CAREER TRENDS

Industry or Academia

Where do I fit in?

Science Careers

From the journal *Science* AAAS

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INTRODUCTION

Based on my career goals and my skills,
am I better off in academia or in industry?

If this is a question you have grappled with, rest assured, you are not alone. Trying to decide which career path to pursue is one of the most frequently discussed topics on ScienceCareers.org. With the increasing limited availability of academic positions, scientists must evaluate their options more critically than ever before and consider options beyond the typical academic path.

This collection of *Science* Careers articles presents scenarios from both industry and academia—offering advice from advancing in one's academic career to preparing for a career in pharmaceuticals to investigating the benefits of a biotech training program. We invite you to read about opportunities that you may not have previously considered.

Ultimately, only you can decide what path will best suit you, but we want to offer as much information and advice as possible so you can make an informed decision that leads to a fulfilling scientific career.

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Good luck with your career.
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Moving Up the Academic Ladder

By Laura Bonetta—*February 11, 2011*

Most individuals who obtain Ph.D.s in the life sciences have set their sights on an academic research career. As this year's *Science* Careers postdoc survey indicated, 61 percent of former postdocs polled and 57 percent of current post-docs hoped to get tenure-track academic positions after completing their postdoctoral studies, and an additional 15 percent of former and 16 percent of current postdocs planned on seeking non-tenure-track research scientist positions.

In reality, only a minority of Ph.D.s actually end up in academic research careers. For those who do, getting that first faculty position is only the first rung up the ladder. In the United States, the academic research path consists of a series of promotions from assistant to associate professor to full professor, followed by subsequent promotions and honors.

While the names of the positions and the degree of job stability associated with each one may vary in different countries, in general, climbing from one step to the next is dependent upon research accomplishments as well as, to varying degrees, other activities including teaching and administrative tasks.

Each researcher finds his or her way of fulfilling the requirements for promotion, but when senior scientists are asked about their approach some common themes emerge.

In the Driver's Seat

While speaking to postdocs and junior faculty attending the Howard Hughes Medical Institute (HHMI) course on laboratory management in 2002, Thomas Cech, HHMI president at the time, likened obtaining a faculty position to getting a driver's license. "All of a sudden you have all of this freedom to turn when you want to turn or to go straight when you want to go straight," he said. "On the other hand, you have to pay for the gas, and you've got some responsibility."

That sense of responsibility took Katerina Venderova by surprise. During her last few months as a postdoc at the University of Ottawa in Canada, before she started a faculty position at the University of the Pacific in California, Venderova was gathering preliminary data, applying for grants, and interviewing prospective graduate students. "I was not prepared for how much responsibility I feel for these bright students' lives," she says. "I was mentoring students as a postdoc but now it's different. I realize that it is not just about me any more."

Hiring the right people is critical when first establishing a research program. To help make the right choices some beginning faculty ask more senior colleagues in their department to also interview prospective students, suggests Giacomo Cavalli, senior principal investigator at the Institute of Human Genetics in Montpellier, France, who will be assuming its directorship in January.

It's also important to get the lab off on the right track by choosing the right projects to work on. One piece of advice that many beginning faculty receive is to have a risky, but very exciting, project to work on and then something that is a "sure thing."

"I learned this early on from my first postdoc advisor to have some bread and butter, but also some juicy turkey cooking on the side," says Giampietro Schiavo, a cell biologist at Cancer Research UK in London. "I would say that it worked well for me although the difference between the bread and the turkey turned out not to be so huge."

Another piece of advice is to become an expert in a particular area of research. "Identify problem x and become known as one of the best people in the world at tackling it. I was lucky in that I could see a hole in my field of research that no one was doing research in and I chose to work on that," says Robert Allison, pro-vice-chancellor at the University of Sussex, United Kingdom.

"When other researchers are looking for a collaborator or to do a sabbatical somewhere, you want them to come to you because you are the person that does x best."

Tenure Pressure

One of the major hurdles of academic tenure-track positions in the United States and Canada, and the cause of many sleepless nights, is obtaining tenure. A tenure-track spot is typically filled by an assistant professor who will work about five or six years before a formal decision is made on whether tenure will be granted. If tenure is not granted the investigator is asked to leave so that someone else can fill the tenure-track spot. If tenure is granted, the assistant professor is promoted to an associate professorship and, at many institutions, will have a guaranteed salary even if grant funds run out.

Institutions in other countries have adopted systems similar to the one in the United States, but that is not the case everywhere. In France, for example, tenure is awarded after a probation period of about a year almost as a matter of course (barring major problems). The main barrier in French academia is to get into the system and obtain the position of assistant professor. Applicants often have to try for several years to get such a position. But once in the system, the job is secure. "We have a tough evaluation every four years. They can close down the lab if you are not producing, but you would go away with your salary," says Cavalli.

Research First

The criteria for obtaining tenure at institutions that follow a U.S.-type system typically form a three-legged stool: research, teaching, and service. In most research-intensive institutions the research leg of the stool is considerably more substantial than the other two legs. “Research is by far the biggest component,” says Linda Walling, professor at the University of California (UC), Riverside and former divisional dean for life sciences. “If you don’t have excellence in research you will not remain within the UC system.”

To establish excellence, tenure committees will typically look for publications in peer-reviewed journals and letters from senior scientists who can testify to the value of the applicant’s research. Having obtained at least one major research grant is also a requirement for tenure at some institutions. “Grants and papers are the standard currency,” says Matthew Redinbo, professor and chair of the Department of Chemistry at the University of North Carolina at Chapel Hill.

> Don’t hate the grant writing process. It’s very clarifying and it makes you think about the important questions to ask to align your ideas and goals. This process sets you up for success.

A good rule of thumb, according to Redinbo, is to first publish a good paper and then obtain a grant. “The grant study section will look more favorably at data that has already been vetted by reviewers and editors,” he says. “This will increase your chances of getting the grant.” Another piece of advice: “Don’t hate the grant writing process,” says Redinbo. “It’s very clarifying and it makes you think about the important questions to ask to align your ideas and goals. This process sets you up for success.”

One of the things a junior faculty member can do to obtain papers and grants—aside from doing stellar research—is to establish a community of colleagues through conferences and collaborations. “These people will be the ones who review your grants and papers,” says Redinbo. “And when it comes time to put together your tenure dossier they will be the ones you ask to write letters commenting on your work and personal attributes.”

And in today’s research environment it is increasingly important to have colleagues and collaborators in different countries. “I believe in international relationships in science. You can do science much faster and in the modern world of big science, the only way to survive is through those relationships,” says Paolo Sassone-Corsi, a professor at UC Irvine. To facilitate these types of interactions, Sassone-Corsi co-directs with Emiliana Borrelli an INSERM Unit that brings French students and postdocs to UC Irvine. “Basically it allows students exposure to the American system and American researchers get to learn more about France.”

Becoming a Teacher

Although tenure decisions at primarily research institutions are based mostly on publications and grants, more and more universities want faculty members who are also good teachers. “When I first started you just had to be an okay teacher, but today excellence in teaching is more important,” says UC Riverside’s Walling.

Teaching ability is typically evaluated based on student evaluations as well as assessments from other faculty in the department. Therefore it pays for junior faculty to take any “how to teach” courses that may be offered on campus and/or sit in on the lectures of colleagues who are known for teaching well. In addition, junior faculty should ask senior colleagues to sit in on their own lectures, not only to obtain feedback but also because “they will be able to write letters about your teaching abilities for your tenure dossier,” says Brett Finlay, a professor at the University of British Columbia in Canada.

At liberal arts institutions, such as Wesleyan University in Connecticut, teaching is valued as much as research. “You have to be effective at both, and one way to do that is to integrate your teaching and research activities such that they enrich each other,” says Manju Hingorani, an associate professor of molecular biology and biochemistry at Wesleyan.

Doing Service

The third leg of the tenure stool is service, or evidence that a faculty member is willing to work for the betterment of the university, profession, and public at large. Service includes work in departmental and other campus committees, research ethics boards, editorial boards of journals, and grant study sections.

When choosing which committees to serve on, junior faculty should have clear ideas about the time commitment involved. “They should definitely talk to the chair of the department to see how much they should take on,” says Walling. It also helps to align ones interests and passions with potential committee work. “Some people are passionate about teaching; they should be on a committee responsible for curriculum development. Other committees are well suited for people who are analytical and detail oriented,” says Walling. “If you can leverage what your strengths are, administration is not as painful.”

And just as important as finding the right match is learning to say no. “Every young faculty member needs to be engaged, but not overly so,” she says. “At the beginning, doing research is the most important thing.”

The Growth of Non-Tenure

For the last 30 years, the share of tenured and tenure-track faculty positions in the United States has been declining, while the proportion of non-tenure-track appoint-ments, both full and part time, has continued to grow. In 2007, the number of non-tenure-track, full-time appointments in the United States reached 18.5 percent, up from 13 percent in 1975. During the same time period tenure-track appointments decreased by half, from 20.3 percent in 1975 to 9.9 percent in 2007.

Non-tenure-track positions are often characterized by higher teaching loads and don’t provide guaranteed salary like most tenured positions. Instead faculty typically have renewable contracts. “It appealed to me because there is no tenure clock," says Julie Sandell, a professor at Boston University School of Medicine and associate provost for faculty development. "I did not take any longer to rise through the ranks than I would have in a place with tenure, and did not have the added pressure."

Non-tenure-track faculty at Boston University go through the same career path of assistant to full professor as tenure-track faculty. "For promotions the standards areno different. In the sciences, you have to have external recognition, a lot of teaching, and an independent lab, usually with external funding," says Sandell.

However, non-tenure-track full-time faculty sometimes feel like second-class citizens in the academic world. To address this and other potential concerns Boston University recently put together a taskforce to examine career tracks of non-tenured faculty. "One of the reasons for the task force was that the non-tenure-track path has grown a bit haphazard and the titles and positions are not well defined across the entire university," says Tanya Zlateva, taskforce chair and associate dean for academic programs at Boston University Metropolitan College.

Stepping Up

Regardless of the career path or country of employment, continued success in science depends on ongoing research output and hard work. In addition, after obtaining tenure and being promoted to full professors, researchers typically find that responsibilities outside of research, such as writing papers and grants or serving on various committees and boards, increase.

Many faculty members also become chairs of their departments or deans for a particular time period (often three to five years). The positions, researchers say, often show another side of science that can be invigorating and reenergizing.

While many researchers return to the lab full time after stints as administrators, for others administration becomes a career path. After becoming dean at the University of Durham, Allison had to choose between going back to research or remaining in senior administration. "I could have done the job of dean for a three-year term and then gone back to the laboratory. When I was then offered an extension I knew that going back to a mainstream research career would be virtually impossible if I accepted," he recalls. "For one thing, no matter how hard you try, your productivity as a researcher plummets when you take on the senior administrative duties of a dean. And secondly, though you are still teaching and publishing, colleagues increasingly see you first and foremost as a member of the senior management team and not an academic researcher."

Academic careers are not for everyone, but for those researchers who decide to go this route, the key is hard work and focusing on the requirements for tenure and promotion at your particular institution. Though the exact path is often unpredictable, proper planning and keeping one's options in mind can help make for a more successful journey.

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Falling Off the Ladder: How Not to Succeed in Academia

By Kathy Weston ~ *February 4, 2011*

One Friday evening in the winter of 2009, I ended a 20-year affiliation with a college of the University of London, lugging three boxes of personal possessions and a bucket containing 12 tropical fish from my emptied office. In the face of looming redundancy, brought on by my failure to contribute adequately to my department's last Research Assessment Exercise submission, I jumped before I was pushed. I left with a compromise agreement and a lot of thoughts about how my career, initially as a reasonably successful scientist, had come to such a sticky end. My story has useful lessons in it, some of which are exclusive to scientific research but some of which reflect, I think, the experience of women in academia.

I was a ferociously smart child who attended a mediocre state comprehensive school, scraping sufficiently good A-level grades to get myself into the University of Bristol, at the start of the 1980s, to read biochemistry. I flourished at Bristol, discovering fellow smart-arses who were more at home with science than the world of glam rock that had obsessed so many of my former schoolmates. I got the top first in my year and applied, with a mixture of terror and chutzpah, for a Ph.D. at the Medical Research Council Laboratory of Molecular Biology (LMB) in Cambridge, which was then at the pinnacle of science in the United Kingdom; seven scientists working there during my time have gone on to win Nobel Prizes.

Working among the vestiges of Fred Sanger's empire, I sequenced the DNA and mapped the mRNA transcripts of a segment of the human cytomegalovirus genome and discovered the thrill of working all hours in the company of like-minded science addicts. Although it was a bit frightening being grilled on one's experiments by people whose brains were the size of whole solar systems, I graduated with a solid Ph.D. from LMB after 3 years and then went for postdoctoral work in San Francisco with J. Michael Bishop of the University of California, San Francisco. Mike advised me to work on the Myb proto-oncogene, whose overexpression is associated with autoimmune diseases and malignancies. By a combination of my luck and his judgment, I ended up with a nice *Cell* paper showing that Myb is a transcription factor. With a pretty good curriculum vitae in hand, I came home in 1989—the same year Mike won a Nobel Prize—to a tenure-track job, running my own research lab at a University of London institute, where I remained until the sad demise of my career.

So, what went wrong? There are a great many alluring things about an academic scientist's lifestyle that are simultaneously liberating and dangerous. The best of these are that you can work pretty much whenever you like, on whatever is interesting; the flip side is that "whenever you like" often translates into "all the time," and "interesting" is a matter of who you're talking to. For the first 5 years or so, I loved the freedom of being a scientist in what was touted as a meritocracy. I did work very hard, and I got somewhere, showing that Myb had an important function in the development of white blood cells.

However, I was always hampered by self-doubt. My initial conviction—essential for anyone who wants to make it as a scientist—that I could really make a difference, maybe even win a few prizes and get famous, eroded when I realized that my brain was simply not wired like those of the phalanx of Nobelists I met over the years; I was never going to be original enough to be a star. This early realization, combined with a deep-seated lack of self-confidence, meant that I was useless at self-promotion and networking. I would go to conferences and hide in corners, never daring to talk to the speakers and the big shots. I never managed, as an infinitely more successful friend put it, "to piss in all the right places."

My loss of belief in my own potential was the first step toward where I am today. Once I had decided I would never be shaking hands with royalty in Stockholm, I downgraded my career expectations drastically, in a way that fellow failed perfectionists may recognize. I focused on more mundane goals, such as getting a permanent job in the U.K. system. I got tenure, and after about 10 years of running my lab, my science declined. I never felt I could take on the big players in the hot topics, so I found myself a secure little niche far from the madding crowds. I went on working on the Myb protein in a small and insignificant field populated by rather nice people with whom it was possible to have fun as well as do science. My obsession with my work declined as normal life seeped in: I got married, learned to ride horses and play the cello, looked after aging parents, and nixed all hope of redemption by having two children in my late 30s and realizing they were far more interesting than what I was doing at work. By the time I carted my boxes and fish out of the building, I was working a standard 37.5-hour week, which simply does not suffice if you want to stay competitive as a scientist. And I was bored, terribly bored.

I should have found myself a mentor. Every scientist needs someone in a position of power who has faith in his or her abilities, to provide advice and do a bit of trumpet-blowing on his or her behalf.

What could I have done to check my descent into mediocrity? I should have put aside my fears of looking dumb and got on with the networking stuff anyway. And—very importantly—I should have found myself a mentor. Every scientist needs someone in a position of power who has faith in his or her abilities, to provide advice and do a bit of trumpet-blowing on his or her behalf. I should have taken more scientific risks, gone for bigger stakes, and thought harder about direction. Finally, I should have followed my instincts and quit my job before it quit me—but I was hampered by an exaggerated terror of being labeled a failure. (In fact, none of my friends and family seems to care a hoot about my fall from grace, and of course I should have known that all along.)

I believe I could have run my lab very successfully if I had been permitted to job-share with a close female colleague, also with two young children.

And what of the system? It failed too, I think. Scientists are judged almost entirely on research output, measured by papers published in the most prominent journals, and grants are not awarded unless your work is competitive at the highest level. Trying to run a lab full time with small children at home is very likely to result in a drop in research productivity or quality, and yet little allowance is made for those of us, mostly women, who find ourselves in this situation. I believe I could have run my lab very successfully if I had been permitted to job-share with a close female colleague, also with two young children. Between us, we could have covered all the bases, and perhaps as a team we would have retained our competitive edge and hence our enthusiasm. This just does not happen in the male-oriented world of science in which, traditionally, dogs are keen to dine on dogs rather than share the bone between them, so to speak.

I know that many readers will think that I had it coming: In the long run, I didn't work hard enough and I was lucky to get out with anything at all. In my darker moments, I entirely agree with them, but simultaneously I feel sad for the idealistic young woman I once was. Part of my speech welcoming incoming Ph.D. students at my institute was to remind them that academic science is a vocational career. It really was that for me when I started, and although I've started a new life as a science writer, and I'm loving it, a small part of me will always miss the excitement of life in the lab—that hopeful voyage into the unknown where sometimes, just sometimes, you look at a result and realize you've found something nobody else has ever seen before.

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Big Thinking At Small Universities

By Jacqueline Ruttimann Oberst ~ *September 10, 2010*

Five years ago Aaron Miller had a big decision to make. He was flourishing as a staff scientist at the National Institute of Standards and Technology (NIST) in Boulder, Colorado, where he wrote and worked on large research grants. However, with a third kid on the way and aging parents, he felt his hometown calling. Luckily for him one of his old physics professors at Albion College, the small college where he and wife completed their undergraduate studies and near both their families, was retiring and he had the opportunity to apply. He got the job and has never been happier—proof positive that when it comes to research institutions, sometimes smaller is better.

Miller is not alone. Many professors choose to teach and perform research at "small" research universities or colleges—often at huge sacrifices such as longer hours and lower pay. But for them, it's their dream job.

Defining Small Universities: Bigger Than A Breadbox?

Ask most people what constitutes a small university or college and you may get as many answers as there are schools. Some choose to define these institutions by their total number of students, others by the number or existence of graduate programs.

Smaller research colleges and universities are informally characterized as those that are not "research 1" universities, nomenclature bestowed by the Carnegie Classifications of Institutions of Higher Learning in 1994 to those institutes who give high priority to research, award 50 or more doctoral degrees each year, and annually received $40 million or more in federal support. This category was renamed in 2000 to "doctoral/research universities-extensive" to "avoid the inference that the categories signify quality differences." The foundation changed the classification again in 2005 and plans another update later on this year, yet despite these series of changes, the defunct term still gets tossed around in academic circles.

Instead of this catch phrase, Kevin Schug, an assistant chemistry and biochemistry professor at the University of Texas at Arlington, likens smaller universities and colleges to "an old system in football in which you had 1A teams and several 1AA teams—they're a little step down, but they're not division 2 or 3."

The majority of people, however, would likely agree that a school with an annual research and development budget around or under $50 million is a good cut-off point. This article identified four such universities and colleges: Albion College, The University of Texas at Arlington, Binghamton University, and Harvey Mudd College to explore the differences between small and large universities.

The Few, The Proud: Why They Come

Why do research professors opt to come to these smaller schools where funding is limited?

"It's often because they had a great experience at small schools in undergraduate school," offers Susan Conner, provost of Albion College, a small private college in Michigan solely consisting of 1,700 undergraduate students and an annual research and development (R&D) budget of $630,000. "They had faculty with a huge passion for their research and teaching. They're actually trying to get back to that kind of experience," she adds. "We're not a stepping stone to something else for them."

This certainly was the case for Roger Albertson, an assistant biology professor at Albion College.

"A community college teacher saw things in me that I didn't see in myself. He helped shape my character," he says. As such Albertson was looking for a way to give back. He sensed, however, that many primary investigators consider it "a step down for people who can't make it in a 'research 1' school." But after much introspection and recognizing his own aptitude for teaching and relating to the students, Albertson concluded that, "for me, it became not do I have what it takes, but what is my true passion and how can I best contribute to this world?"

Another reason, states Pamela Jansma, dean of the College of Science at The University of Texas at Arlington, a mid-size university comprising around 30,000 undergraduate and graduate students and an annual R&D budget of $52 million, is that "people choose to come if they felt the environment was less stressful in terms of the pressure to raise external funding and publish."

Schug shares this same sentiment. "When successful in obtaining grants, it's easier to become a bigger fish in a smaller pond," he says. "With success comes respect a little bit earlier, especially in a school our size."

Gerald Sonnenfeld, vice president for research at Binghamton University, another midsized university with around 15,000 graduate and undergraduate students and an annual R&D budget of $44.5 million, offers a quality versus quantity argument. "The quality of what we do here I would put up against any other university," he says. "It's just we don't do it in as many areas as a larger university would do."

Supporting this argument is Wayne Jones, an inorganic and materials chemistry professor and department chair at Binghamton University. "Larger universities are more rigid and have lots of infrastructure and lots of redundancy," he says. "This is different at smaller universities where one has to struggle to get the critical mass to do research. However, this shortage provides lots of opportunities to do interdisciplinary research, which, in my opinion, is where the most exciting science can be found."

For faculty at undergraduate institutions, the choice is deliberate: For us, there is no greater honor than to have the accolade 'teacher-scholar' associated with our name.

For others, the choice is one of pride explains Kerry Karukstis, former president of the Council on Undergraduate Research and chemistry professor at Harvey Mudd College, a private California college with 750 undergraduates and annual R&D expenses of $2.3 million, "For faculty at undergraduate institutions, the choice is deliberate: For us, there is no greater honor than to have the accolade 'teacher-scholar' associated with our name."

Funding: One Size Fits All?

When it comes to research funding, institutional size does not matter, according to Conner. "Everybody's pretty much in the same pot," she says. To increase a university's funding chances from this limited supply, she adds, "You want some faculty who have grant experience because they know how to write grants and can mentor others from their experience. Also, successfully obtaining grants creates a track record, thus enabling researchers to obtain even more grants."

Most faculty members in the sciences receive startup funds ranging from $10,000 to $70,000 to start up their lab. However, once settled, the faculty members must venture forth and accumulate their research nest egg. These foragings typically involve federal institutions such as the U.S. Departments of Energy and Defense, the National Institutes of Health (NIH), and the National Science Foundation (NSF).

Among the highly sought-after grants are the NIH's Academic Research Enhancement Award (AREA) and the NSF's Research Undergraduate Institute (RUI) grant. Both are extremely competitive and selective; only the top 10 to15 percent of applications receives funding. Even more daunting: These grants, while offered solely to undergraduate institutions, do not distinguish smaller universities from larger and more research-experienced institutions.

"We're out there competing with everybody," comments Robert Drewell, an associate professor of biology at Harvey Mudd College.

The funding situation forces institutions to be creative and seek other sources of support from foundations like the Howard Hughes Medical Institute (HHMI) or private companies. The American Chemistry Society's Petroleum Research Fund, for example, lends a hand to many faculty researchers at Albion. Similarly, The Welch Foundation provides funding for the chemistry and physics departments at The University of Texas at Arlington. Situated near IBM's hometown, Binghamton's research allowance partially stems from the electronics companies in the area.

More For Less: Workload Balance

For most professors teaching is their full-time job—they do research solely on a part-time basis.

Although the teaching load varies from college to college, ranging from one to three classes and/or laboratories per semester, for the most part, undergraduate professors have the summer off from their teaching duties. This is the period during which the bulk of their research gets done.

Some, however, multitask during the semester.

"Since there's not much time to do research during the semester I usually bring it into the teaching labs," says Albertson. It also serves another purpose for him: to identify which undergraduate(s) would like to work in his lab and do research for academic credit.

Choosing an undergraduate student as a research assistant—as well as a research project—can be tricky, notes Alex Weiss, professor and associate chair of physics at The University of Texas at Arlington.

"They have a different way of working," Weiss says. "Doctoral students provide a lot of ideas, go to the literature themselves, and contribute to the direction of research—they are not just hands-on. Undergraduates and masters students are mostly doing the research under the director supervision of the professor—the amount of research done this way is limited."

As such, he adds, "at a smaller university, professors tend to go into niches where they're not directly competing with big groups. One can't jump on the bandwagon since one doesn't have the resources to beat out the MITs, Caltechs, and Cornells. You have to pick your research topics carefully."

Because teaching is given first priority in smaller research universities, some institutions struggle with encouraging professors to obtain external grants while maintaining their teaching requirements. Most universities reduce the teaching loads for those professors who bring in a significant amount of research funding by either lowering the number of classes they have to teach per semester or allowing the professor to "buy out" of their teaching requirement. In the latter option, teachers use part of

One can't jump on the bandwagon since one doesn't have the resources to beat out the MITs, Caltechs, and Cornells. You have to pick your research topics carefully.

their grant money as their teaching salary, thereby allowing the university to use the teaching salary it would normally pay these professors to hire class lecturers.

Safety In Numbers: Collaborations

Balancing research and teaching can be tricky for university professors, regardless of whether they're from big or small universities.

Aaron Miller, an associate professor in the Department of Physics at Albion, succinctly sums up the research/teaching balance conundrum: "How do you stay up in your field when you can only put a quarter of your year into it?" he says. "That's the real challenge."

Typically, Miller says, professors perform side projects that are less relevant to the scientific community and maintain collaborations with larger universities and corporations for more high-profile research. Miller, for instance, does contractual work at larger institutions such as Northwestern University, University of Virginia, and NIST-Boulder (the latter at half the salary he used to get when he worked there full-time).

Still many point out that despite the slower pace and limited supplies and time, the quality of the research is the same regardless of the quantity of papers produced.

The tools needed for research can also be lacking in smaller research universities, thus further encouraging collaborations. Albertson conducts a portion of his summer research with his collaborators at the University of California Santa Cruz so that he can use their confocal microscope—an expensive piece of equipment that his school does not have. Similarly, while Schug has mass spectrometry instrumentation in his laboratory, the University currently lacks a core mass spectrometry facility. Core facilities are key infrastructure components, and when they are missing, forward progress in some research areas can be impeded.

"Collaborations are a way for people at smaller places to get around the scale problem," says Weiss.

Despite working fewer hours on their research and with fewer people—typically a handful of undergraduates and graduate students—most of the professors felt that their publication rate would not vary whether they were in a larger versus smaller university.

Some, however, felt that in the publish or perish environment of research, there is safety in numbers.

"Without continued collaborations, I would not get many publications at all," says Miller.

Still many point out that despite the slower pace and limited supplies and time, the quality of the research is the same regardless of the quantity of papers produced.

Yet, Karukstis points out, "Our work is published in the same peer-reviewed journals."

Conclusion: Good Things Come In Small Packages

"There are pluses and minuses to working in a small institution," says Weiss.

Some, like Jones, feel that it is a call of duty, "Right now the United States struggles getting more students interested in pursuing careers in science," he says. "The key going forward is to find ways to get more students excited and interested in science and engaged in the process of discovery. It will take all types, sizes, and shapes of universities to sustain our technology work force and solve the next generation of problems."

Certain intangibles need also to be considered.

"The quality of life issue was a major decision for us," says Miller. "That's hard to weigh but it's significant. We were looking for a way to get back to a small environment where we can be highly involved in our kids' educations, but can still be involved in doing some world-class research."

For Miller, and many other faculty members, their decision to pursue a career at a smaller research university was an easy one.

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Lab Management: The Human Elements

By Carol Milano ~ *March 12, 2010*

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

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

Networking and Collaborating

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

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

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

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

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

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

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

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

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

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

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

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

Acquiring People Skills

Ask if your university holds workshops for new supervisors on management, delegating, interviewing, or other interpersonal responsibilities.

People skills are teachable. Make a commitment to learn consistently, not in fits and starts.

Use available books, like Academic Scientists at Work, by Jeremy Boss and Susan Eckert (Springer-Verlag, 2002) and Kathy Barker's At the Helm: A Laboratory Navigator (Cold Spring Harbor Laboratory Press, 2001). Slack, impressed with how "it spells out all you need to run your own lab," gives a copy of the Boss-Eckert book to each postdoc progressing to the next position.

Look for a special interest group on campus or nearby, such as Women in Science and Engineering. Members are often generous with support and information.

Consider a few sessions with a private coach. Morris Consulting Group trains individual scientists seeking stronger managerial skills, and it recently published, Leadership Essentials for Women Scientists: Tips, Tools and Techniques to Advance Your Career (equally relevant to men.)

"People skills are teachable," Susan Morris assures. "Make a commitment to learn consistently, not in fits and starts."

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

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

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Mentoring

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

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

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

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

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

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

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

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

Motivating and Managing

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

One person may complete projects by setting a timeline for each day's work, while another needs the adrenaline of last-minute pressure, completing the project by several all-nighters. Yet both produce a quality product.

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

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

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

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

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

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

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

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

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

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Finding Balance: The Professor/ Entrepreneur

By Alaina Levine ~ *September 14, 2012*

The science of biology is one thing but the science of business is another animal all together. For academics who recognize that their discovery or innovation can be commercialized into a product or service for which people will actually pay, the promise of entrepreneurial endeavors can be exhilarating and confounding at the same time. Issues of intellectual property ownership, human resources protocols, and time management, as well as the challenge of keeping a delineated barrier between professorial and business activities can be difficult to manage, but these concerns shouldn't prevent academics from seeking to create a startup company. The key is to find avenues to balance the two worlds so that scientists can still continue to excel in what they do best and enjoy most—research and discovery.

Know Your Priorities

Omid Farokhzad has been involved with three startups and holds 60 patents, and still manages a prolific laboratory of 25 people in nanomedicine and biomaterials at Brigham and Women's Hospital in Boston. The Harvard Medical School associate professor of anesthesiology completed his postdoc in a group headed by MIT's Robert Langer, where "the mindset of doing translational work was part of my training," he says. So commercializing technology while contributing to the academic enterprise was a natural part of his genesis as a scientific leader.

But not every scientist has the luxury of learning about patents and products from their postdoc principal investigator. When Dave Berque, a professor of computer science at DePauw University, started as an entrepreneur, "I was uncomfortable at first. I wondered if it is appropriate for an academic to have products that spin off research," he shares. But soon he found himself at ease with the process of becoming an entrepreneur, he says, because this is similar to the "textbook publication model that has been long-accepted in academia, as a way of blending scholarly and commercial activities."

If you are a professor who ponders whether your research can be developed into a technology that can be commercialized, your initial step should be to ponder your priorities. Do you want to stay in academia? Do you desire a career in industry? Deciding these choices early on, even before the lawyers and university representatives get involved, is crucial to forging a balance and a satisfying career.

Farokhzad says part of the reason he has been successful is because he recognized that "my primary goal is to be an academic, and I don't have any desire to run any of these companies."

Figuring Out What Path to Take

For every innovation that an academic thinks has market potential, there are seemingly endless ways of transferring that invention into a business. From weaving a multilayered licensing deal, to launching a company, to selling the technology outright, the dizzying array of entrepreneurial outlets can be unfamiliar territory for a professor whose training has been spent in the lab.

To wrangle the options and make it through the multiverse of marketing and manufacturing without sacrificing professorial duties, an academic's initial stop should be their institution's office of technology transfer (OTT).

The key is creating complete transparency from the start, suggests Adam G. Marsh, associate professor of marine biological science at the University of Delaware. Ensure the university knows what you are doing, and "make sure the university is happy with what you're doing," he advises. Get to know your institution's human resources regulations and how they may impact your work in the private sector. For example, at Marsh's institution, there are restrictions on how much time a professor can consult for an outside organization, he says. And there is also a rule that a faculty member can't work for another company while employed at the university, a stipulation that is common throughout academia.

The OTT can assist faculty with understanding how much time they can spend on outside endeavors and how it must be structured. Technology transfer professionals also provide insight into patent law and can help professors navigate intellectual property (IP) issues. But you need to be proactive, recommends Berque, and find out your school's IP policies early on. "The worst time to ask," he notes, "is after you launch, when the stakes are high and you have value."

Gregory Phelan, an associate professor and chair of the chemistry department at SUNY College at Cortland, jokes about intellectual property: "If you're breathing university air, they have the right to it." Professors need to have an IP plan from the start and should engage their university's tech transfer office early on. The collaboration between the professor and their OTT will be a vital factor in ensuring that the proper balance and separation is maintained between their entrepreneurial and academic endeavors. But "do not labor under the misconception that your tech transfer office automatically knows what to do with your research, because they probably don't," cautions Michael Zemel, a professor of nutritional science and medicine at the University of Tennessee. "You'll need to explain what the commercial value is, the utility of your work, and who would benefit. Insist on a conversation."

Although there are multiple avenues to engage in entrepreneurship, many professors choose to license their technology to an existing firm or start their own company, and then back off. They might serve as a science advisor, but they prioritize their time so that they can maintain their teaching and research loads while offering outside counsel to industry. “My primary commitment is to MIT,” says Nobel Laureate Phillip Sharp, who cofounded Biogen in 1978 and served as chair of its science advisory board and then as a member of the board of directors for 20 years. “MIT and Biogen recognized that my interactions would be limited to one day a week.”

Joop Gäken, a senior lecturer in the School of Medicine at King’s College London, has three patents. When he licensed his microRNA target identification technology to a company, he did so in part to forge equilibrium between the two worlds he was straddling. “Because we didn’t spin off our own company, it hasn’t been disruptive for me,” he explains. “Keeping the balance was not very difficult, and I still did most of the same work I was doing before.”

Managing Potential Conflicts of Interest

Once you engage in entrepreneurship, you must create a distinct separation between your university lab and your company’s facilities. IP can’t flow freely between the two, and neither can labor—your grad students cannot work for you in your group and intern at your company at the same time. Safeguards that prevent mingling are necessary for legal purposes, say experts, as well as to synthesize a balance between being in academia and being in business.

David Baker, a professor of biomedical sciences in the College of Health Sciences at Marquette University, partnered with his institution to set up “firewalls” to manage any potential conflict of interest that could occur. The university enlisted the help of a third party contractor, he explains, who implemented certain checkpoints that would catch and resolve possible concerns.

“There is a demarcated line between my academic labs and the companies that got started in part through my inventions,” says Farokhzad. Anything that is or could appear to be a conflict of interest is immediately shuttered. He doesn’t accept sponsored research from companies, either his own or others, and any work that is “earmarked for the companies doesn’t connect with my academic lab.” And to ensure that his postdocs and staff don’t feel they are doing work in the lab that can be funneled into one of his ventures, he encourages open discussion about patents and he generally doesn’t transfer any IP discovered in his academic lab into an old company. Instead, “if the new IP is viewed as game-changing, then it may form the foundation for a new company.”

Sharp urges that an almost excessive amount of communication about your dual paths is warranted to prevent even the perception of misconduct. “I utilize wide disclosure to audiences during speeches,” he says.

University of Delaware’s Marsh even keeps separate computer systems for his university and company research.

Finding the Right People

“I’m very comfortable working with the investors that I trust and leave it to their judgment to bring in the best business and scientific team to advance our technologies,” says Farokhzad, pointing to a lesson that many faculty learn early on even in academia—surround yourself with talented people and you will shine.

“Your company will be more successful if you personally don’t do stuff that you are not good at,” says Marsh. “One has to recognize the difference between what you ‘can do’ because of related prior experience and what you ‘should not be doing’ because of overconfident ignorance.” For example, he adds, negotiating a license agreement with your institute’s OTT should be handled by a lawyer familiar with the commercial value of similar IP.

Marsh launched his company in 2009 and serves as its chief scientific officer. On paper he is not employed by the firm, but rather serves as a consultant. His advice is echoed by other successful professor-entrepreneurs: “Find the best business partners you can,” especially people with experience managing startups.

I was surprised how busy I was. I couldn’t believe it took this much time to get a company started, funded, and a product made.

A synergistic team will help you productively manage your time. “Get ready for a busy life: one that is three times as busy,” jests Phelan. “I was surprised how busy I was. I couldn’t believe it took this much time to get a company started, funded, and a product made.”

Getting ROI on the Faculty Side

“As daunting as it seems, entrepreneurship is very worthwhile,” says Baker. “It has energized me and even though I have fewer publications than I would otherwise have, I’m so much more enthused about my research.” Moreover, his interaction with patients who have benefited from his technology “gives us a real sense that what we’re doing may have a profound impact in addressing unmet medical needs. We wouldn’t have this without the entrepreneurship.”

Even with a targeted separation of academic and business endeavors, pursuing commercialization can actually enhance your skills in education. “My computer science classes are better because I can bring in my own experiences from my work,” says Berque. “This influences students to think about innovation and entrepreneurship as career paths.” He draws on examples from his software company, and ultimately, he says, “I serve as a more informed career counselor.” His professional advice is augmented with contacts in the business world who can arrange for pupils to acquire internships and jobs, or to pursue other kinds of research collaborations.

“Students see the passion we bring for science and entrepreneurship and it’s easier for them to see themselves doing it too,” echoes Phelan.

The connections that faculty make not only help the students but benefit the department and university as a whole as well. Phelan describes how after speaking with local businesses about his technology, he invited an industry representative to serve on a department board, which helped bolster the department's profile for fundraising and public relations purposes, and generally paved the way for more interactions between university and industrial scientists.

Paul DeAngelis, a professor of biochemistry and molecular biology at Oklahoma University Health Science Center, notes that being an entrepreneur opens up the academic to novel potential revenue streams, even with a hard separation between the activities. "NIH isn't the golden ticket that is going to be feeding you forever," he cautions. "My advice is to not rely solely on NIH resources if you have the ability to create a company and a drug or device that can help people."

Entrepreneurship activity invariably also helps scientists improve their ability to articulate concepts to numerous publics. "As you explain complicated scientific processes to different audiences," says Phelan, "it makes you a better teacher and helps improve your critical thinking and communications skills." In addition, as you gain more knowledge about the commercialization process, and have a better understanding of the business world, you can improve your grant proposals. "Your work is directly benefiting society and humankind," he continues. "Entrepreneurship helps make grant applications stronger, because it stimulates new ideas and demonstrates potential commercial partners," giving you more return on your investment. If you can establish in your proposal that your innovation has commercial appeal, adds DeAngelis, it further increases your chances of landing the grant.

An entrepreneurial undertaking has myriad benefits on the academic side, and in the long run can help you reset your priorities as a scientist. Farokhzad emphasizes that entrepreneurship has helped him be a better professor because it has sharpened his ability in identifying significant research problems. "It takes just as much time and capital to work on really important problems as it does on the less important ones," he says. "As an academic entrepreneur, you're required to have that litmus test—is this impactful research? If not you let it go."

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Advancing in Industry: Choosing Among Many Paths

By Laura Bonetta ~ *June 17, 2011*

Yinges Yigzaw probably never envisioned a career in biotechnology as he was growing up in a rural part of Ethiopia. "The area was so remote the only technology I had experienced was a plane flying overhead," says Yigzaw, who joined Amgen's Seattle research facility in 2004, where he is currently a senior scientist in process and product development.

Having completed a Ph.D. at the University of Leuven, Belgium, and a postdoc at the University of Tennessee, what appealed to Yigzaw about working in industry was "to work on cutting-edge scientific innovations that directly apply to saving or improving patients' lives," he says. "In academia, the primary objective is to pursue an area of research and have a paper published. At Amgen, we apply that knowledge to solve a problem and determine the best therapeutic agents to treat human disease."

The desire to apply research to a medical problem is a common refrain among scientists who have joined biotechnology or pharmaceutical companies. But to succeed in industry, that desire has to be coupled with flexibility and a willingness to collaborate and work in teams—skills that are not always promoted in an academic environment.

In addition to providing research careers, industry opens the door to other paths for Ph.D. scientists, such as in regulatory affairs, strategic planning, business development, or marketing. For those who find the right fit, a career in industry can be a very rewarding choice.

Embracing Collaboration...

The career trajectory for industry researchers typically consists of a series of promotions and recognitions, such as titles, awards, or pay raises, often accompanied by increased responsibilities overseeing increasingly larger research teams.

When Jennifer Leeds first joined the Novartis Institutes for Biomedical Research in Cambridge, Massachusetts, in early 2003, she was hired as the head of an infectious disease lab. She rose through the ranks to her current job as the head of the antibacterial discovery group within the infectious diseases area, overseeing a team of over 30 biologists working in partnership with medicinal chemists. "I basically started out as the equivalent of a PI for a lab and grew to a section head or department chair," she says.

Industry does not have a step comparable to tenure that beginning researchers can aspire to. "There isn't one milestone where you can sit back and finally take a breath; in industry you are constantly evaluating the next career step," says Leeds. "At the beginning, the challenge is that you have to learn to be an effective project leader and project team member. But then there are new challenges along the entire path."

Success at Novartis is based on the quality of a scientist's research, similar to an academic environment, but unlike academia the end goal is to bring a product forward. As a result, priorities in industry are slightly different. "You have to be at the forefront of science, but you also need to be a collaborative and team-oriented person," says Leeds. "In academia it was historically frowned upon to have too many authors on a paper. In industry the most important thing is to get the best people to work with you on your team. Projects are more likely to succeed if you can capitalize on all the resources that are available to you."

There isn't one milestone where you can sit back and finally take a breath; in industry you are constantly evaluating the next career step.

Another important factor in paving a successful career path in industry is networking with colleagues—and for a global company like Novartis that means plenty of travel. "I often travel to our campus in Switzerland and spent four months there on a sabbatical. I have traveled to China and Taiwan as a representative of the Novartis Infectious Diseases program. I travel quite a bit to the campus in New Jersey. I also visited the site in Siena, Italy, where Novartis has a vaccine group," says Leeds.

...and Flexibility

A willingness to collaborate and work in teams means that researchers in industry have to share credit for research advances. "You have to pay less attention to personal achievement and more to what is rewarding for the team," says Jeffrey Nye, head of external innovation in the neurosciences at Johnson & Johnson (based at the Titusville, New Jersey, facility).

Nye left a tenured faculty position at Northwestern University Medical School in Chicago for industry because he was "very excited about practical research applications and less interested in the personal glory associated with being first on a publication," he says. The inability to work as part of a team and share credit is one major reason a researcher may not be successful in industry.

In biotech you have to adapt very easily—that is the fun part of the game. You will start with one project and as it moves to the clinic, you will need different skills, all of which you have to learn.

Another difficulty for some Ph.D.s in industry is having to be flexible and adaptable to change. In academia it is not unusual for a researcher to stick to the same line of research for decades, digging deeper and deeper into a particular mechanism or pathway. That generally does not happen in industry. A researcher in industry will have to let go of a project once it progresses from the research phase to clinical development. In addition, a project may be dropped if it is not yielding promising results or if the company's business focus changes. A researcher may also be pulled to work on a different project to provide their particular expertise.

"You have to be attached to what you are working on, but the overall mission in industry is to bring new therapies to market, so you have to accept if that requires you to work on something else," says Nye. "I have not found it difficult to follow business decisions because my interest at heart is to address big medical challenges."

Flexibility and adaptability are particularly critical in startup companies. In these smaller companies researchers often play many different roles, which can change as the company grows and its mission evolves. "In biotech you have to adapt very easily—that is the fun part of the game," says Sharon Shacham, chief scientific officer of Karyopharm Therapeutics in Natick, Massachusetts. "You will start with one project and as it moves to the clinic, you will need different skills, all of which you have to learn."

In addition, startups are often fast-moving and unpredictable environments. To be successful, researchers have to be able to deal with the stress. "In a biotech company you typically have one product, or if you are lucky, two or three at most, so everything you do is live or die. You are constantly fighting for the life of your baby, so mentally it is more exhausting," says Shacham. "In a big pharmaceutical company, if one project does not work you move on to another."

Multiple Paths to Follow

Researchers who opt for a career in industry will find that there are many career paths for them to follow—more than would have been available in an academic environment. The choices range from research to medical development to business and commercial careers. The key is figuring out which path is the best suited to one's own skills and aspirations.

For those interested in a research career, there are many levels or ranks in industry. Similar to academia, researchers who advance through several levels may consider a more managerial or strategic-planning position at some stage. "I spent most of my time in research with a science role and then moved to a more strategic role in the last couple of years," says Mark Goulet who leads strategic operations for the global discovery and preclinical sciences organization at Merck Research Laboratories. "I was very happy running a chemistry department, but after a point in time I had the right experiences to take on larger things and think more broadly. You have to be ready to step up to be a good fit for what the company needs next."

Goulet, who has been at Merck for 24 years, says that researchers in industry should expose themselves to different projects within the company and grow their expertise in different directions. "The attitude here is that Merck wants you to develop and take on more, keeping your eyes open for the best way to grow your career," says Goulet.

Reevaluating Options

Industry researchers are often faced with the option of staying in basic research and development or moving into the more clinical side of the business. Nye, who obtained both an M.D. and Ph.D. degree, rose from being a team leader for a discovery group in charge of nine research labs to heading clinical phase III trials for a blockbuster anticonvulsant drug and an Alzheimer's therapy to then becoming chief medical officer and head of early development for a research and early development organization.

Nye then moved to his current position as head of external innovation for neuroscience. "My job now is to recognize great science and to give advice and direction to the company to make investment decisions," he explains.

To be successful in industry, researchers have to demonstrate the ability to lead teams, to be great communicators, and to be trusted by others, in addition to doing great science.

To be successful in industry, researchers have to demonstrate the ability to lead teams, to be great communicators, and to be trusted by others, in addition to doing great science, says Nye. "In industry we are so reliant on each other that we have to be able to trust one another," he explains.

Networking skills and having good mentors are also key. Most companies have formal mentoring programs in place, but Nye recommends that researchers be proactive at finding their own mentors in different areas of the company.

Moving to the Commercial Side

Some researchers move away from bench research to take on a commercial role in marketing, finance, or business development. "Business development is a good career for someone with a degree in science and an interest or training in business," says James Sabry, vice president of partnering business development at the South San Francisco-based company, Genentech. "Going to business school is the fastest way to get a business education. At Genentech two-thirds to three-quarters of people in the business development unit have an MBA."

Business development is a good career for someone with a degree in science and an interest or training in business.

Sabry himself never attended business school. However, after obtaining his M.D. and Ph.D. degrees he founded and served as chief executive officer (CEO) of a company, and later did a stint as CEO of another. Doing business development in a startup has some advantages for someone who is just starting out in this career path, according to Sabry. "You will have two to three people in the business unit of a company with 30 people, so you will know everything that is going on in the lab and you will see the CEO every day. You will get a very good education if it's a good company," he says.

On the other hand, a startup may not have an established mentorship program as in a larger company like Genentech, so the positions are more risky in terms of career development. "Another disadvantage is that the work in a startup is less varied," adds Sabry. "At Genentech you can work on a wide variety of business deals, whereas at a startup you will more likely focus on just one for a long time."

There are many routes to advancement for Ph.D.s who switch over to a career in business development. "Some people love doing contracts and sealing in deals and stay in those types of jobs; others want to follow more management-style tracks and advance up the ladder in that way," says Sabry.

Taking Initiative for Your Career

Strategic planning and marketing are additional routes within the business world for researchers to take. Many companies value the scientific knowledge Ph.D. scientists bring to the job. "Customers like to speak to someone who understands the science," says Andy Last, chief commercial officer at Affymetrix. "You don't have to be an expert in every pathway or structure, but you need to stay on top of the science and keep current with trends and market drivers. As you progress along the business hierarchy, you will also have to acquire more strategic and leadership skills," added Last, who is responsible for the entire product mix and roadmap for Affymetrix.

Shortly after obtaining his Ph.D., Kevin Cannon found a position in product development at Monsanto. After working at several other companies, he has risen through the ranks to vice president of strategic marketing at Affymetrix. He says that some of the questions that a person working in marketing has to tackle—such as identifying unmet needs in a particular market, what the company can offer, and what the value is for a particular technology—are as challenging as doing research. "You have to formulate hypotheses and investigate. If I say in the next five years nanotechnology will take over, I will need to justify why that is, determine unmet needs, and propose what Affymetrix can bring to that new market landscape," he explains.

A typical career trajectory for someone in marketing is to start as a product manager and then move up to senior product manager to the director level and then on to vice president and beyond. Advancement not only depends on doing your work well, "but it's also about flexibility, the willingness to try something new, and being open to change," says Cannon, who heads up the RNA gene expression side of Affymetrix product lines.

But advancement is not guaranteed—people have to carve out their own paths to make sure they end up where they want to be. For example, someone who wants to be given more responsibility or to branch out in a new area should approach his or her manager with the idea. "Most academics are not trained to ask for things," he adds. "But you have to manage your own career; you can't let the system manage it for you. If you are not paying attention you could get lost very quickly."

Of course taking initiative for one's career is a recommendation that applies not only to those embarking on business path but to any career choice. With adequate planning and consideration, Ph.D. scientists can find a rewarding future in industry—one that is perfectly tailored to their skills and aspirations.

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Advice for Future Pharma Scientists: Start Small

By Michael Price, Elisabeth Pain ~ *December 9, 2011*

The drying drug pipeline and looming patent cliff, together with the ailing economy, has hit the drug discovery business hard, forcing the industry to lay off workers and rethink and restructure its research and development models. In the United States alone, the pharmaceutical industry has shed more than 20,000 jobs this year and, over the last decade, layoffs have surpassed 300,000, according to the outplacement services consulting firm Challenger, Gray & Christmas.

Will the industry recover? Probably—in some form. The need for better health and treatment for disease isn't going away. It's early still, and far from obvious what shape the new pharmaceutical industry will take, but patterns are emerging that can help guide the career-related choices of aspiring pharma scientists. *Science* Careers spoke to scientists from several companies, big and small, seeking tips on where and how to seek scientific jobs in drug discovery and development. Their answer: Go small, but think big.

Shrinking revenues, shrinking companies

The most important change occurring in the industry is a shift away from the traditional "big pharma" model for drug development, in which research and development are concentrated inside such companies as Pfizer, Merck, and AstraZeneca. As industry giants lose patent rights on big-money drugs such as Lipitor and Plavix, they are looking to offset lost revenues by cutting costs and lowering exposure to the risks and expenses of drug discovery and development.

One of the most important ways they're doing this is by, in effect, outsourcing early-stage research and development to smaller pharma and biotech companies. The result is more jobs at smaller companies -- especially biotech companies—for innovative scientists, says Steven Braithwaite, senior vice president of drug discovery at Signum Biosciences, a 10-person biotech company located in

Monmouth Junction, New Jersey. “I think there is more open opportunity in small biotech for people with an academic background,” he says. “Innovative ideas are risky, and taking that [risk] out of big pharma is probably the future.”

Braithwaite himself, who holds Ph.D.s in neuroscience and anatomy, is an example of the trend. He moved to Signum from a large pharmaceutical company because he wanted to be involved in riskier, more innovative projects. Another advantage: A smaller company allows him to be more involved in other aspects of the business besides research, he says. “You’re not just part of a conveyer belt. You have to get involved in a whole range of techniques at the bench, but you also have to get involved in the business side, in the business thinking.”

Gretchen Snyder, executive director for molecular neuropharmacology at the 25-person Intra-Cellular Therapies Inc. in New York City, agrees that job opportunities are shifting to smaller companies. “Smaller companies, I think, are in a position to provide some of the early-stage work that big pharma used to do in-house.”

I think there is more open opportunity in small biotech for people with an academic background. Innovative ideas are risky, and taking that [risk] out of big pharma is probably the future.

The poster child is Vertex Pharmaceuticals, a small company headquartered in Cambridge, Massachusetts. Launched in 1989, Vertex won FDA approval in May for a new drug for hepatitis C, which is expected to earn big money. The company, which already has R&D sites at several U.S. locations, as well as in Canada and the United Kingdom, grew by more than 30%—from 1400 employees to about 1900—between early 2010 and September 2011. The company plans to add an additional 500 jobs through 2015 and is building a new headquarters in Boston, where it will relocate its Massachusetts workforce.

Will job growth in smaller companies offset losses in big pharma? Not likely, or not for a while. Vertex is in many ways an exception. Many smaller companies are finding it hard to finance their operations, says industry journalist Ed Silverman, who edits the Pharmalot blog. The global economic downturn has kept many start-ups on the ground, says Derek Lowe, author of the pharma-industry blog In the Pipeline. Still, “those that are financed for the moment to continue their work are going to hire people to do that research,” Silverman says. The bottom line: “The big drug-makers proportionally are doing more cutting back,” he adds.

Traditionally, job security hasn’t been as good at smaller companies. As Josh Bloom, director of chemical and pharmaceutical sciences at the American Council on Science and Health in New York City, sees it, “the trouble is if you work for a place like that you lose two ways. If you’re not successful, the company goes out of business, and if you are successful, then the [bigger] company that maybe you’re partnered up with ... will buy you and then you lose your job then.” It makes sense to anticipate layoffs, by living and working in a place like the Boston area or the San Francisco Bay area with a lot of small companies, so “if you have to go to another company, you can do it without calling the moving trucks,” Lowe advises.

Michael Ehlers, chief science officer for neuroscience research at Pfizer, says that even big companies are moving toward something like a small-company model. Ehlers will head Pfizer’s new neuroscience research division, stationed on the campus of the Massachusetts Institute of Technology in Cambridge, slated to open by summer 2013. “There’s been a trend across the industry within large companies [to organize] around smaller, nimbler units,” he says. “Within Pfizer neuroscience, we’re clearly autonomous research units. I’d say we’re moving toward a highly enabled biotech kind of structure where we have all the innovation of a more biotech setting.”

Tailor-made

Another trend in the industry is a shift away from small-molecule/big-market solutions and toward biologically-derived drugs for targeted populations. As new blockbuster drugs for large, general populations become harder to find—and as scientific advances make new biological approaches possible—prospective drugs that target smaller populations are getting more attention, says Dale Edgar, a research fellow and chief scientist of a sleep disorders research unit at Eli Lilly, based in Guildford, U.K.

Scientists involved in such projects need to be able to determine why a drug works very well in some patients but fails completely in others. So, scientists seeking work in the pharmaceutical industry benefit, both Edgar and Snyder say, from a deep knowledge of biogenetics, computational biology, and bioinformatics. “A genetics background is extremely important for understanding how drugs work as tailored therapeutics, why one drug might work in one person but fail in another,” Edgar says.

Genetics is also important for understanding how research scales up—or fails to—and translates from animal models to humans and among different human populations, says Henry Bryant, a research fellow at Lilly Research Laboratories in Indianapolis. “Right now, one of the biggest areas of failure is in phase II trials, when you get to those places where you’re looking for efficacy and you suddenly discover that the compound that worked great in your animal model doesn’t do much in humans,” he says. “That’s a long experiment to find a failure. So the more that we can understand the human validation of our targets and perhaps even build model systems that take advantage of human biology,” the better off we’ll be, he says.

A genetics background is extremely important for understanding how drugs work as tailored therapeutics, why one drug might work in one person but fail in another.

Be fresh, broad, and innovative

Small companies are looking for creative-minded scientists who aren't afraid to involve themselves in several areas of the company, Snyder and Braithwaite say. Small companies with shoestring staffs can't afford to allow their scientists to limit themselves to pet research interests. "Being flexible and trying to expose yourself to as many types of techniques as possible in your training really sets you up in a good place in terms of being in a small company, because the projects, the targets, the approaches all change," Snyder says. Braithwaite adds, "small biotech is really fueled by innovation, ... so it's very important to be getting experience in techniques that are really the cutting edge of science and not just the old standard techniques."

Postdocs and Ph.D. students, Braithwaite continues, should do everything possible to establish reputations as innovative thinkers with fresh ideas. When working on a dissertation or a project as a postdoc, "you really need to take the lead and you need to find the interesting, novel aspects of it. Don't just go for the low-level types of experiments; go for something that really is innovative. I think you have to think very early in your scientific career, in your Ph.D., in your postdoc, about doing studies that are worthy of *Science* and not just worthy of low-level journals. You've really got to take those risks."

Meeting academia halfway

Another place where scientists may find opportunities is in academic labs. "There are a lot of companies that are trying to have closer ties with academic labs and many very good, high-quality academic centers now have the same equipment and research abilities. They're looking at the same types of pharmacological targets that maybe only used to be pursued at a drug company in the past," says Philip Mayer, president of the American Association of Pharmaceutical Scientists in Arlington, Virginia. In the United States, Mayer counts a dozen universities—including the universities of Texas, Kansas, and Kentucky -- that "are interested in providing compounds for industry and taking that compound even into clinical studies if they can." While discovery-type positions tend to be filled by postdocs and graduate students, people who perform drug formulation research and contract manufacturing at places like the universities of Kentucky, Iowa, and Maryland often take permanent positions as group leaders, supervisors, or technicians, Mayer adds.

Outside the United States, the University of Toronto in Canada and the University of Oxford in the United Kingdom have been working to solve protein structures to identify drug targets as part of the Structural Genomics Consortium (SGC), which is partly funded by GlaxoSmithKline, Novartis, Lilly, and Pfizer, writes Sarah Jones, education and skills manager at the Association of the British Pharmaceutical Industry in London, in an e-mail to *Science* Careers. At the University of Liverpool, the Centre for Drug Safety Science collaborates with pharma companies to do research on tissue damage to help with drug safety.

Some new kinds of collaboration are also emerging. Like other big pharma companies, Pfizer is partnering with academic institutions to share the risk of drug development and take advantage of academic scientists' broad base of knowledge, says Boston-based Anthony Coyle, vice president of the Centers for Therapeutic Innovation (CTI) at Pfizer. Pfizer created its CTI program a little more than a year ago, forming partnerships with 19 academic institutions in San Francisco, San Diego, New York, and Boston. At these centers, academic principal investigators and postdocs submit research proposals to Pfizer. Pfizer acts like a granting organization, funding projects it deems worthy in exchange for rights to develop the resulting drug.

Small biotech is really fueled by innovation, ... so it's very important to be getting experience in techniques that are really the cutting edge of science and not just the old standard techniques.

These partnerships afford valuable training, mentoring, and networking opportunities, Coyle says. Academic postdocs whose projects are approved spend 50% of their time working in a Pfizer facility alongside Pfizer scientists. The project is too new to have produced any Pfizer hires, but Coyle "absolutely expect[s]" some CTI postdocs to be offered positions.

Snyder hopes such partnerships, combined with the emergence of small companies that serve as drug-development innovators, will allow the pharmaceutical industry to rebound and create new jobs. "I think everyone's job picture is a little uncertain right now ... but I'm hopeful that an increased focus on small companies and pharma-academic integration might end up creating more companies and more opportunities. I certainly wouldn't discourage anybody from going into this science, if that's their passion. And maybe it will end up creating some new avenues we can't even anticipate now."

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Tooling Up: Little ‘r,’ Big ‘D’

By David G. Jensen ~ *December 17, 2010*

The current economy—including hiring—is especially unpredictable. The media has been predicting upswings, but hiring just keeps on stagnating, with every halfway-decent month followed by a disappointing one. A month or two ago, I reported in my column that things were looking up and that hiring is increasing, but the latest numbers from Washington (which admittedly aren’t focused on science) say that we haven’t made any progress at all.

I still believe, based on the number of senior hires companies are now making, that downstream job openings should soon start picking up. But it doesn’t pay to prognosticate in such a wacky climate. The best approach is to make your best guess based on solid workforce trends.

The big trend in biosciences industry is away from research and toward development. R&D is now “little ‘r’, big ‘D’.” Couple this trend with our current economic mess—some say it will take 6 to 8 years to fully recover—and it’s clear that anyone considering an industry career should give some thought to going over to the “D” side.

As opportunities in basic research and discovery decline, operations, manufacturing, and support positions are becoming more numerous. For a while it looked like smaller companies were stepping in to the discovery void left by the bigger companies, but today even small startup companies are shying away from looking like “research boutiques.” Instead of doing their own basic research in-house, companies are licensing molecules that are closer to development, often from academia. So although what evidence we have suggests that industrial hiring isn’t exactly vigorous, it’s probably a lot better on the development side than it is in basic research. In this month’s column I will suggest some ways that scientists with roots in academia can prepare themselves for the development side of today’s biopharm industry.

Different mindsets

Hiring managers downstream in development don’t operate the same way as their colleagues in basic research and discovery, and these differences are reflected in the people they want to hire. (An important caveat: There will always be exceptions to generalizations like these.)

A hiring manager in a discovery position works with less-definite deadlines and timetables than the person who runs the department charged with, for example, scaling up a biomolecule. Although there is never an endless supply of time, there’s a sense on the discovery side that deadlines are guidelines, important but nonbinding. The discovery manager knows you can’t rush discovery.

But when a product candidate is handed off to the director of process development, the deadlines get a lot more serious. That tells us something about a major difference in the way that these managers look at your application.

Many managers in the discovery area hire like academic departments do: They look for the best labs and plenty of publications, and they like to hire from relevant postdoctoral positions. The development team—and its hiring manager—has priorities different from those of the discovery folks. They are less interested in your elegant science and more interested in what you can do to keep their project moving. They care about your ability to get stuff done and the specific skills you bring to the job. They pay more attention to what techniques you’ve used and what equipment you’ve had experience on, and less to the number of publications you display. These differences should affect how you structure your application.

Four strategies

Transforming your experience in an academic niche into something that appeals to the fastest growing parts of the biopharm industry requires some retooling of your CV and your plan. Here are my four strategies:

- **Refocus the skills and abilities section in your application.** If you’ve got the right experience, you can get yourself ready for a big-D career just by changing the way you’re portrayed in your written materials. Refocus your CV on your project-management experience and emphasize skills and techniques you know are in use by the development team you’d like to work for. This works only if you’ve already put together a strong package, but if you’ve got relevant skills on your list already -- most people list about 10 skills -- moving skill number three to the top position is an easy and appropriate fix. For most people, though, it takes more than just shuffling items on a CV to make a convincing case.

- **Take, and list, certificate courses and extended education.** It might seem strange that, after all the high-end education you’ve had, a course at a community college is what you need to get hired. But sometimes a couple of relevant courses, listed up top with your other educational attainments, can go a long way toward getting you noticed. For example, GMP (good manufacturing practices) skills are essential in many departments downstream from research. Local courses are available from community colleges, trade associations, and independent GMP training companies. You may not need an expensive certificate program; sometimes just a course or two will show you are headed in the right direction.

- **Emphasize affiliations with professional organizations.** Interested in a development niche like quality assurance or regulatory affairs? Professional associations that specialize in those fields (such as the Society of Quality Assurance and the Regulatory Affairs Professionals Society) are worth paying attention to and perhaps joining at an early stage of your career. When your affiliations with organizations like these are mentioned on your CV, hiring managers notice. Trade organizations also have professional coursework designed to assure employers of a certain level of knowledge across the organization. Certifications generally are awarded only to people already practicing in the field, but that doesn't stop you from starting the process. Showing that you have started your Regulatory Affairs Certification program can open doors in the regulatory affairs department, for example.

- **Do another postdoc.** A lot of people consider doing another postdoc—extending the period of underemployment by another year or two—a first option. That's only because postdoc opportunities are out there and not so hard to find. But consider another postdoc a last-ditch option, one you should pursue when the other options fail. If you don't have any alternatives left, find a postdoc with a close tie to industry, or even an industry postdoc, that gives you marketable experiences for the development niche of your choice.

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Mythbusting for Academics: Considering a Job in Biotech/Pharma

By Emma Hitt ~ *April 23, 2010*

Among academics, a job in industry can represent the quintessential black box; for example, intellectual property that results from commercial science is necessarily protected. As a result though, certain myths, some of which carry extra weight because they do in fact involve a kernel of truth, tend to circulate among academics about industry. These include the idea that working in an industry job is somehow "easier" than pursuing a career in academia, or that a job in industry does not allow the opportunity to be creative or to publish work in one's own name. Also, fueled by the existence of closed off labs and lack of published results, aspersions may be cast about the quality of science practiced in industry and even the validity of the data.

MYTH: Industry Is the Easy Road

With rates of government grant funding in academia currently lower than 10 percent, no guarantees exist anymore in the academic world. "The fact is it's a lot harder being an academic scientist today than it was even 15 years ago when I made the transition," says Harry Klee, professor in the Plant Molecular and Cellular Biology Program at the University of Florida in Gainesville. Klee spent 11 years in industry in the plant sciences program at Monsanto before returning to academia. According to Klee, in academia, grant funding is harder to get and there are fewer jobs than there were previously. "These factors put pressure on people to work harder and harder to succeed," he says. He adds that "it's not necessarily the students with the best grades that succeed in academia—it requires a very large skill set, only one part of which is intelligence." According to Klee, these challenges in academia lead students to think they will not have to work as hard if they go into industry.

However, Klee says it's an "absolute fallacy" to think that if you cannot write well, give a good talk, or do not want to justify your spending, you should simply get a job in industry. "If you want to succeed and really get ahead, you'd better know how to write and how to talk in front of a group. At the company I worked for," he says "we had to justify what we were doing and defend it to our peers because we were competing for a pool of money."

MYTH: You Cannot Publish or Present Your Work in Industry

Another misperception is that no opportunity exists to present or publish research findings in industry. According to Klee, one of the things that fuels misperceptions about industry is the fact that the best scientists in industry generally have to keep their work confidential. "Some of the best scientists I know are in industry, and none of them will ever get the recognition they deserve because they don't present it outside the company," he says.

> There is an opportunity to present and publish research findings, just less than in academia, where the old adage is "publish or perish."

However, it depends on the company whether research findings get published. There is an opportunity to present and publish research findings, just less than in academia, where the old adage is "publish or perish." Considerations about patenting and intellectual property exist in industry, although the same is true for academia these days, says Alan Goldhammer, vice president of scientific and regulatory affairs for Pharmaceutical Research and Manufacturers of America (PhRMA), an organization that represents the country's leading pharma-ceutical research and biotech companies. "It just means that publishing may be delayed until the intellectual property considerations have been dealt with adequately," he says.

"The requirement to publish is not as strong in industry, obviously," says Sarah Jones, education and skills manager for the Association of the British Pharmaceutical Industry. "Making sure that intellectual property is secure before publication has become essential, but this is becoming more common in academia also."

MYTH: There Is a Lack of Intellectual Freedom and Ability to be Creative in Industry

The misperception also exists that scientists in industry lack intellectual freedom, that they are told what to do by the company, and are not encouraged to think for themselves or pose research questions not closely related to the bottom line.

Mary Delong, director of the Office of Postdoctoral Education at Emory University in Atlanta, Georgia, says that postdocs tend to see industry as a place where they have less independence—where they cannot do "their own thing." By the time a graduate student has transitioned to being a postdoc, independence and ability to think for oneself are traits that have been well honed. "Most postdocs who avoid going into industry tend to cite lack of independence as the reason," she says.

To some extent, concerns over lack of freedom may be well founded, but the extent varies depending on the goals, structure, and especially the size of the company. "Industry jobs do tend to prize creativity, but within the confines of a predefined goal," says Paul M. Matthews, vice president for imaging and head of the GlaxoSmithKline Clinical Imaging Centre in Hammersmith Hospital within the company's drug discovery division. According to Matthews, there is as much freedom and as much encouragement to use creativity to find innovative solutions in industry as anywhere else.

"Certainly, in industry it is critical to work within teams to accomplish goals that are defined more by the company than by individuals," he says, "but I see industry and academia as equally exciting and valuable career options for students," says Gregory E. Amidon, a research professor at the University of Michigan, College of Pharmacy, in Ann Arbor and American Association of Pharmaceutical Scientists (AAPS) Fellow.

> Certainly, in industry it is critical to work within teams to accomplish goals that are defined more by the company than by individuals, but I see industry and academia as equally exciting and valuable career options for students.

The level of independence and also the percentage of time spent doing research may vary depending on the size of the company. According to Jennifer Flexman, a bioengineer who now works in technology transfer at the University of British Columbia in Vancouver, large companies such as Genentech have a strong basic research component that is not so closely related to the pipeline. "By contrast, a smaller company or startup may be more focused on the bottom line and will not provide as much opportunity for exploratory research," she says. However, at a smaller company, a scientist may wear many hats, performing nonresearch roles, such as "marketing or sales, which can be interesting, but may not be what was expected."

MYTH: Biased Results in Industry?

With only one approval being given for every 5,000 to 10,000 compounds entering the R&D pipeline, according to PhRMA, and the cost of bringing a drug to market estimated at over $1 billion, the pressure to produce results in industry is high. Results are directly tied to the bottom line. For this reason, science conducted in an industrial setting might be distrusted, says Jeffrey S. Barrett, associate professor of pediatrics at the Children's Hospital of Philadelphia, University of Pennsylvania, and member-at-large on the AAPS Executive Council.

According to Barrett, for the most part however, industry studies are "well designed, well conducted, and above reproach due to the obvious regulatory scrutiny they endure." He added that skepticism exists regarding the fact that potential safety concerns are masked by industry scientists or simply ignored. There are a few bad apples, with any occurrence of transgressions making head-line news, but "the Hollywood version of this is much more interesting than the reality," he says.

Academia v. Industry— Kernels of Truth That Help Fuel Misperceptions

Although the two worlds of academia and industry are similar, distinctions do in fact exist that may help contribute to some of the misperceptions. The first is that the speed of work is usually much slower in academia as compared with industry, in which time is more directly linked to financials.

"Coming from the pharmaceutical industry, I see one of the biggest differences as being the timelines over which things in academia and industry are accomplished," says Amidon. In the pharmaceutical/biotech industry, projects move very quickly, and there is a tendency to integrate both science and problem solving into a project under a tight timeline, often less than a year, he says. By contrast, in an academic setting, timelines are generally longer and the focus is more long term, fundamental, and educational. "In academia, it is necessary to think three to five years or even more into the future with a research project," he says.

> **In the pharmaceutical/biotech industry, projects move very quickly,... under a tight timeline, often less than a year.**
>
> **In academia, it is necessary to think three to five years or even more into the future with a research project.**

Likewise, the mechanism of financial support is different between academia and industry, and leads to differences in job function. In academia, says Amidon, there is a need to develop scientific concepts and write grants that will generate the support needed to carry out a project as well as a requirement to work closely with students and collaborators to make sure progress is being made. By contrast, in an industrial setting the focus is more directly on research, with much less focus on infrastructure issues, such as securing lab space, administrative support, and the funding of material costs. "In an industrial setting very often the goals are established by the company and senior management. It is the scientists' role to figure out the best way of accomplishing the goals that are set out," he says.

Matthews concurs that, in industry, science tends to be probably a much more "hands-on" experience, until a scientist reaches a very senior position. "Whereas in academia, a young investigator is often heavily distracted by the need to fund a laboratory, do research, and teach to demonstrate a contribution to the academic community."

Crossing the Chasm

Twenty years ago the worlds of academia and industry were more clearly delineated; now, the lines are less clear. Tentacles of academia reach into industry and vice versa. "Science in academia and science in industry are becoming a lot more similar than they used to be," says Jones with the ABPI. "Certainly, in the United Kingdom, there is an increasing push for academic research to have practical applications and for those applications to be recognized by the people doing the research." In addition, collaborations between pharmaceutical companies and academic institutions are becoming much more common, with pharmaceutical companies supporting Ph.D. studentships and providing placements for students in commercial laboratories.

Barrett agrees that a growing number of industry-based postdocs and internships are now extended to students. "As someone who trains and supports research in these disciplines, I have witnessed both the support from industry in the form of funding for postdoc training as well as the competition for students/trainees."

Industry funding of universities for various studies has also increased. Academia is simultaneously expanding its relationships with industry with more "biofeeders," and commercial enterprises springing from academic endeavors, which did not occur so much 20 years ago, Delong says.

In general, starting salaries are similar between industry and academia, although in academia, early postdocs trying to prove themselves can potentially put in many more hours than an industry scientist. "Academics put in long hours competing for grants, and it's a very tough lifestyle," says Delong. "Postdocs

American Association of Pharmaceutical Scientists 2009 Salary Survey

According to the American Association of Pharmaceutical Scientists 2009 Salary Survey, the median annual income of a Ph.D. with less than five years of experience working outside of academia is about $90,000.

A large majority of AAPS members employed outside of academia (68 percent) are involved with a variety of specialties, led by pharmaceutical development, biopharmaceutics/pharmacokinetics, and management/administration of research and development.

Job responsibilities held by pharmaceutical scientists outside academia include 3 percent who said they are owners or partners, 10 percent executives, 41 percent directors or managers, 19 percent supervisors or coordinators, 19 percent technical contributors, and 10 percent staff or something else. Nearly three-fourths indicated they directly or indirectly supervise others, and about a third manage a budget (over half of which are $1 million or more).

Among AAPS members working in academia, 45.2 percent of an academic's assignment time is devoted to research, with teaching requiring 32.1 percent, administration 16.1 percent, and other activities the balance of 6.6 percent.

who have gone into industry typically put in more than a 40-hour workweek, but they are not always struggling for the next grant or trying to prove themselves in the same way," she says.

Klee points out that he actually made more money when he returned to academia from industry, but the pay scales for a starting scientist and a starting assistant professor are similar. "I think it's more the attraction of industry that students feel," he says. "I've heard comments like, 'I can write a great grant proposal, and it doesn't get funded.' What that means is that there is a perception that you can be really good and not make it in academia through no fault of your own, and I think that's probably true."

Principal Industry Facts

The biosciences industry sector is defined as including the following four subsectors.

- Agricultural Feedstock and Chemicals
- Drugs and Pharmaceuticals
- Medical Devices and Equipment
- Research, Testing, and Medical Laboratories

As of November 2011 (the latest time point for which information is available), there were 47,000 bioscience companies in the United States.

There were 1.4 million employed in US biotech companies in 2006.

The average annual wage of US bioscience workers was $77,000 in 2011, more than $32,000 greater than the average private-sector annual wage.

SOURCE: How to Grow Jobs Through Biotech Industry Development, November 2011, Biotechnology Industry Organization (BIO)

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Biotech Training Programs Expand Employment Options

By Clifford Mintz ~ *March 9, 2012*

By some estimates, no more than 20% of Ph.D. life scientists land tenure-track faculty jobs within 6 years of earning their terminal degrees. Yet, most graduate programs continue to groom graduate students and postdocs for faculty jobs. Meanwhile, the market for industrial research and development (R&D) jobs is declining: American life science companies have shed about 300,000 employees since 2001, about half of them in R&D.

The result is an employment market where companies can afford to be choosy —and companies have mostly stopped choosing scientists straight out of grad school or a postdoc. "Companies are no longer willing to hire Ph.D.s who don't bring additional skill sets to the table," says Eric Celidonio, a veteran corporate recruiter. "They tend to hire candidates who they think will add value [to the company] in addition to research skills."

What does that mean for industry job seekers? It means they need to go beyond traditional training. Jules Mitchel, president of Target Health, a small New York City–based clinical research organization (CRO), says his company hires Ph.D.s who "show me that they have gone out of their way to learn about the life sciences industry and how it works." Tom Ippolito, vice president of regulatory affairs and quality at Chembio, a diagnostics manufacturer, believes that Ph.D. scientists who have acquired additional industrial life sciences training "have a much better idea of what they want to do professionally, and over the long term can bring enormous value to a company."

That, then, should be the goal for scientists in training who want to work in the life sciences industry: Get familiar with industrial work. The best way to prepare for a job in industry is to have one—the familiar catch-22—but fortunately that's not the only way. Training programs, including short-term certificate programs and specialized degree programs, can provide at least some of the additional knowledge and skills scientists straight out of academia need to impress industrial hiring mangers and display their commitment to industrial employment.

Biotech fundamentals

One such program is the Fundamentals of the Bioscience (FBS) Industry Program administered through the New York Biotechnology Center at Stony Brook University. Approaching its 10th year, the 3-month program (taught from January to May at the Stony Brook University campuses in Manhattan and Stony Brook) is open to graduate students, postdoctoral fellows, and industry professionals. Students meet in the evening twice weekly to learn about regulatory affairs, drug development, marketing, finance, and intellectual property. All the instructors are industry professionals. In a capstone project, students work in teams to write a business plan, which they present to a panel of venture capitalists and life science industry executives.

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Sarah Oliver knew by the third year of her graduate training at New York University (NYU) that she didn't want a career as a research scientist. She enrolled in the FBS program and, shortly after completing it, decided to pursue a career in regulatory affairs. With that objective in mind, she took action: She conducted informational interviews with regulatory affairs professionals and attended regulatory affairs meetings. At one of those meetings she met a Genentech employee who encouraged her to interview for a regulatory affairs internship at the company. Oliver interviewed for the position but refused the offer of an internship. "Much to my surprise, they came back and offered me a full-time job in their regulatory affairs department," she says. She joined the company shortly after defending her Ph.D. thesis in 2008. She now works at Genentech as a regulatory affairs manager.

Perrin Wilson decided midway through her Ph.D. program at Rockefeller University that a life in the laboratory was not for her. After completing the FBS program in May 2007 and receiving her Ph.D. in developmental neuroscience several months later, Wilson networked her way to a summer internship at a midsized New York City pharmaceutical company. By fall, she was working full time in the company's business development department. "I think they offered me the internship because they were looking for a person who had a strong technical background and good communication skills," Wilson says. She is currently a manager in business development.

Shortly after starting work on a graduate degree in tumor biology at NYU's medical school, Carolina Pola, a native of Spain, decided that a research career was not for her. While still a Ph.D. student, she enrolled in the FBS program to explore alternatives. "One of the main benefits of the FBS program was that I quickly learned what I did not want to do after receiving my degree," Pola says. She earned her Ph.D. in 2008 and landed a temporary job as an editor at Wiley Publishing. She currently is an associate editor at Nature Medicine in New York City.

Industrial degrees

Despite the rise of the biotechnology industry over the past 2 decades, only a few universities—mainly in biotechnology-rich regions—offer Ph.D. programs that emphasize industrial training. Benefiting from these programs requires thinking ahead—or being lucky enough to be enrolled at the right institutions.

Dane Wittrup oversees the Biotechnology Training Program at the Massachusetts Institute of Technology (MIT), an interdisciplinary program administered by the university's Department of Biological Engineering. Students participating in the 25-year-old, National Institutes of Health (NIH)-sponsored program "take a broader range of course material to integrate biochemical, genetic, and engineering knowledge," the program description says. "In addition they participate in small seminars identifying the problems at the cutting edge of the application of biotechnology to medical, industrial, and environmental problems."

While students are required to take three core courses that offer an overview of business best practices and industrial drug development, the most important aspect of the program, Wittrup says, is a mandatory internship at a local biotechnology or pharmaceutical company, a feature common to all 19 NIH-funded predoctoral training programs in biotechnology (see box). "This is where the students really learn about the ins and outs of the biotechnology industry," Wittrup says.

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Another NIH-funded program is the University of California (UC), Davis's Designated Emphasis in Biotechnology (DEB) Program. DEB began in the early 1990s in response to the rapid growth of the Bay Area's biotechnology industry. In 1999, Judith Kjelstrom took over of the program and increased its capacity from 10 to 220 students. The program requires students to take courses on legal and business best practices and bioethics, a seminar series with industry professionals, and internships of 3 to 6 months at regional biotechnology companies.

The DEB Program is open to graduate students who have passed their Ph.D. qualifying exams in any of 29 participating UC Davis departments. "Our goal is to equip our students with a smattering of leadership, business, and project management skills that they will need to succeed in the biotechnology industry," Kjelstrom says. Many DEB graduates have landed jobs at biotechnology and pharmaceutical companies, and three graduates have started successful companies. "I routinely receive phone calls from companies like Genentech and Amgen inquiring about our students who may be on the job market," Kjelstrom says.

The University of Virginia's (UVa) Biotechnology Training Program is open to all interested graduate students in the university's life sciences and engineering departments. Like the MIT and UC Davis programs, the UVa program is funded by grants from NIH and features several core courses, an industrial seminar series, an annual biotechnology symposium, and internship programs. About 50 students have matriculated since 2000 and a majority of them have landed jobs at biotechnology, diagnostics, and science instrumentation companies.

Lessons

All the training program graduates interviewed for this article agreed that their industry internships were among the most important aspects of their training. "It opened my eyes to all kinds of possibilities that I never knew existed," says Bryan Czyzewski, an FBS graduate who received his Ph.D. in 2010 from NYU and is currently working as a research scientist at a New York City start-up. Erwin Gianchandani, a graduate of the UVa program and currently director of the Computing Community Consortium, a National Science Foundation-funded consortium that promotes high-impact computer focused research, says, "My 2-month internship showed me what industrial R&D was all about." Rebekah Neal, another UVa graduate and currently a postdoc at MIT, says, "It allowed me to add that coveted 'industry experience' to my CV."

Several trainees said their experiences helped them develop skills overlooked during their traditional graduate training. "Until I took the FBS course, I had no idea that I could do other things besides basic bench research," says Pola, the Nature Medicine editor.

"If you are undecided about your career, talk to as many other people possible," advises Wilson, the business development manager. "This will help you determine what you may or may not want to do with your career. However, once you figure out what you think you may want to do ... go for it. Waiting until the end of your graduate work when funding is running out and you are pressed for time is a big mistake—one that may force you to take that postdoctoral position that you desperately wanted to avoid."

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Institutions Offering Certificate Programs in Biotechnology

Northeast

- Roxbury Community College
- Boston University
- Columbia University
- Community College of Rhode Island
- University of Rochester
- University of Massachusetts, Boston

Mid-Atlantic

- Essex County College
- Johns Hopkins University
- Community College of Baltimore County

Midwest and West

- Madison Area Technical College
- Ball State
- Ivy Tech Community College
- Colorado State University

West Coast

- Solano Community College
- Ohlone College
- California State University, Long Beach
- University of California, San Diego
- City College of San Francisco
- California State University, East Bay
- Shoreline Community College
- Portland Community College

Other Industry-Focused NIH-Sponsored Programs

A complete list of biotechnology programs funded by NIH is available on the NIH website. All programs funded by NIH's Biotechnology Predoctoral Training Program require a two to three month industrial internship.

ADDITIONAL RESOURCES

Books

- *"So What Are You Going to Do with That?": Finding Careers Outside Academia*
  Susan Basalla and Maggie Debelius
- *The Chicago Guide to Your Career in Science: A Toolkit for Students and Postdocs*
  Victor A. Bloomfield and Esam E. El-Fakahany
- *What Color is Your Parachute? A Practical Manual for Job-Hunters and Career-Changers*
  Richard Nelson Bolles
- *Put Your Science to Work: The Take-Charge Career Guide for Scientists*
  Peter Fiske
- *Finding Your North: Self-Help Strategies for Science-Related Careers*
  Frederick L. Moore and Michael L. Penn

Further Resources from *Science*/AAAS

- *Science* Careers Job Board
  sciencecareers.org
- *Science* Careers Forum
  scforum.aaas.org
- Other Career-Related Booklets
  sciencecareers.org/booklets
- Career-Related Webinars
  sciencecareers.org/webinars
- Communicating Science
  communicatingscience.aaas.org
- Science & Technology Policy Fellowships
  fellowships.aaas.org
- Science News Writing Internships
  aaas.org/careercenter/internships/science.shtml
- AAAS Mass Media Science & Engineering Fellows Program
  aaas.org/programs/education/MassMedia
- ENTRY POINT! Internships for Students with Disabilities
  ehrweb.aaas.org/entrypoint
- Social Networking Communities—MySciNet
  community.sciencecareers.org

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There's only one
DR. SHIRLEY MALCOM

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

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

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

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

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