of demands placed on them and surprised by the lack of collegiality at their institutions. Junior faculty members have vividly described their difficulties in adjusting to the “freedom to work all the time” and to the “professional alienation” they have experienced in their tenure track positions (Boice 1992, Newman 1999, Olsen 1993, Tierney 1997, Tierney and Bensimon 1996). In contrast to the focus on research in graduate school, teaching and work with students often consume most of the new faculty members’ time. They typically have little energy or time left to establish their research programs. Although teaching, research, and service are listed as the criteria for tenure, the specific standards and weighting of them seem unclear to new faculty. Moreover, new faculty have constant fear that whatever they accomplish will not be enough to earn tenure.

In addition, many new doctorate recipients today are hired in positions that did not exist when their graduate mentors were junior faculty. During the 1990s, the majority of appointments to full-time faculty positions involved jobs that were not on the tenure track (Finkelstein and Schuster 2001). Although some of these appointments mimic the expectations of tenure-track appointments, many of these positions focus on teaching rather than the traditional triad of teaching, research, and service.
Faculty work has long included responsibility for some aspects of governance of the institution, usually in the form of a faculty senate and associated committees. Committee service is usually required of all faculty, although new faculty may be spared assignments in their first semester or year. Time commitments for committee work may range from minimal to several hours a week; some committees are neutral, while others are politically powerful.

Most graduate students are aware of departmental politics, but they are unfamiliar with faculty decisions by powerful committees that may affect areas as diverse as curriculum, personnel, and budgets. New faculty must expand their outlook from the focused environment of graduate study to encompass the faculty role in issues such as broader curriculum revision, working conditions, and distribution of financial and physical resources. Such faculty decisions typically involve political land mines that new faculty may want to avoid. Committee work will be one way colleagues outside their department can get to know them as well as a way of establishing their presence on the broader campus.

Since service seems to count little toward positive performance reviews, new faculty are unsure about how to judge the importance of multiple requests for service that are usually made by senior faculty and administrators. Faculty of color are espe-
cially vulnerable to such requests, given their additional responsibilities of serving as role models for minority students and as institutional representatives for issues related to race or ethnicity. Similar “extra” expectations occur for new female faculty in disciplines that are non-traditional for women. They also often find themselves carrying extra service commitments in part because of stereotypes about their “innate” abilities to counsel students and organize departmental social events. Likewise, at smaller institutions faculty are expected to participate in community events that frequently occur at night or on weekends. They are sometimes surprised both by the impact their institution’s mission has on the overall curriculum and by the assumption that they will support the mission in their teaching and research, a task many feel unprepared to do. The variety of demands requires the ability to balance them in ways seldom anticipated when they were in graduate school.

Recommendations to Graduate Faculty

Doctoral training currently focuses almost exclusively on building competence in an academic discipline and the research skills necessary to make significant contributions to the field. This singular focus does not match the career goals of most students who plan to seek academic positions nor the real situation they find at hiring institutions. Graduate faculty and administrators have an obligation to learn about the reality of academic life in different types of positions at a variety of institutions. Knowledge about the multiple responsibilities of new faculty would enable graduate faculty to design programs that provide additional experiences relevant to the responsibilities their graduate students will face as new faculty. For example, graduate students should be involved in discussions about the benefits and potential pitfalls of participation in faculty governance, the implications of a term position for their career, the potential impact of joining a department as the only female or person of color, etc.

Currently, all graduate students have a research mentor; they may need additional mentors to learn about the various other aspects of academic life. Faculty from a variety of institutions (including research universities) could serve as consultants to graduate programs, presenting sessions on academic life and expectations of faculty at their institutions. Graduate students could “shadow” these faculty at their home institutions for several hours, for a day or even a week, experiencing first hand the myriad responsibilities faced by faculty in non-doctorate awarding institutions.

Optimally, graduate students would visit more than one type of institution so that they could see differences and similarities across campuses.

4. JOB SEARCH

Many new Ph.D.s are unprepared for the academic job search process (Heiberger and Vick 1996). In their recent survey of Ph.D.s ten to thirteen years
after gaining the degree, Cerney and Nerad (Pollak 1999) found large numbers of them criticized the information they received from faculty members about career planning or the job search. While new doctorate recipients are knowledgeable and confident about their discipline and highly skilled as researchers, great anxiety is associated with the job search.

Because a single position announcement can elicit hundreds of applications, it is critical that graduate students become savvy about how best to match their skills and interests to potential jobs and thus make wise decisions about where to apply. They must also learn how best to present their credentials in order to stand out among a large number of qualified applicants. Too often the files of qualified applicants are not considered because their cover letter is too general or is better suited to a different type of institution. During interviews, applicants must be prepared to evaluate an institution and potential colleagues as well as to be evaluated themselves. Applicants should assess the fit between their skills, interests, and goals, the institution’s mission, and the department’s focus. In addition, new faculty too often realize after they are hired that they should have negotiated more effectively for such things as salary and resources including travel money, research support, computer equipment, and office and lab space. These resources can be critical to success in their first academic position.

Too many graduate faculty belittle academic positions that are not at major research institutions, even though research universities have provided employment to a very small percentage (for example, 5 to 10 percent from one highly ranked university) of new Ph.D.s over the last decade. At the same time, graduate faculty often have little knowledge of, or interest in the faculty responsibilities at institutions where most jobs are found.

Recommendations to Graduate Faculty

Faculty in graduate programs have a responsibility to assess the employment patterns of their graduates and to evaluate their program’s success at preparing their students for the search process. They should annually survey students who have recently completed job searches with the goal of identifying deficits in their knowledge about and preparation for searches. Such information could guide departments in designing revisions or additions to their curriculum. For example, departments may decide to assist students in preparing to teach a sample class in addition to making a research presentation as part of the campus interview process.

On an individual basis, graduate faculty should be aware of the importance of writing letters of recommendation geared to the specific position and the nature of the hiring institution.

Faculty should advise students that their application cover letters be similarly relevant to the position and institution.

Graduate programs may need assistance in preparing their doctoral students for successful job searches since their own faculty’s experience typically has been at large research universities.
Junior and senior faculty from various types of institutions could develop a program that presents information about the search process from a variety of perspectives and thus better prepares new doctorate recipients for the rigors of their first job search.

5. **Academic Options**

Today, fewer available faculty positions are tenure track than in past decades. Many new Ph.D.s are offered part-time or temporary full-time work for their first academic appointment (Finkelstein, Seal, and Schuster 1998; Schuster 1995). These positions are likely to emphasize teaching and to carry few, if any, research expectations. Furthermore, they may require that the faculty member teach only introductory courses, multiple sections of the same course, or remedial courses.

The option of temporary or part-time faculty status raises significant questions that graduate faculty may need to help their students sort through. For example, should a new Ph.D. accept an offer only if it is tenure track? Is it preferable to

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**What Do New Faculty Members Say About the Benefits of PFF Programs?**

Although PFF programs have been thoroughly assessed, it has not been until recently that there have been enough doctoral students completing a PFF program, finishing requirements for a Ph.D, securing an academic position, and gaining enough experience to assess the value of PFF in their early career. That is changing, and Leigh DeNeef, associate dean of the graduate school at Duke University, was commissioned to survey a sample of PFF alumni and conduct follow-up telephone calls with several (in Leigh DeNeef, *Preparing Future Faculty: What Difference Does It Make?* Washington, DC: Association of American Colleges and Universities, 2002). Here are some of his findings:

- PFF changed the nature of the graduate experience. Specifically, individuals reported that it created a sense of intellectual community that had been missing, legitimated conversations about teaching, gave a broader view of the diversity of institutions, and gave them more sophistication about navigating academic organizations.

- PFF helped students successfully negotiate the job market. In particular, PFF alumni believed that they knew more about the academic scene and the variety of institutions than their competitors. They also believed that they knew better how to present themselves as professionals who could “fit” in different institutional environments.

- PFF prepared alumni for the early stages of their careers. For example, because they had had some meaningful teaching experience and had acquired a “basket of tools,” they were less stressed than their colleagues with their teaching responsibilities. One surprising finding was that these new faculty were asked by their cohorts for advice and several served as de facto mentor to their new colleagues.

Obviously, more research needs to be done on conditions that produce most and least benefits, on which kinds of students benefit the most and least, and on what the long term impact is on academic careers. But the early results are promising and confirm the several recommendations in this essay.
take a post-doctoral fellowship over a temporary faculty position? (A post-doc will build the research skills and one’s resumé, but will ignore the acquisition of other skills required in a faculty role. In this sense, a post-doc continues the research focus of graduate school, thereby perpetuating the narrowness of graduate training.) Will a temporary, full-time job or even a series of temporary jobs imply that a new doctorate recipient is deficient in some way when s/he later applies for tenure-track positions? Will part-time teaching bolster an application for tenure-track positions in the future, particularly if the applicant gained little or no teaching experience in graduate school? Or, is part-time teaching the beginning of an endless cycle of part-time, temporary positions? Graduate students need to consider the long-term implications and consequences of their decisions and would benefit from the advice of those who know and understand the academy.

Approximately one-half of the enrollments in postsecondary institutions are in two-year colleges, with 20 percent of the current faculty at these institutions having earned the doctorate. Currently, numerous faculty vacancies exist at community colleges. If the job market for academic positions at four-year colleges and universities remains extremely competitive, and if attitudes toward teaching at community colleges improve, more Ph.D.s may seek employment at community colleges. Yet, the typical doctoral program does not prepare its students to teach at these institutions.

At community colleges the student body is more diverse than that at the typical four-year college or university. Compared to other types of institutions, the teaching load is heavier, but research is usually not required. Essential criteria for an academic career at a community college include evidence of effective teaching, ability to relate to students, interpersonal skills, communication skills, proficiency in the use of technology, and a degree in the discipline one is teaching (Higgins, Hawthorne, Cape, and Bell 1994; Law 1994). Except for the degree, current doctoral programs do not usually emphasize these characteristics. Often, graduate faculty view employment at a community college as a failure on the part of their students, even when a graduate student’s primary interest is in teaching in this setting. Given the number of job opportunities available at community colleges, graduate programs may be limiting their students’ career choices in academe if these are not considered as possibilities.

Further, opportunities are growing in alternative educational settings: for instructors in electronic universities, virtual programs, and distance learning providers, some at traditional institutions and others non-traditional. Corporate universities provide a large and growing market for education and training. Continuing education programs in both non-profit and for-profit sectors are expanding at a rapid rate. In short, the range of options that are available to graduate students interested in a career in postsecondary education is large and expanding, and many of them would appreciate knowing about these alternatives.
Recommendations to Graduate Faculty

Faculty in doctoral programs should explore the various career opportunities available for their students, and they should educate themselves about the realities of the current academic job market in their field. Recent graduates may be an excellent resource for this information.

Graduate faculty should consider multiple types of academic careers when mentoring their students, and graduate programs should provide students alternative experiences related to their long-term goals.

If programs offered more preparation in teaching, opportunities to gain expertise in the use of technology as an educational tool in their field, and education about diverse student needs and learning styles, their graduates would be better prepared to meet the faculty expectations at many institutions.

In addition, graduate faculty should be prepared to assist students in considering the pros and cons of accepting part-time or temporary positions. They might help students develop alternative career plans depending on the type of job they find immediately after graduate school.

Information about alternative educational careers in community colleges, virtual universities, corporate universities, and continuing education programs should also be available to graduate students.

SUMMARY

Although the roles and responsibilities in colleges and universities have significantly changed over the last two decades, graduate faculty and administrators have yet to embrace the reality that the present job market demands skills and experiences of new Ph.D.s that were not required twenty years ago. Graduate faculty need to be aware that to succeed, the next generation of faculty needs more than research skills and an in-depth knowledge about a narrow specialty in their field. The attitudes and goals of graduate faculty members are particularly important, since they are the mentors and advocates for the pool of future faculty. Graduate faculty, of course, are tied to a reward structure that reinforces research productivity above all other responsibilities that faculty assume at other institutions. Changes to graduate curricula will require that institutions revise and broaden their current expectations of graduate faculty from the sole focus on research productivity. The reward structure that influences the responsibilities of graduate faculty should recognize not only the contributions of a faculty’s research but also their responsiveness to the career preparation needs of future faculty who are their graduate students.

Graduate programs should expand graduate study from the current singular focus on research to address the multiple responsibilities new faculty are likely to face.
face. The structure of graduate programs could be modified to include several tracks, each equally valued and supported, that prepare students for different career paths and provide internships in business, government, or non-profit organizations. In adopting these recommendations, graduate faculty members will need to form new collaborations with faculty members in different kinds of colleges and universities and with professionals in other organizations.

This essay suggests several areas of doctoral education that need immediate attention in order that universities prepare their graduate students for successful careers in academia.

- Graduate training has not yet recognized the importance of teaching in the triumvirate of teaching, research, and service responsibilities. In response to this fact, graduate programs should provide a variety of teaching experiences for doctoral students beginning with the first semester and extending throughout students’ training.

- Research remains an essential aspect of faculty work, and new Ph.D.s emerge from their graduate work highly trained in this area. Graduate programs, however, must help students to develop research programs that will meet the expectations and resources of diverse institutions.

- New faculty must negotiate their way through the maze of written and unwritten expectations that govern the unique academic life of hiring institutions. Graduate programs have a responsibility to educate students about the reality of expectations at a variety of institutions.

- While a successful job search is a goal common to all graduate students, they report feeling unprepared for this process because graduate faculty are often not well versed about the search process at hiring institutions other than research universities. Faculty who teach in graduate programs should assess their previous graduates’ employment patterns and enlist the aid of alumni and faculty employed at other types of institutions to develop programs that address the needs of students entering the current academic job market.

- Academic options have expanded to include non-tenure track positions, teaching in community colleges, and electronic and corporate universities. Preparation for academic careers should recognize these forms of employment and provide alternative experiences for students interested in pursuing non-traditional academic opportunities. Graduate faculty should learn how best to mentor students for success in differing types of academic positions.

Although the recommendations noted throughout this essay may seem impossible, Preparing Future Faculty programs (PFF), funded by The Pew Charitable Trusts, the National Science Foundation, and The Atlantic Philanthropies have been experimenting with these ideas and recommended practices since 1994. They have discovered that acting on these recommendations is practical, not complicated or
costly, and that the recommended practices do work. Research universities should maintain primary responsibility for the education of graduate students, but other institutions can make valuable contributions through consulting and mentoring activities. PFF has created partnerships composed of forty-three graduate universities, each clustered with several other partner campuses. The 294 institutions collectively involved in these clusters offer multiple models of departmentally based and university-wide programs as well as cooperative programs among all types of institutions (research institutions, liberal arts colleges, comprehensive universities, historically black institutions, single-gender institutions, community colleges, public and private, etc.). PFF’s diverse programs have been successful in addressing concerns about the preparation of doctoral students for academic positions, and graduate students are overwhelmingly enthusiastic about their experiences with PFF (Bogle, Blondin, and Miller 1997). No one model will work for all graduate universities, but for the advantage of their students, graduate programs must respond to their career goals and needs by exploring practices that better prepare them for one of the common career paths of Ph.D. recipients.

Note

1This work was supported by the Preparing Future Faculty (PFF) program, which is jointly sponsored by the Association of American Colleges and Universities and the Council of Graduate Schools, and has been funded since 1993 with a series of grants by The Pew Charitable Trusts, the National Science Foundation, and The Atlantic Philanthropies. PFF resulted from the recognition by these professional groups of the need to revise graduate training to better prepare graduate students for the expectations they will face in faculty positions. The project currently involves a total of 294 schools, including research universities, liberal arts colleges, comprehensive universities, historically black institutions, community colleges, and single gender schools working in clusters with doctoral granting institutions. Many of the recommendations proposed in this document have been piloted and adopted by the schools involved in PFF.
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I’m writing this letter with the assumption that you intend to maintain an active research program and remain part of a broader research community, but that you are considering doing this at a primarily undergraduate institution. As a graduate student, I was pretty certain that I wanted to teach at a "liberal arts" college. My dissertation advisor strongly recommended that I do a postdoc rather than apply for positions directly from grad school, and this turned out to be excellent advice. Had I not taken his advice, I have no idea what my future would have been, but I’m pretty certain it would have been worse. For personal reasons (i.e., the "two-body problem"), I was a postdoc longer than I intended (four years), building up a reasonably solid publication record that probably had little to do with getting my first academic position at XXX University.

XXX is a state comprehensive institution -- primarily undergraduate, but with some masters programs, generally in "professional" areas. There was little incentive to do research, although several of my colleagues in Biology were active and publishing papers now and then. Some senior faculty were openly hostile to research, and my chairs and dean were not especially supportive. The provost was an exception; she seemed to genuinely support scholarship. However, as much as I wanted to maintain a strong program, the environment was not suitable. First, there was little in the way of a "research community." Most students did not do undergraduate research; in my time there, we had anywhere from five to a dozen students doing research in a given year. Second, research did not seem to figure into tenure and promotion decisions. I would say that, aside from personal desire to remain active, my main incentive to maintain a solid research program was to stay marketable. When it became clear that my wife ("Jane") would not find a permanent position in the area, we chose to relocate back to the northeast once either of us had a good offer. This time, Jane had the offer (research faculty at MED SCHOOL). After doing another year of postdoc, I took a position at another state comprehensive institution, YYY University. I should state that, based on my experience at XXX, I did not view that as a permanent position at the time; if things worked out well, so be it. If not, I knew the drill. I also knew that there was a good chance that, a few years down the line, Jane and I would be facing the two-body problem again, and remaining marketable was still not optional.

YYY was somewhat more supportive of research. My chair, not active in research herself, was behind me. In many ways, she was the best chair with whom I have ever worked. The university hired a new, ambitious director of sponsored programs. The university also had a competitive, renewable "untenured faculty research initiative" that provided up to 6 hours/year of release time for research. A similar program was in place for tenured faculty. The teaching load at YYY was comparable to that at XXX, though because of a strong union, the teaching load was much better defined.

As expected, in 2001, Jane and I started looking again for permanent positions. In the course of events, I applied for a position at ZZZ College. Although I was offered the position in 2001, I was unable to accept it because Jane could find nothing suitable in the area. However, when she took a position in industry in 2002, I asked that my application be reactivated (ZZZ had re-advertised the position). The main reasons for moving were (1) that the Biology Department at ZZZ was more supportive of research, (2) that ZZZ was more of a "liberal arts" college and (3) that working at YYY was aggravating. Because of parking and traffic problems, I would arrive at work by 8 AM and often not begin teaching until 5 PM. It gave me time to be productive, but the hours, well, sucked. You might think that sounds like a weak reason to leave, but think about doing it for 30 years! Also, it was even harder to find students for research at YYY than at XXX. The criteria for advancement were also unclear, and there were strict quotas on the number of faculty who could be promoted in a given year, making the process very political.
While ZZZ isn't perfect, I've found it to be a much better "fit." I remain friends with former colleagues at XXX and YYY, but I can't say I miss working there. My teaching load at ZZZ, while high in comparison to private institutions with larger endowments, is manageable. We are on a "12/12" load, similar to XXX and YYY, but calculated a bit more liberally (1 credit lecture = 1 credit teaching; 1 credit lab = 2 credits teaching). We also get 2 credits each semester for teaching undergraduate research, which brings us to a de facto 10/10 classroom/lab teaching load. There is reason to think that we will soon be awarded more credit for supervising undergraduate research. I have arranged for additional release time (bringing me to an 8/8 load) as part of the College's commitment to my NIH support. [I should note that YYY had agreed to the same load.] Although I have less personal lab space than I did at XXX or YYY, I have better equipment, no shortage of interested research students (eleven at the moment) and strong institutional support.

This is what I've learned in my travels. If you want to teach, you can do that anywhere. If you don't want to teach a lot, you should absolutely avoid state comprehensive institutions. Liberal arts colleges are quite variable with respect to their support for research; some require even more teaching than the state comprehensive institutions, so if you want to maintain a strong research program, fact-finding is a must. In my case, I had seven years of teaching experience prior to moving to ZZZ and, like a third-time home buyer, I was a much more intelligent shopper. I knew to not be optimistic when assessing institutions. That's not intended to sound cynical. But if most of the faculty are not engaged in publishable research, then you can be fairly confident that the institution isn't going to suddenly start placing emphasis on scholarship because you have arrived. If there are not many students doing research, you will find it difficult to find students to join your lab. I was able to succeed at XXX and YYY because I was willing to take the chance that senior faculty, chairs and deans might (and sometimes did) cause problems for me. I am fortunate to have a supportive wife, who is also a scientist and who understands why I felt it necessary to buck the system. I suppose it's also in my nature.

Teaching at a primarily undergraduate institution is very rewarding -- but look for a few red flags:

- Faculty, chairs and deans who constantly remind you that "we're a teaching college." Every college is a teaching college, so those who use this phrase usually have another agenda. If this seems to be the mantra of the institution, you better not be wed to research unless you're willing to put up a strong fight (and take your chances with dismissal). A corollary: faculty and administrators who tell you that you shouldn't plan to do research until you have mastered your teaching.

- A shortage of associate professors. Find out why! It could be coincidental, but it could also reflect an unsupportive environment for junior faculty. Also, assuming they exist, ask associate professors what they had to do to get tenure. They've gone through the process most recently, so they provide the best insight into the institution's priorities.

- An absence of visible evidence of faculty/student scholarship. At ZZZ, the walls are covered with meeting posters; tour guides make a point of highlighting student research. Putting up posters at YYY was actively discouraged, because it might make unproductive faculty feel bad.

- Any unwillingness to let you meet the students. Students, especially when they are away from faculty, tend to be more honest about the good and bad aspects of the institution, if only by accident. The students you meet are not likely to be a random sample, but you know that already.

- An absence of faculty with research grants. NIH and NSF have specific programs in place to support faculty at undergraduate institutions. The grants are still competitive, but they exist. There are also foundations that provide support, if not for summer salary, at least for supplies. If no one has extramural support, or if you're told that you ought to be able to succeed on a couple thousand dollars a year, then you might want to ask some obvious questions.
ONE PRIMARILY UNDERGRADUATE INSTITUTION WITH MASTERS PROGRAM

I am an Associate Professor at XXXXX considered a research intensive state university. I accepted this position seven years ago as an Assistant Professor after completing a Ph.D. at LARGE STATE University and a postdoctoral fellowship at IVY LEAGUE University. The Biology Department has approximately 20 tenure track faculty at any one time, and we have a Master’s program with approximately 35 students. We are currently planning a small Ph.D. program, and if approved, will be in transition during the next five years. My teaching load is officially three courses a semester. However, having undergraduate research students counts as one course, and thus our ‘class’ teaching load is two courses a semester. Service activities such as department and university committees take approximately one day a week of my time.

There are many advantages to teaching at a mid-level institution such as ours. First, there is a great degree of freedom in the courses I teach, and I interact with students on a daily basis. I am able to have the freedom to set up the structure of my laboratory as I see fit and perform research in any area I choose. Both undergraduate and graduate students are eager to participate and often eager to learn. Teaching, particularly through research is, in my mind, the biggest perk of this job. I typically teach one lecture class at an undergraduate level with large enrollment, and one laboratory, or a graduate level course each semester. I am given freedom to choose the graduate level courses as I see fit and sometimes offer lecture-based courses, and other times seminar based courses, always in a topic that interests me.

My laboratory space is generous and the startup package allowed me to fully equip my lab and fund my research for two years after my appointment began. Most of our faculty compete for both NIH/AREA and NSF/RUI grants, which typically provide enough funds for small research programs involving a couple of graduate students and several undergraduates. Very few of us have postdoctoral scientists, although there are a few in the department. Many of the faculty have part or full time technicians, although it is always a struggle to find skilled technicians and budget enough funds in our grants to pay them adequately. We rely primarily on masters students to generate laboratory data in addition to the data we are able to generate ourselves. Because of our teaching and service responsibilities, however, there is very little time for us to work on our own experiments in the laboratory. Typically, when I am working in the laboratory, the students require enough attention that I am unable to perform experiments myself. Many of our faculty find this frustrating. However, I enjoy teaching through research and it does not bother me. Most of our younger faculty have been successful at finding federal funding and several of our senior faculty have substantial research programs. Writing manuscripts and grants take up a significant amount of time, much of it in the evenings and on weekends.

One significant drawback to working at an institution such as ours is the pace at which research proceeds. I typically find that I have to combine two or more master’s theses to publish in my field. Furthermore, since the students are only here for two years, and have little or no experience writing when they arrive, I typically have to do much of the data analysis and all of the writing for publications. Thus, the rate of publication is much slower than at a major research institution. Although both the university and federal funding agencies expect this from an institution such as ours, it is a constant source of concern and sometimes very frustrating. The biggest challenge of this job is to strike the right balance between accepting good students, helping them design projects that contribute to publications, making satisfactory progress on research, and deal with students who produce very poor quality work and tend to require more time than much more productive students. This challenge requires assertiveness, astute attention to student’s needs, and time management skills. It is very easy in this job...
to spend your time in very unproductive ways and enable students who, in the long run, should not be pursuing an advanced degree in the field.

Another major challenge at this university is to strike the right balance between time spent teaching and research. Teaching preparation can occupy as much time as it is possible to give at the expense of your research, and vice versa. Finding the balance is a constant struggle, and I think many of the faculty often fear they are performing both in a mediocre manner rather than one or the other in an outstanding manner. The university claims to value teaching very highly and spends significant time collecting data on both peer and student evaluations. However, tenure and promotion, and merit reviews are clearly based almost entirely on research progress. We are told that three publications in six years plus attempting to secure a federal grant is adequate for tenure. However, it has become clear to me that one would have substantial trouble with tenure if they were not to publish at least one paper a year and have a major grant funded plus be aggressively pursuing a renewal. This is often very confusing to young faculty. The priorities of the administration change routinely, so the guidance given is often short-lived. Ultimately, I think that one has to view this job as meeting at least the minimum requirements for publications and grants as judged by faculty who recently went through the tenure process rather than the administrative suggestions, and then finding the balance that they feel happy with in their career.

Service duties are probably the most frustrating part of the job, which I believe is typical of faculty at most institutions. I have served on numerous job search committees, been the Director of Graduate Studies, and served on numerous committees at every level, in addition to community service. Although it is possible to maintain a low service load, there is substantial pressure from the administrators to serve.

This is a job I love because I was educated at similar institutions and feel comfortable with the responsibilities and student body. I believe it is as intensive and time-consuming as a faculty position at a major research university, but differs in the focus of the responsibilities. One must be comfortable with a wide variety of activities. In my mind, the key to success is in finding a balance between teaching and research and honing time-management skills.

Finally, since I routinely sit on job search committees, I can advise those considering a career at this level that research productivity and fit to the department are the primary foci of the committee for choosing job candidates. Teaching statements are very important, and we are particularly impressed with candidates who have taken the time to review our curriculum and discuss their potential fit. However, the number and quality of publications take precedence. Candidates should prepare an excellent research based seminar aimed primarily at the faculty and be prepared to discuss the role of master’s level students and undergraduates in their research program and their fit in our teaching curriculum intelligently during an interview.
I was a non-traditional student, starting college at 27 after a career in retail sales. I became interested in sexual selection on visual signals in butterflies and went to IVY LEAGUE for my Ph.D. Or so I thought. During my first field season, I began noticing more about how the physical environment: time of day, cloud cover, temperature, etc. limited the courtship options of males and the OOO habits of females. I ended up taking a master’s and heading off to the LARGE STATE SCHOOL for my Ph.D. I changed organisms a few times, AMONG VARIOUS INSECT SPECIES, but I have retained an interest in how the physical environment creates an arena in which all fitness related behavior takes place. Today, with global climate change and other habitat alterations taking place at an unprecedented rate, the shape of that arena is changing rapidly. It is an open question whether biological systems will evolve, emigrate, or collapse in response to these changes.

After a five-year postdoc, I landed my first job, at XXX University. This is a private engineering and science college. I had been very undecided about whether to go the teaching college route or the research college route. The XXX job offered some of the small, personal touches of a teaching college, but also came with a significant research expectation. Faculty members were expected to teach one course per semester, plus obtain external funding to support research, publish regularly in quality journals, and provide meaningful experiences for undergraduates. Because of the size of the department (six bio faculty when I arrived, with about 60 majors), there was a significant service expectation as well. Faculty expectations are often expressed as percentages; at XXX, this was something like 40% research, 40% teaching, and 20% service (a typical research university might be 70:20:10, whereas a teaching college might be 20:70:10). For a starting faculty member, service meant advising freshmen and majors, service on one departmental and one college level committee, and advising honors students.

After four years at XXX, I moved to YYY. YYY has a master’s program and a national reputation for turning out good undergrads for Ph.D. programs and professional schools. The job expectation at YYY is similar, with maybe a bit less service expectation at first; I would say more like 45% research, 45% teaching, and 10% service. YYY is a much larger department (23 tenure track faculty, and about 500-600 majors). There are lots of other differences as well. XXX was private, whereas YYY is public. Most XXX students had strong quantitative skills, whereas most YYY students do not. At XXX, we used peer TA’s (usually our top seniors) in the intro classes, whereas at YYY we have master’s students who often come from less rigorous programs than ours. I do not regret my move to YYY, but in retrospect XXX was a better place to be than I gave it credit for at the time, with an administration that was strong and supportive of biology.

Both XXX and YYY are similar in expectations for faculty quality, however I think the research expectation was a bit higher at XXX, whereas the teaching expectation is higher at YYY. Both schools place a much greater emphasis on undergraduate research than you find at either research or teaching universities. Many faculty at top colleges around the country were YYY undergrads. At both XXX and YYY, the opportunity to work with excellent undergraduates and to help them find their way to a good graduate program is one of the major satisfactions of the job.

The research part at these "research undergrad" institutions is just as anywhere else: get funding, do good research, and publish regularly if you want to get tenure. Two catches at a place like this are 1) you do not have Ph.D. students to help plan your research and 2) your teaching matters a lot (more about that in a minute). At these places, one or two good papers a year is suitable output, but without grad students, it may not be easy to get even that done. Part of your research expectation is mentoring of undergrads, so finding good ones early in their college years is important. You have to look at research undergrads...
more as proto-grad students because they are your ticket to getting your work done. I try to recruit freshmen or sophomores and encourage them to spend the rest of their undergraduate career doing research in my lab. The best of them are more like master’s students during their senior years, with substantial independent projects that may occupy 15+ hours a week. What they can do is plenty of bench and fieldwork, keep a lab notebook, and organize data. What they have more trouble with is thinking through a project, analyzing data, and writing papers. I try to prepare them for graduate study with weekly lab meetings, forcing them to read more primary literature and ensuring that they can write a simple proposal. I usually have six (about right) to ten (too many) undergrads working in my lab at any one time. The best of them go off to REU programs between junior and senior years, even though I would like to keep them working in my lab. The goal, however, is to get them into top grad programs (I rarely have pre-meds working for me, but the same things apply when I do). Finally, having a postdoc is a great thing. You get someone who can analyze data and write, plus they get experience supervising student researchers. Postdocs, however, are expensive, so you have to keep that grant money coming in!

Teaching is a big deal at places like XXX and YYY. Excellence is expected and your teaching evaluations will be scrutinized. The first time through any course takes a lot of time and energy. I figure six hours or more prep for each 50-minute lecture. In an intro course that I have already taught, I can cut that to about two hours or less the second time around, depending on how much updating is needed. For an advanced course, it is more like three to four hours every time because you have to be more up to date and know more details when you walk into class. Students expect you to be available for them and will denigrate you on evaluations if you are not. YYY students often come to office hours, whereas when I taught a big intro course (380 students) at LARGE STATE UNIVERSITY, probably not more than 10 visited me the entire quarter. Students generally do not like easy classes, but they don’t like them too hard either. It’s a fine line, but better to err on the difficult side. At YYY, I usually teach {zzz} in the fall, and biostatistics in the spring. The latter class has a computer lab that I have to organize and run without TA assistance. These are difficult classes to teach as they both require a significant amount of homework in addition to the usual exams. I do not get a whole lot else done during the semester.

You need to consider your personal and institutional expectations for service. Advising of students is important and a valuable service to both your institution and your profession. Serving on a college committee or two is useful for getting to know folks outside your department. Being on search committees is a lot of work, but if you value your colleagues and want a hand in directing where your department is going, you should do it. At YYY, service at the professional level is not expected (and it is not even clear if it is valued). I think, however, it is important for your research community. You have a responsibility to review papers and grant proposals. Serving on a NSF panel is a great education as well as great service. Once you have tenure, editing for a journal is interesting and a significant challenge. If your career depends on peer review, then you must support the system that provides it.

I will sum up life in an undergrad research college as interesting, but difficult. I like to teach and I like to do research, so it’s a good mix. The downside is that it is difficult to do both things well. In particular, I sacrifice some of my research goals to the demands of teaching. It is hard to find the time to write and analyze data, especially without grad students to help (but friends at research institutions tell me it is not so different with them). Some days you feel as if you don’t have enough time to do either teaching or research well. And sometimes the service is a drag. But the year is varied and you rarely feel bored! I delight in my students’ moments of understanding and their accomplishments. And I look forward to the next surprise that leaps out of my data. If only I could find the time to write it up…
LARGE STATE SCHOOL AND "IVY LEAGUE"

My first faculty position was at XXX, a large state school in one of the traditionally poorer states of the USA. I was a postdoc at IVY LEAGUE UNIVERSITY at the time I got the job. Even though XXX was the primary research university of that state, other people at my postdoctoral institution would ask me, "Why do you want to give up research and go to a teaching school?" They were always shocked to learn that I would only be teaching one class per semester (3/4 semesters an undergrad class, 1/4 semesters graduate class) and that there was a PhD program.

Things went pretty well at XXX overall. There were many benefits to being there. The faculty there were active researchers, and it was clear that one could not get tenure without having at minimum 4 research publications that clearly stemmed from research primarily done while on the faculty at that institution (i.e., residual postdoctoral publications didn't count) and a federal grant. I had one friend who had several more papers than that, but nearly all were in second-tier journals and with his postdoctoral mentor as a coauthor. He did not get tenure primarily for that reason. Others did not get tenure because they had not been awarded a federal grant, and again, their 4-5 papers were in second tier places.

Research productivity also affected the perceptions of other faculty. People who got grants early on and published well were labeled "hotshots". This label was usually intended as a compliment, but some of the less-secure faculty would downplay the hotshots to allay their insecurities ("Aw, but his research is easy, not like mine…"; "There's so much more grant money available for people working on X…").

Teaching was valued as well, but it was clearly secondary. I only know of one case of someone not getting tenure there because of teaching, but that person's student evaluations were atrociously poor (perhaps the worst in the department), and he/she was going up for early tenure. Had that individual waited and gone up for tenure "on time", I suspect the decision would have been different. I do not know of any cases where bad teaching particularly affected perceptions of other faculty. Indeed, quite the contrary- if someone had unusually good teaching evaluations, they were often eyed with some suspicion regarding the rigor of their course.

That said, teaching and research were weighed equally in terms of faculty raises. Our formal appointments were 50% research, 50% teaching, and that was exactly how it played out. Interestingly, teaching was evaluated almost exclusively by student evaluation scores. Assistant professors sometimes had senior faculty sit in (once a year or so) their classes, but these observations were merely used for providing feedback, not for evaluation, though it would go in the tenure folder.

The tenure rate while I was there was on the order of 75-80%. I will say that I felt a few of the people who were granted tenure were "marginal" in their research. It was not uncommon for assistant professors to publish their 4-6 papers within a year of going up for tenure, but then not publish again in the coming 2 years (suggesting this was not an "emergence" of a growing program, but instead something more intentional).

Service was expected, but it was considered extra and not considered in raises. It was noted, however, in the chair's yearly evaluation letters.

My laboratory did well there overall. There were MANY programs for engaging undergraduates in research, or even having them as just hired help. Some were state-sponsored, and you could literally have 5-6 undergrads paid to work 10 hours per week through the academic year in your laboratory, whether doing research or just for support! Obviously, there was a lot of variance in who you'd recruit,
but you could keep the good ones and let the poor ones go. Since XXX was in a poor state, I also tapped into the NSF EPSCoR program, which basically is like affirmative action grants to help disadvantaged states. What this essentially meant was that my grants had a slightly higher probability of funding solely because I was at XXX and not Harvard or whatnot! Further, since this was the premier research university in the state, the state was fantastic at providing periodic grants. These were not trivial - new professors could get $200K grants, and there were many recurrent fund grants in areas like genomics. I was able to put multiple students in my lab on RA through some of these recurrent grants. We also got nice yearly allotments of research money from the department, as well as 10% of our overhead back into a non-expiring account. There was lots of money for research about, and if one suffered a short-term lapse in federal funding, it could go almost unnoticed because of all the other funds.

There were negatives, too. Many on the outside saw XXX the same way as those at my postdoctoral institution did. Hence, I was very rarely able to recruit competitive PhD students or postdocs. Some of the ones I got were outstanding, but the reason I got them was because they had a stain on their records (e.g., bad GRE scores). Faculty who worked on charismatic megafauna (e.g., birds) were able to recruit some students with outstanding records, but there wasn't a niche like that for people who worked on flora or fauna that were less charismatic. I understood, too - when I was an undergraduate, I would naively not have considered applying to XXX, even if someone there was doing something I thought was exciting. Finally, the infrastructure at XXX was abysmal. I'd constantly get grant statements with erroneous balances. The library basically didn't exist. IT support (especially at the university level) was dreadful. Some of the university staff gave new meaning to "incompetent." Sometimes, I felt that it would have been better to put that 10% overhead back into infrastructure!

After spending 5-6 years there, I felt that my program had hit a "glass ceiling", and that I could not get to the next level without going someplace with a better infrastructure and better name (for recruitment). I was fortunate to get a job at YYY (IVY LEAGUE SCHOOL), and I think it was a fantastic decision to move. Frankly, I could have stayed at XXX, and it would have been very comfortable. My program had peaked as much as one could do there, so I could have remained a "big fish." My interactions with the administration were very positive, and I felt very valued and respected. The raises at XXX were fantastic - so much so that I literally took a pay cut going to YYY!

Still, I wanted to push my research forward, and my family wasn't totally happy living in that state. YYY had the name, and immediately upon my departure being announced, I started getting inquiries from people interested in coming to work with me after the move. I mentioned the possibility of a move in an NIH grant proposal, and one of the reviewers had the program administrator write to me to inquire if it had been sealed up, implying that I'd get a better score if I moved (since the facilities would be presumably so much better). That was sad - it's true the facilities are better at YYY than XXX, but I could easily have done the research at XXX, too. But that's the perception I fought at XXX all along.

In moving, I did lose the safety net. There's internal money at YYY, too, but the expectation is that we should be getting our own federal funds, so there's not nearly as much of it so easily available. YYY is not EPSCoR-eligible. Also, I'm no longer such a "big fish" - most of the faculty at YYY do top-notch research. The 10th percentile at XXX would be equivalent to the 50th percentile in productivity at YYY.

But, I couldn't be happier. My lab has grown and expanded in the ways I could have only dreamed, and the infrastructure is amazing. Other faculty aren't so insecure, and they make outstanding collaborators. Finally, it's where my family and I always wanted to live. That would have been enough right there.
TWO LARGE STATE SCHOOLS

I would like to take a little of your time to talk about teaching and research expectations at mid-sized vs. large institutions. However, before I dive into lessons learned from my own experiences I should probably briefly outline my background. To start, I did a B.S. at a small liberal arts college, a M.S. in three years at the LARGE STATE UNIVERSITY and then a Ph.D. in three years at LARGE STATE UNIVERSITY. After my Ph.D., I did a 1-year post-doc at LARGE STATE UNIVERSITY (AG) before starting my first faculty position at XXX (a Ph.D. granting Institution, but not the primary one of the state). Following five years at XXX, I joined the faculty at YYY (LARGE STATE UNIVERSITY WITH AG SCHOOL). My background covers small teaching colleges to large state schools, so hopefully I can offer some insights into these types of institutions.

My take home message is going to be simple – beware of the mid-sized University (e.g., undergraduate institutions with masters programs or “young” research institutions with historically high teaching loads). The rationale for this statement is simple, high teaching loads and high expectations for grant dollars don’t mix. My first faculty position was at a University where one may have to teach up to three courses per semester while also having the pressure of bringing in federal grant dollars. Like most research institutions, you would typically get a reduced teaching load for the first year or two (i.e., one or two courses per year). However, the real differences between established research Universities and “mid-sized” Universities become apparent after this initial reduction in teaching load. At XXX, a formula was used to determine how many classes you taught. The baseline was three courses per semester. If you had graduate students sign-up for >15 research hours/semester, you could reduce your teaching load by 1 course per semester. This is equivalent to having 5 graduate students each sign-up for 3 research hours/semester. Next, if you had a federal grant bringing in ≥ 30-50K per year, you could reduce your teaching load by 1 course per semester. In the end, if you have a large lab and federal dollars, you only teach 1 course per semester. However, if you don’t have enough graduate students or federal grant dollars, your teaching load can be 2 or 3 courses per semester – which is equivalent to many purely teaching institutions. In the end, while the expectations of a certain number of graduate students and a certain amount of federal funding is perfectly reasonable, the timing of these expectations is what causes problems for Assistant Professors.

Typically, it takes 3 to 4 years for a new Assistant Professor to establish his or her lab and often longer to attract federal funding (especially in the current funding climate). So, what are the consequences of this when you are at a mid-sized University? Simple, you’ll be teaching more during years 2, 3, 4, etc. – the exact time period when you should be focusing on your research efforts. Interestingly, here at YYY (a large, land-grant research University), the teaching loads are light in my Department (only 3 courses over 4 semesters) and Assistant Professors in Biology only teach 1 course per year. This allows Assistant Professors to focus on their research and establish their labs – the typical expectation at a "Research University".

The above isn’t meant to convey that all mid-sized Universities are "bad", in fact, XXX was a wonderful institution and I enjoyed my time there. However, it should emphasize that you need to know (1) what are the expectations for teaching and research (both as an Assistant Professor and beyond) and (2) if teaching loads vary from year to year, what factors determine how much you will be teaching? In the end, the success of your research program is going to depend on how well you can focus on completing particular experiments, writing grant proposals, and thinking about the exciting questions. If a successful research program is your goal, then excess teaching hinders your ability to achieve that goal; as it isn’t just class time, but the time spent prepping for class, making and grading exams, and dealing with...
students (the never-ending parade of students that will be knocking on your door). Time is your most precious commodity – know where it is going to go before you accept a job!

Although there are many other strategies to discuss for getting a job and being successful once you have a job, I hope the above provides a little insight into some major factors that can influence your success in academia.

"IVY LEAGUE" AND LARGE STATE SCHOOL

At any University, but especially at a state school with a tradition of "faculty governance" one can easily and quickly get swamped in service work. You have a choice of being a selfish person who pushes only your research program (being unpopular and often, it seems to me, unhappy) or you can be a good citizen and also put your talents and time into making the institution better, both for the students and for the researchers (including you one hopes). Combine that with one's desires to be a good teacher, to improve scholarly societies, and to be a good citizen on the national scientific stage (e.g., by serving on grant panels) and one has to work very hard to maintain active research. The secret is to be so comfortable with your research that you can make use of small blocks of time to efficiently keep the various "balls" of your research in the air: grant proposals, papers needing attention, mentoring students, networking with colleagues, etc. One does not have the luxury of spending days, months, or weeks generating a first draft of a paper, one needs to be able to do it in hours. If there is one skill I encourage your students to work on it is speed and efficiency. That and stress management - which really just involves learning to enjoy the craziness and being tough about leaving some time aside for real life. I would also give them the good news that the insanity doesn't (or shouldn't) really kick in until after tenure - most good departments protect their junior faculty through the tenure hurdle. So, one has time to grow into a faculty position. It is a wonderfully challenging job, but one that can generate a great deal of satisfaction.
LIBERAL ARTS COLLEGE

Dear Graduate Students,

I write to tell you about what life is like as a biologist at an exclusively undergraduate institution. I am in my ninth year as a professor at XXX College, which is a liberal arts college in the northeast. I will break up my description into five parts: the college environment, teaching, research, service, tenure expectations and general considerations.

(1) Environment:

XXX College is small—roughly 1700 undergraduates taught by 170 faculty members—and there is no graduate program here. The 200-acre campus is situated within the town of YYY. Admissions is fairly selective—about 20% admission rate—and the students majoring in the biological sciences tend to be among the best on campus. The comprehensive fee for attendance this year (06-07) is >$40,000, so there are quite a few students from wealthy families on campus, although the college remains committed to "need-blind" admission and spends a big chunk of the budget each year on financial aid. The biology department consists of 11 full-time, tenure-track faculty. In addition, there are 9 full-time laboratory instructors who help run the teaching labs. In a typical year there are also several other colleagues around, including postdoctoral fellows, research associates, visiting faculty, and so on.

(2) Teaching:

XXX has two semesters each academic year—one semester runs from September to December, and another from January to May. The college-wide teaching expectation is four courses per year. In the biology department, one of these four slots is considered to be filled by the teaching laboratory associated with one of our courses. As a result, the annual teaching expectation for each member of the biology department is as follows: one course at the introductory level (whether a course for non-majors, or responsibility for half of the semester-long introductory course for majors), one course at the advanced level (typically a small seminar, kind of like a journal club on steroids), and one course at the "core" level of the curriculum, with an associated weekly laboratory (taught in a laboratory space that is dedicated to that course for the semester, with the assistance of a laboratory instructor who is dedicated to that course for the semester). In addition, each faculty member is expected to mentor a few students each semester in independent studies—almost always, these are laboratory-based research projects. Students here take four courses each semester, and an independent study counts as one of those courses. Many of the best students conduct a year-long independent study during their senior year, culminating in an Honors Project that requires a public talk and submission of a written thesis by the student. Typically, each faculty member in the biology department mentors 1-3 honors students each year.

Although the introductory biology course is large (60-80 students each semester), most other courses taught at XXX have small class sizes. Advanced
courses usually have 5-10 students enrolled, and core courses for the major typically have 15-25 students enrolled (occasionally up to 35 students). The small class size allows faculty to get to know each student, and to encourage the best students to get involved in research. Coursework based on the lecture material is graded by the faculty member (there are no teaching assistants to help with the grading), whereas the laboratory assignments are usually graded by the laboratory instructor. A standard class is expected to consist of 3 hours of lecture each week. Core courses have an associated laboratory, for which there are typically two laboratory sections, each of which meets for 3 hours per week. As a result, the typical time spent in class each week for a faculty member ranges from 6-9 hours (occasionally up to 12 hours), depending on the semester.

(3) Research:

The expectation is that each faculty member keeps an active research program running that involves undergraduates consistently and contributes to scholarship in their field (see below for more details of tenure expectations). During the academic year, most biology faculty members spend 40-60% of their time dealing with research—whether mentoring, ordering supplies, organizing, or working in the lab (or field) themselves. During the summer, although research students are still mentored, the balance of work shifts substantially in favor of research.

Each faculty member has their own research laboratory. This is generally a single room of about 500-600 square feet, with lab benches, work tables, sink, refrigerator and –20 freezer. The startup funds are small compared to most research universities—approximately $100-150K, depending on negotiations with the college deans at the time of hire.

In addition, there is a great deal of shared space that is filled with shared equipment. For example, the department shares several compound microscopes equipped with fluorescence and digital imaging capabilities, a confocal microscope, an ultra-centrifuge, a couple of large centrifuges, a fully-equipped dark room, four –80 freezers, ice machines, fume hoods, autoclaves, several PCR machines, and two nanopure water systems. All of this equipment is within the same building. The college has a science library in the next building, with a reasonable set of subscriptions to journals, and we can obtain most other articles within a few days via inter-library loan. Finally, XXX has two active field stations where student and faculty do research that is supported by endowments.

Some of the ongoing research is funded by the college (for example, each honors student has up to about $1000 to spend on research costs) and large institutional grants (ongoing HHMI and NIH grants that provide 10-20 summer research opportunities with associated supply money for undergraduates). In addition, about half of the faculty in the department have a research grant of one form or another (mostly NSF grants, and one NIH AREA grant). About one-third of the faculty have enough grant money to pay the salary of a full-time research technician. The rest of us must take care of lab business ourselves (sometimes with the assistance of responsible undergraduates).
The size of startup fund and availability of shared equipment varies substantially among undergraduate institutions. There are a few places where startups are probably larger than at XXX, but there are many places where startups are much smaller and there is much less shared equipment available. According to a personal communication from someone on the job market this year, only the "top 25" liberal arts colleges can afford startup in the six figure range—more typical at many exclusively undergraduate institutions is a startup in the 10-50K range.

(4) Service:

Each faculty member is expected to serve on two college committees, and everyone is expected to pitch in when it comes to departmental governance. Committee assignments are 3 years in length. The amount of time spent on committee and departmental work varies quite a bit, but the total time spent on service to the college rarely averages more than a couple of hours each week. A new department chairperson is chosen by the deans in consultation with the department every 3 years, and each faculty member in the department is expected to take turns rotating into this duty.

(5) Tenure Expectations:

Ostensibly there are three criteria for tenure consideration: teaching, research, and service. Accordingly, the candidate is asked to write a self-evaluation of their progress in each of these areas. In reality, however, the truly important criteria are excellence in both teaching and research (both are required, and neither takes precedence over the other).

Teaching excellence is evaluated during discussions among faculty on teaching practices, during discussions with students about experiences in a colleague's course, based on evaluative letters requested from a sample of former students, and based on both the scores and comments written on the course opinion forms that students fill out anonymously at the end of each semester. In addition, the candidate submits teaching materials (syllabi, handouts, etc). If these sources of information do not suggest strongly that you are an excellent teacher, then you will not get tenure at XXX.

Research excellence is evaluated by publication record, evaluative letters solicited from faculty at other colleges or universities, and the information gleaned from discussions and presentations on the research going on in the lab. In addition, the review committee looks for evidence of professional engagement as well as signs that colleagues in the same field outside of XXX value the work: grant proposals and manuscripts reviewed, grants awarded, presentation of papers at national and international meetings, seminar invitations at other institutions, etc. If these sources of information do not suggest that you have an active, productive research program that contributes excellent scholarship, then you will not get tenure at XXX. Of course, since faculty are expected to spend about half of their time and effort as teachers, the expectations are lower for a place like XXX than for some larger institutions. At present, the expectation in the biology department seems to be something like at least 3 substantial publications arising
directly out of your lab (and involving undergraduates in the research), although this may vary somewhat by sub-discipline. Evidence of success obtaining grants is helpful, but is not required; on the other hand, it is expected that people will apply for grants when possible.

(6) General Considerations:

For someone who enjoys teaching, and also enjoys keeping their hand in the laboratory rather than getting bogged down with grant applications and administration, the mixture of responsibilities at a place like XXX is excellent. When I find that I am getting tired of grading or lectures, I can usually switch my focus to the research lab. When I find that I am tired of working in the laboratory, I can always go back to my office and grade a quiz or work on a lecture. Both sets of activities are valued highly. Of course the flip side of this flexibility is that multitasking is a way of life here, which can be difficult at times—one cannot just ignore teaching and focus on research during any given week, or vice versa. The salaries are competitive with most university faculty (although not with the highest paid faculty members at a top-tier university), and the pressure to "publish or perish" appear to be somewhat lessened when compared to many other places. The entire department attends a weekly seminar with topics that span a wide range (molecular biology to ecology and back again), which can be refreshing or confusing, depending on the topic and speaker.

Perhaps the greatest drawback of a place like XXX is the absence of a graduate program and graduate students. I recall fondly the hallway or classroom chalk sessions where the graduate students, postdocs, and faculty from a couple of labs would hash out their latest results, or evaluate an exciting new paper. This "heady research atmosphere" does not happen as often or as readily at a place like XXX. The undergraduates do not have the time available to spend all day in the lab or talking about research, and only the most advanced students are truly able to interact with the faculty as peers when it comes to our specialty. Since there are only 11 full-time faculty in the department, there are few overlaps in research—one person is the only community ecologist, another is the only neurophysiologist, another is the only evolutionary geneticist, and so on. We try to serve as a sounding board and provide advice on each other's research as much as possible, but the material is often too far out of our expertise to generate a meaningful or fulfilling discussion. The end result is that annual meetings become extremely important for maintaining research momentum and keeping abreast of the latest developments.

I hope this is helpful, and wish you the best of luck as you decide on the career path that suits you best.
READY, SET, HIRE

For junior science-faculty members and staff, hiring researchers is an important way to boost career success. But without management training, it’s a shot in the dark. Genevive Bjorn reports.

When systems neuroscientist Bijan Pesaran landed his first faculty job at New York University in 2005, he needed to hire a research team. Although he was lucky enough to find a postdoc straight away, hiring other team members seemed to be an overwhelming task. He turned to his senior colleagues for advice, which helped — but it wasn’t enough. Hiring was the thing he knew least about. So Pesaran took a scientific management training class offered through the Howard Hughes Medical Institute (HHMI; see “Making the right moves”).

The class soon paid off. To find a technician, Pesaran advertised through an Internet job site, received heaps of mostly unsuitable responses and interviewed many candidates, eventually finding one whose enthusiasm outweighed her relative lack of experience. The management training course had prepared Pesaran to carry out the essential tasks of hiring and team building. Indeed, two years later, he has six people working in a productive lab and no regrets.

Making a productivity-boosting appointment is not a formal part of PhD curricula or the research culture, but poor or delayed hiring decisions can strain a young career. Navigating recruitment issues — such as how to go about finding a suitable postdoc or technician, honing your interview techniques, negotiating salary and motivating people to get the best results — can seem daunting. For many, it’s a huge shock for which they are unprepared.

What’s not taught

“Most postdocs don’t get training in management skills,” says Alyson Reed, executive director of the US National Postdoctoral Association. “But being able to put together and manage a team becomes a vital part of every scientist’s career.”

Management training could easily be built into career paths, perhaps in the form of mentoring or seminars tailored specifically to the needs of young scientists, says Janet Metcalfe, director of the UK GRAD Programme, an organization that provides support to postgraduate researchers. Part of it would involve making trainees more aware of the non-scientific skills they use regularly, such as communication, organization and leadership. The first step is getting young scientists to recognize that these skills are as important as their scientific ones. “Researchers often find it surprisingly difficult to reflect on their competency in areas other than their science,” says Metcalfe.

Learning about his non-scientific skills was a key part of Pesaran’s HHMI training. He benefited from taking a personality profile and receiving anonymous feedback. “It is very interesting to see what people think about you,” says Pesaran. “I took those lessons to heart.” He has tried to improve his patience and tolerance as a result of the comments.

Several institutions in the United States and Europe, such as the European Molecular Biology Organization (EMBO), offer seminars based on the HHMI model for either science postdocs or junior science-faculty members. Cassandra Extavour took EMBO’s lab management course in 2006 while doing a postdoc at the University of Cambridge, UK — before she started her faculty job at Harvard in evolutionary biology.

Compared with colleagues who don’t have this kind of training, Extavour says that she is less stressed as she isn’t starting from scratch. Although postdocs can focus on their research, junior faculty members also have to prioritize and juggle hundreds of tasks they know nothing about — including hiring. “The EMBO course presented some useful ideas on how to decide what’s important as well as very practical advice on interviewing, hiring, team building, coaching, mentoring and conflict management,” says Extavour. “I wouldn’t have got this training from my job.”

Javier Martinez, junior group leader at the Institute of Molecular Biotechnology of the Austrian Academy of Sciences in Vienna, took EMBO’s training course in 2004. He describes it as intensive but helpful in dealing
with issues that come up every day for scientists, including making that crucial first postdoc hire.

“Your postdoc is the person who will help you train other PhD students and will be the experienced one pipetting by your side,” says Martinez. “You have to remember that you were a postdoc not so long ago.” The skills he learned in the management course prepared him to make the transition from postdoc to group leader himself and to choose the right person.

Learning what hiring challenges to expect and how to deal with them is an important part of these training programmes. One common challenge faced by junior faculty members is the urge to make a decision on the basis of immediate research needs, rather than what might be needed in the next three to five years.

“It’s important to think long term,” says Extavour. Another challenge is feeling lonely in a new job and approaching the interviews with candidates as if making a new friend, she warns. “It’s important not to forget why you are on the hiring side of the table,” she says.

Learning a few hiring strategies is another important part of these training programmes. Writing a thorough job description before posting help-wanted ads can make the whole process more efficient. Those hiring should include any must-have qualifications, such as an academic degree; other highly desirable skills, such as experience with animals or programming; and optional skills, such as experience with certain types of reporting or writing. Being as specific as possible leads to better candidates, a faster screening process and more discriminating interview questions later.

Another strategy is to compare apples with apples by asking each prospective candidate the same interview questions. It’s also important to avoid asking personal questions about marital and family status, which are potentially discriminatory and illegal. And interviewers should watch for any red flags that may come up, such as lack of enthusiasm for the job, complaints about previous co-workers or colleagues, or simply avoiding questions.

Once the recruitment, screening and interviews are complete, a helpful strategy for evaluating candidates is to assign each one a numerical grade immediately after the interview. At the end of the process, compare the pool and make a shortlist of the best three or four. Make an offer to the top candidate as early as possible, and let the others know that they are on the shortlist. Be prepared to wait for them to choose among other offers. Top candidates will be in demand. It may be necessary to offer enticements, such as a new computer and paying for publications, in order to get the best candidate.

More responsibility earlier

Not everyone waits to reach postdoc or junior faculty stage before learning essential management skills. Globally, fewer than 30% of PhD scientists go on to work in academia, which means that most researchers are looking for jobs in industry or government. Those jobs often require some management know-how.

Even without formal training, there are practical ways to go about gaining some management skills. Koen van Dam, a PhD candidate at Delft University of Technology and president of Eurodoc, the European council of doctoral candidates and young researchers, worked at developing his own relevant skills set. He helped to interview and evaluate some PhD student candidates, which gave him an insight into the hiring process.

This kind of initiative gives young scientists a sense of the nuts and bolts of hiring. “Even if you’ve received some scientific management training it is very useful to have a working general knowledge of local labour laws and hiring practices,” says Extavour. She also recommends finding out as early as possible about the department’s specific recruitment practices, because extra layers of paperwork could add more time to the hiring process.

Figuring out how to make a career-boosting appointment at the junior faculty or staff phase requires a self-awareness that less-stressed researchers seem to grasp: acknowledging that scientific management skills are needed, knowing where to look for help and mustering the resources to go and do it. The long-term career pay-off of making a successful first hire is potentially huge — whether it’s winning a future tenure bid or landing a dream job outside academia.

And scientific management training is a key component in the drive for success. “Postdocs are excited about it. Junior faculty are desperate for it. But senior faculty still tend not to see the point,” says Extavour.

Genevive Bjorn is a freelance writer in Maui, Hawaii.

MAKING THE RIGHT MOVES

In 2002, the Howard Hughes Medical Institute (HHMI) and the Burroughs Wellcome Fund recognized a pressing need for additional career training. So they offered a lab-management workshop to members of their research community, which included junior faculty members and recipients of funding awards.

“The participants raved how useful it was and wanted the programme to become widely available,” says Maryrose Franko, senior programme officer at the HHMI. Instead of publishing the results as proceedings, the workshop was morphed into a freely available book called Making the Right Moves and a training course called ‘Training Scientists to Make the Right Moves’.

One book chapter, for example, breaks the hiring process down into easily digestible pieces that include how to recruit, screen and evaluate applicants. It also has tips on interview questions and techniques. The programme has expanded to become a model for scientific management training and 72 institutional departments have requested copies of the second edition of the book.
Mounting responsibilities can swamp the newly independent scientist. Kendall Powell asks if it’s possible to manage your time without losing your creativity.

Christina Hull rarely drops the ball. After two years as an assistant professor at the University of Wisconsin, Madison, she has her lab up and running, teaches undergraduate courses, serves on several committees and still manages to find time for the gym and for dinner every night with her six-year-old daughter, Madeline, and her husband, industry scientist Rob Brazas. But she’s put one of her favourite leisure activities — playing the piano — on hold.

How does she do it all? She and her husband stick to a schedule that revolves around Madeline’s school and daycare. That keeps everyone on track to be home for dinner and ensures that Hull works efficiently during the day. But, she admits, it isn’t a perfect system.

“I did no time management when I was teaching a new course. I got in no workouts, cooked no dinners, and only slept from about 2 a.m. to 6 a.m. for those six weeks.” Luckily, her family’s schedule does allow for flexibility when one spouse needs it.

But as the responsibilities of being a new investigator pile up, forsaking sleep will only get you so far. Time management is a skill all academics have to master early in their careers. By year two, a new lab should be equipped and staffed to run smoothly on a daily basis, freeing up time to refocus mental energy on research goals and bench work.

But by year two, non-research responsibilities such as committee work and teaching have also ramped up. With only 24 hours in a day, it can be hard to carve out time to help lab workers, write grants and manuscripts, and just think about projects amid all the pressing but tenure-neutral matters you’re also dealing with. No matter how well you serve on committees or advise undergraduates, by about year seven your career will depend on publishing and advancing deep science. Securing tenure takes an enormous investment of wisely managed hours early on.

**Watching the clock**

Administrative duties such as interviewing and grant-writing dominate the first year or so for most new investigators. But as the lab settles in, they find long stretches of time harder to come by — just as they are ramping up their experiments.

Joaquin Espinosa, a molecular cell biologist starting his second year at the University of Colorado, Boulder, says it can be difficult to switch from managing time in monthly blocks to managing it by the day or hour. “I’d better start learning how to do these big things in small chunks of time,” he says.

Hull has made that transition. Every morning, she asks herself: “What do I have to do today to make my lab run?” and starts organizing her day while still in the shower or commuting to work.

She and her husband each keep a detailed calendar on their computers of all work and home commitments at least a few months ahead. Carol Thornber, a marine ecologist at the University of Rhode Island in Kingston, goes one step further, colour-coding her calendar into research, teaching, other work and home categories. This gives her an immediate picture of whether she has balanced her week and also tells her when she still has free time for writing or preparing lectures.

Thornber asks her colleagues to bug her when manuscripts slip down her to-do list, so she can make them a priority. Both Thornber and Hull rely on their faculty mentors to guide them in weighing their campus and departmental duties against their research goals.

“Mine sat me down and while shaking his head ‘No’ told me: ‘You need to practice this motion,’” says Thornber. Hull sought guidance for how many papers she should peer-review in a semester, when to turn down reviews and how much time to spend on committee work.

“You have to be a little bit selfish at this stage,” she notes. “Do the maths — how long does it take you to review a paper? Am I using my time during the week to move my lab forward?”

Sandra Schmid, a cell biologist at the Scripps Research Institute in La Jolla, California, suggests using a time-management matrix. Tasks are divided into two columns, important or not important, and two rows, urgent and not urgent.
“If you are focused on the tenure clock, that’s what goes in the important, not urgent box — getting three papers published, giving seminars, getting funded,” she says. “Focus towards accomplishing those things and then go home at six.”

Inevitably, a young lab head will get caught up in immediate, seemingly urgent tasks such as purchasing or paperwork. Junior faculty members agree that it’s only natural to attend to such matters when setting up — but they warn the new investigator to maintain focus on longer-term goals, or risk becoming a great lab manager and a poor planner of original research.

Not enough hours
Daily admin tasks, service work and teaching can eat up time. Paperwork and committee meetings may not be glamorous, but they come with the territory. To keep a lid on these potential time drains, you need to work out short cuts and self-imposed rules.

Bernard Golding, an organic chemist at the University of Newcastle upon Tyne, UK, says handle paperwork promptly to avoid “worrying about the nasty tasks you haven’t done”. He also urges committee members to rethink the habit of scheduling meetings in hour-long units. Can a quick agenda be covered in 15 minutes? Can a decision be trusted to a select few? Can a consensus be reached by e-mail?

Schmid approaches service opportunities as ways to advance her influence in both her department and field. She recalls being asked to serve on the editorial board of a respected journal after about four years as an assistant professor. She agreed — but immediately stopped reviewing papers for other journals. She saw the decision as ‘trading up’ in responsibilities. She also found that being a “fully engaged, participating member” of one committee helped her to decline invitations to join others without suffering any political fallout.

Likewise, junior faculty members should dedicate significant energy to their teaching responsibilities. After all, Golding points out, high-quality teaching can attract the best students to your group and can influence the direction of your research. Although preparing lectures for a first course can be daunting, it should not take inordinate amounts of time.

Sam Sia, a bioengineer at Columbia University in New York, found a simple way to ensure that his undergraduate thermodynamics course would not take over his first semester. “I use the chalkboard. No handouts and no fancy slide-show presentation,” he says. He also advises “pick a good textbook and stick to it”, using its standard problems and diagrams. Students, he notes, appreciate clear, organized lectures and do not need originality.

Creative juices
As Espinosa points out, once the lab is functioning, planning experiments and pondering projects gets squeezed into shorter, more frequent time slots. New investigators find this adjustment particularly tricky. Tap into when you do your best thinking and then talk to lab members and do other daily jobs outside those sacred times.

Dirk Schübeler, an epigenetics expert at the Friedrich Miescher Institute in Basel, Switzerland, says the hardest part of the pre-tenure position is maintaining creativity under time pressure. Coming out of a meeting and switching into creative mode doesn’t come naturally to most people, he says, so you have to reserve time to get into the groove.

“Follow your biological clock and recognize which parts of the day you are more creative than others,” he says. “Then keep those hours open for thinking.”

Thornber and Golding reserve one day a week or month to stay home and work on creative tasks. As he grew busier, Golding began scheduling formal meetings with his trainees each week. Schmid urges investigators to keep lab workers informed of grant aims and timelines. Lab workers should be trained to be self-sufficient and goal-oriented, Schmid says. “Don’t agonize about a person who is not producing,” she warns. Instead, ask to see improvement in the next three months.

Schmid and Hull say that not all the ingredients of a successful career need to happen simultaneously in the first five years. But planning and organization help ensure they will come to fruition eventually.

As for leisure activities, some use the prospects of engaging in them again as a way to stay motivated in the lab. Hull expects to take up the piano once she catches up.

“I’ve got my eye on a baby grand that in a few years from now will make a great tenure present for myself,” she says.

Kendall Powell is a freelance science writer based in Broomfield, Colorado.
SERVICE – the "time-sink"

What is service? Service is contributions to your department, college, university, or field of study that are beyond research and teaching/mentoring. Here are examples:

Departmental: Service as a department officer (chair, DUS, DGS), departmental standing committees (Seminar, Graduate advisory, Curriculum), departmental temporary committees (Search committees, subcommittee to formulate statement for X), individual student-oriented service (Graduate thesis committees, Evaluation of undergraduate honors theses, Undergraduate course advising), individual faculty advising/mentoring committees, etc.

College/University: Similar to standing and temporary committees above (Programmatic steering committees, Academic council, Faculty senate, Executive committee of the graduate faculty, Task force to evaluate X, etc.).

Field of study: Editorships/editorial boards, grant panel participation, ad hoc reviews of grants and papers, organizing conferences/workshops/symposia, service as society officer, governance/advisory committees, participation in working groups, spending a year (or more) as a program officer, etc.

This is all over-and-above generally being a "good citizen": attending faculty meetings and talks; meeting with students, postdocs, or faculty to discuss issues with their research in which you may be able to provide expertise; informal "friendly review" of manuscripts or grant proposals by your colleagues; attending ceremonies (e.g., graduation, award presentation) and socials (e.g., post-seminar gatherings). This is also considered separate from attendance/presentation at scientific meetings, presenting departmental seminars, etc. Add to all of the above one's research and teaching/mentoring responsibilities, and no wonder faculty often feel overwhelmed!

Why do service? The system just doesn't work without volunteer service work such as that described above. Although some committees probably don't need to exist (or, more often, are inefficient in their execution), the majority actually do a good thing. We need people to administer our departments and programs. We can't have whole faculties go through hundreds of applicant folders for every faculty search. We can't have journals without editors and reviewers. We don't want scientific funding decisions to be made in the absence of feedback from active scientists. Many important issues arise for societies that need to be addressed by more than one person. In short, it's vital that people play an active role in their universities and their disciplines.

Why does it seem that a handful of people do far more service than others? This is probably true to a degree, but it is perhaps not as extreme as it is perceived. There is some variance in service among faculty, but people are always most aware of their own loads and loads of those in very highly visible posts (the department chair, DGS, etc.). Beyond that, there is variability not just in how much load one accepts but also in how much load one is asked: some people are more meticulous or better suited to diverse tasks.
Example of service report: 2006 for Mohamed Noor

- **Service as Departmental Officer (Chair, DGS, etc).**
  1. DGS, University Program in Genetics and Genomics

- **Departmental Committee Service in 2006.**
  1. Steering Committee
  2. Biology graduate student Ph.D. committees
     On dissertation committees of: Dexter, Garfield, Hayden, Henzler, Hopkins, Lowry, Preuss, Tung
  3. Performance Review Committee
  4. Seminar Committee

- **University Committee Service in 2006.**

  None

- **Service to the community in 2006 (Papers refereed, conferences organized, NSF reviews and panels, etc.)**
  1. National Evolutionary Synthesis Center (NESCent) governance committee
  2. PLoS One advisory board
  3. Organizer of NESCent working group to develop novel journal concept
  4. Participation in NESCent working group to study interspecies gene flow
  5. Evolution, senior editor, handled 360 papers in 2006 (~20% ed reject)
  6. PLoS Biology, Academic editor, handled ~30 papers
  7. BMC Evolutionary Biology, Editorial Board, handled 3 papers
  8. American Naturalist, Associate editor (finished in January, 2006)
  9. Faculty of 1000, Faculty Board, contributed 5 evaluations in 2006
  10. Reviewer for multiple journals, Reviewer, January 1, 2006 - December 31, 2006
      13 manuscripts reviewed this year, not including those handled editorially.
  11. Ad hoc reviewer for 4 grants from Norwegian Science Foundation
  12. NIH Study Section (NRSA postdoc fellowships), Panelist, November, 2006
  13. NIH Study Section (Genetic Variation and Evolution), Panelist, June, 2006
  14. NIH Study Section (NRSA postdoc fellowships), Panelist, March, 2006
  15. Tenure/ Promotion reviewer for 3 universities
The job search

Jeffry L Dudycha¹ and C Kevin Geedey²


Marco is an Associate Professor in the Department of Biology at Springfield State University. The department has about 20 faculty members, six of whom are in ecology and evolutionary biology. Marco has become the spokesperson for the ecologists in department politics. He is a herpetologist who studies the physiological ecology of lizards and salamanders – in particular, the spatiotemporal variation in the relationships between thermoregulation and nutrition. His wife, Maryann, is also a physiological ecologist in the department, but she works on lichen. None of the other ecologists in the department work on physiological questions, and Marco is the only zoologist in the group. Two other faculty members in the department are physiologists, but neither have much understanding of ecological concepts.

Marco and Maryann probably have the most successful research programs in the department. Christine, a post-doc, joined Marco’s lab a few months ago. She plans to study how water regulation has evolved in relationship to habitat shifts in all the reptiles. There are also three graduate students in the lab. Sheila is starting this year, and just knows that she’s loved watching frogs since she was 3 years old. Evan is in his third year, and is co-advised by someone in the molecular genetics group. For his dissertation, he’s investigating the genetic regulation of toxin production and how seasonal variations in nutrition may influence production costs in poison dart frogs. Kenji has spent 5 years studying spatial, seasonal, and ontogenetic variation of osmoregulation in salamanders. He expects to defend his dissertation within a year.

For the past few years, Maryann has been unhappy in Springfield because she feels isolated from her family, who all live on the opposite coast. Consequently, Marco and Maryann have decided to leave SSU if they can get jobs near her family.

Q: When should Marco let the members of his lab know about his decision to leave SSU?

Q: Who else could be affected by the decision to move? When should he tell them?

The Provost has discussed the possibility of the university expanding “sciences related to the environment”, perhaps by adding three ecologists to the biology department. However, the department has a strong and vocal group of senior cell biologists and geneticists who have made it clear that they have little respect for ecology. They want the funds for environmental scientists to be used to reinstate an undergraduate biotechnology training program that ended 2 years earlier. Marco believes the biotech supporters would use his and Maryann’s departure to argue that ecology was crumbling, and that the Provost should spend the money on biotech. Marco therefore wants to keep the job search and departure quiet for as long as possible, at least until the ecology expansion is decided one way or another.

Maryann argues that rumors spread rapidly, and thinks it’s best for the future of ecology at SSU that they tell no one at the university about their plans. Marco’s not so sure. The move would definitely disrupt the lives of the people in his lab.

Q: Whose interests is Marco looking out for by wanting to keep his departure quiet? How important is his responsibility to them in comparison to his responsibility to others his departure will affect?

Q: Does this change the timing of when Marco should let the members of his lab know of his plans?

¹Dept of Biology, Indiana University, Bloomington, IN 47405-3700 (jdudycha@bio.indiana.edu); Dept of Biology, Augustana College, Rock Island, IL 61201 (bigeedey@augustana.edu)

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Commentary on “The job search”

The central issue in this case is the student–advisor relationship, and the potential for advisors to make decisions that have major effects on their students. Essentially, Marco has made a decision that will disrupt the lives of Christine, Sheila, Evan, and Kenji, and he has an ethical obligation to minimize that disruption.

Faculty moves are reasonably common, but may have different impacts on ecology students than do moves by faculty in other areas of science. This is because the experimental skills students have acquired and the research they do are not easily switched to another lab, and starting new projects typically requires a substantial time investment. In addition, ecology students are relatively independent in their research (which is generally a good thing), so they might not want to simply take over a part of a new advisor’s research grant.

In this case, it would be difficult for members of Marco’s lab to change advisors and remain at SSU, since there are no other faculty members who work on the types of questions and organisms that Marco studies. However, Evan has a co-advisor, so it is possible for him. Kenji is nearly finished, so he may be far enough along that he could manage to stay at SSU without Marco. Things would be different if Evan didn’t have a co-advisor, or if Kenji still had a field season or two to go. But many ecologists expect to “defend within a year” for 2 or more years.

The different characters in this case exist solely to illustrate that Marco’s departure will have different consequences for various members of his lab. Feel free to change their circumstances to explore the range of other possible impacts. This should spark a discussion about whether different lab members should be told at the same time, or whether the different impacts justify telling them at different times. Initially, at least, the case indicates little reason for secrecy, so most people are likely to conclude quickly that they should all be told at the same time. Marco’s obligation to minimize the disruption in his lab derives from simple respect for them as individuals. As such, it doesn’t depend on how much the different members of his lab will have their lives disrupted.

One additional consideration is that Christine and Sheila are relatively new in the lab. Marco may have known, or at least suspected, that he and Maryann would be leaving when these two individuals were interviewed for their respective positions. Should they have been warned at that time? Alerting prospective new lab members to the possibility of a move may be difficult, but if such a move is reasonably likely, the best policy is to give them a heads-up. This puts them in a position to make the best decision for themselves that they can, which is ultimately also in the lab’s best interests.

The second part of the case introduces a reason why Marco and Maryann want to keep their plans secret for the time being. They have an interest in keeping ecology strong at SSU. This may be due to a sense of loyalty or responsibility to a variety of parties: the other ecology faculty members (their friends?), SSU undergrads interested in ecology, the ecological science community, and perhaps others. It will be useful to explore the effects Marco and Maryann’s move will have on people outside their labs before focusing on which of Marco’s possibly conflicting responsibilities should take precedence.

In reality, if the Provost decides to hire the new ecologists, and then Marco and Maryann announce their decision to leave, there is no guarantee that they will be replaced. The discussion may become mired on this point, with the argument that Marco is misguided and it doesn’t really matter who knows that they are leaving. However, keeping their departure confidential may still prevent an overall reduction in ecologists. Also, remember that it is Marco who has a decision to make, and it is his perception of what will happen that will affect his decision.

A second issue worth discussing occurs if Marco decides to tell his lab about his decision, despite Maryann’s objections, but wants to keep it secret from the rest of the department. Is it ethical for him to ask his lab members to keep a secret? What kind of problems could it create for them? Secrets are not in and of themselves unethical, but keeping secrets can induce stress in people, and the bigger the secret, the greater the stress. It would also create a dilemma if rumors began to circulate and Marco’s lab members were asked about the possible departure. Leading people into situations where they are forced to choose between lying and keeping promises is not exactly responsible advising. It is probably best that when the lab members are told, they should not be asked to keep it a secret. However, if Marco explains to his lab why he’d appreciate keeping it quiet, especially if there’s a clear end of the secrecy in sight, they may collectively agree that keeping the move confidential is best. Marco could further help matters by acknowledging that rumors may get out, and if his lab members are asked about them, they should direct the questioner to Marco himself.

This is the fifth in our Ethical Issues series. For the introduction, please see the August issue (2003; 7: 330–33).
Climbing the Academic Ladder to Tenure

**PUBLICATIONS**- Typically, this is #1. There is no "required number", as it will clearly vary institution-to-institution and field-to-field. However, you are deceiving yourself if you think there isn't both a "numbers" and quality game to it. In most departments, there are few, if any, faculty who can truthfully evaluate the quality of your work, so most individuals will instead look to numbers AND the quality of the journals in which you've published (as well as the external review letters' evaluations of impact). Many in third-tier journals is worse than few in top-tier journals, but as one chairman once said, "Zero is not enough, and one is zero."

**GRANTS**- Typically, this is #2, but in some places, it can actually go up to #1. The idea here is to have received a FEDERAL grant from NSF, NIH, USDA, or whatever. Some higher-level places suggest you should receive either 2 such grants or 1 grant with a renewal. Failing to get any federal support will often sink a tenure case if the other factors aren't exceedingly strong.

**TEACHING**- Unfortunately, this largely comes from teaching evaluations from students. Some places will have a senior faculty member sit in on 1-2 lectures of yours, but the most data comes from evaluations. This is surely part of the cause for grade inflation, as such evaluations are often influenced by the grade distributions of the course. However, another aspect that works into teaching is mentoring of students, both undergraduate and graduate.

**SERVICE**- This is generally #4. Most places understand that assistant professors are very over-extended in trying to set up a lab group, doing much of their research themselves, developing courses, and general stress over tenure. Hence, you'll be asked to serve on relatively few committees (departmental, university, or student), but you should have SOME work to show for here.

At more teaching-oriented institutions, the teaching segment is weighted more heavily than at research universities, but even places like Southeastern Louisiana University are now requiring that faculty obtain federal research money, publish frequently, etc., despite having higher teaching loads than schools with PhD programs (where it is often one class per semester).

Your **tenure package** will typically have the following:
- Your CV
- Your annual performance evaluations from the chair
- Your teaching evaluation summaries
- A statement of research interests
- A statement of teaching interests
- Review letters from 3-8 anonymous external reviewers who are experts in your area
Indicators of National Research Prominence

These are just some of the indicators that departments will use to determine if you have achieved national prominence

A significant number of publications in premier journals in your field and from work done since you became a faculty member

Being awarded grant money from highly competitive federal agencies

Success in attracting graduate students

Success of your graduate students in publishing, being awarded grants or awards, and subsequently getting good jobs

Being invited to present your research at national conferences/symposia (contributed talks do NOT have the same impact)

External review letters attesting to the quality of your research

Chairing a session at national/international conferences

Awards from societies (e.g., "Young Investigator awards" for early career individuals)

Being asked to referee papers for prominent journals or proposals for federal agencies

State or national committee memberships in societies

Being asked to serve on grant agency panels

Being asked to serve as associate editor or member of editorial board for premier scientific journals

Being nominated or elected as an officer in a scientific society