And Second Gladly Edition Teach

A Resource Book for Chemists Considering Academic Careers

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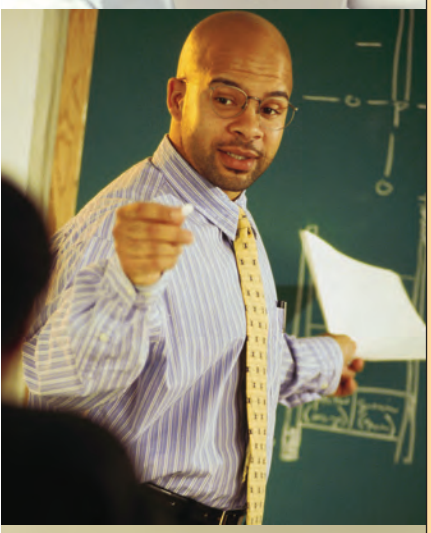

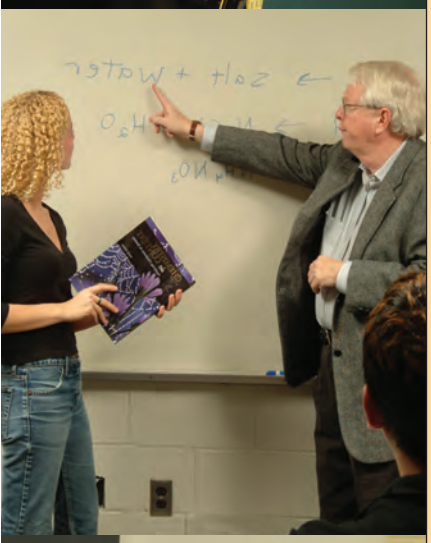
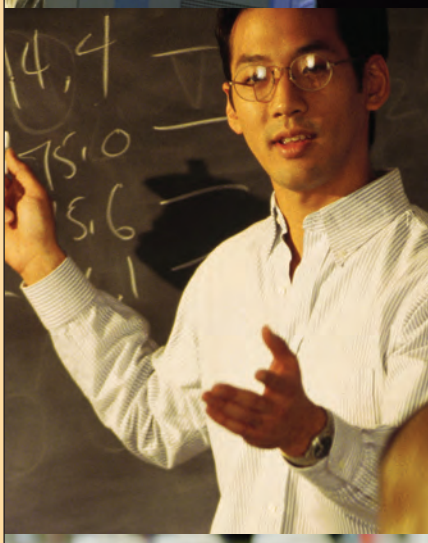

A Project of the American Chemical Society

And Gladly Teach

SECOND EDITION

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A. Truman Schwartz
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PREFACE TO THE FIRST EDITION

Every chemist knows that quantum mechanics has significantly aided our understanding of atomic and molecular structure. It is considerably less well known that quantum mechanics provides an insightful metaphor for the well-lived life. The secret of a richly rewarding career is simply to maximize the overlap integral between the wave function that represents what you must do and the wave function for what you want to do. If those two expressions are identical, you should achieve much and enjoy yourself while doing so. But if those wave functions are orthogonal, with no overlap whatsoever, your life will be drudgery. The aim of this little book is to help you make your job and your joy the same.

The book is an outgrowth of the Preparing Future Faculty (PFF) project of the American Chemical Society. In 1998 ACS received a grant from the National Science Foundation that led to the creation of PFF programs centered at five research universities. In the course of implementing this project, it became obvious that, although there is much printed and electronic material about academic careers, there is no single volume that collects information that might be particularly useful to chemists in graduate school and on postdoctoral appointments. Jerry A. Bell and Marta Gmurczyk, chemists and teachers who are currently ACS staff, invited me to assume primary responsibility for writing such a book.

Essentially my entire 36-year teaching career has been spent at Macalester College, a highly selective private undergraduate liberal arts college in St. Paul, MN. I know that world well, but I am less familiar with two-year colleges, master's degree–granting comprehensive universities, and research universities. Therefore, my acceptance of the invitation was contingent on acquiring the collaboration of chemist colleagues experienced in these other types of postsecondary institutions. I was particularly pleased that the first three individuals I asked to join me on the editorial board all accepted. They are Ronald Archer, University of Massachusetts, Amherst, MA; Amina K. El-Ashmawy, Collin County Community College, Plano, TX; and David Lavallee, State University of New York, New Paltz. At my request, they wrote position papers describing personnel practices at their own institutions and at similar ones. I incorporated many of their observations into the manuscript.

I also decided to gather additional information about the qualifications and characteristics sought in new appointees to faculty positions and the expectations for tenure and promotion in a broad sampling of colleges and universities. To that end, I prepared a questionnaire that was sent to approximately 2000 chemistry departments across the country. The roughly 400 responses have been very helpful in the preparation of the manuscript. I am grateful to those who took the time to complete and return the questionnaires and to Kathryn McNally, a chemistry major at Macalester College, who helped digest the data.

Among the more than 4000 postsecondary educational institutions in the United States, diversity is so great that generalizations are difficult and dangerous. The members of the editorial board briefly considered organizing the book around the chief institutional categories represented: two-year colleges, four-year colleges, comprehensive universities at which the highest degree awarded is usually the M.A. or the M.S., and Ph.D.-granting research universities. We soon agreed that the book would be more useful if it were organized around the various steps associated with deciding on, preparing for, searching for, and keeping a faculty position. Therefore, the book consists of four chapters: Deciding on an Academic Career, Preparing for an Academic Career, Searching for an Academic Position, and Keeping an Academic Job. Variations among the types of colleges and universities are addressed as needed.

Interspersed within these chapters are statements from eight recent Ph.D.s who describe their trajectories toward academic careers. Most of these young people were partici-

pants in PFF programs, and they were identified with the assistance of Marta Gmurczyk. Rebecca Eikey, who was a PFF participant at the University of California, Los Angeles, prepared the extensive bibliography, a critical part of this volume. Arlene Russell of the UCLA chemistry faculty and a principal investigator of the UCLA PFF program recommended Rebecca and provided valuable assistance to her and to me.

The editorial board members read and critiqued an early draft of the manuscript, correcting errors and misconceptions and making many useful suggestions. If the book proves to be of value, much of the credit goes to Ron, Amina, and David. I also owe thanks to four other readers. Raymond O'Donnell, State University of New York, Oswego, and Richard L. Bretz of Youngstown State University, Youngstown, OH, are highly experienced in issues relating to academic careers. A Macalester colleague, Kathleen Parson, provided the perspective of an established faculty member and administrator, and a former student, Chad Rienstra, called on his experience as a recent tenure-track appointee at the University of Illinois at Urbana–Champaign. The careful copyediting was done by Elizabeth Wood of ACS. Finally, the opinions expressed in this book are those of the author, influenced by the good advice of others. They do not necessarily represent the position or policy of the American Chemical Society.

A. Truman Schwartz

Background to the Second Edition

The first edition of *And Gladly Teach* has been used as a resource for participants in a variety of graduate student and postdoctoral fellow workshops and seminars focused on preparation for academic careers, as well as by individuals who share this career goal. Much of its usefulness derives from the generalizations the authors extracted from their varied points of view and experiences. These fundamentals underlie all the advice and recommendations for preparation and application for academic positions and survival as a new faculty member. Discussion of differences in the preparation and job search were largely limited to the differences in types of institutions a candidate might be targeting. Note that we use the terms "chemistry departments" and "chemistry professors" as shorthand to refer to departments and professors of chemistry and chemistry-related fields that include among others materials science, engineering, chemical biology, and environmental science. Most of our advice is applicable across the chemistry-related fields; the few instances where differences are significant are noted in the text.

Although the first edition has some explicit discussion about issues that affect women differently from men, these issues and others faced by women, underrepresented minorities, and people with disabilities are not prominent. In planning this second edition, we tried to retain the generality that characterizes the preparation of all future faculty while taking explicit note of the issues and their possible resolution that confront these groups of future faculty. We are pleased to acknowledge the contributions of Saundra McGuire and Geraldine Richmond, who provided enriching text that has been added at appropriate points. Four more young faculty have also contributed personal statements that complement, reinforce, and extend those previously included. In addition, we have expanded the bibliography to include more resources and recoded some that were already there. Representatives of the ACS Committee on Minority Affairs, the Women Chemists Committee, and the Chemists with Disabilities Committee provided comments and critiques that helped to strengthen this edition.

We owe a great debt of gratitude to our copy editor, Susan Robinson, who did a superb job of smoothing the new text and integrating it with the original. Our skilled designer, Neal Clodfelter, brought all the pieces together into this book that we all hope will help you prepare to gladly teach.

Jerry A. Bell and Marta Gmurczyk
Office of Graduate Education
American Chemical Society

DECIDING ON AN ACADEMIC CAREER

1

Souning in moral vertu was his speeche,
And gladly wolde he lerne, and gladly teche.

Geoffrey Chaucer
Prologue to The Canterbury Tales

Chaucer's description of the 14th-century Clerk of Oxenforde still applies, or at least should apply, to modern academics. If someone professes to be a professor, he or she had better gladly learn and gladly teach, because that's what the job is all about. Chaucer's other criterion is a bit more daunting. It would be nice if today's college and university faculty also conversed in speech that was "resounding in moral virtue." They don't all, but neither did they in 1386.

The task of deciding whether or not to seek an academic career is, of course, more complex than simply applying this test. Many positions outside of higher education provide ample opportunities to learn and teach and demonstrate moral virtue. Indeed, thanks to the ubiquity and usefulness of chemistry, a fresh Ph.D. in the discipline probably has more employment options than are available to his or her counterparts in any other field. Almost 70% of chemists with doctorates work in industry or government, where the intellectual and economic rewards can be great. But this book is intended primarily for those who are considering a career in a postsecondary educational institution.

The fact that we do not include careers in elementary and secondary teaching in no way denigrates the importance of these professions. The effectiveness of higher education depends to a great extent on the instruction that precedes it. This country desperately needs elementary and secondary teachers with knowledge of chemistry, pedagogical mastery, and a commitment to their students. Some Ph.D.s in chemistry have found stimulation and success in teaching at the precollege level. Thirty-six percent of the recent doctoral graduates who responded to a 2002 survey by the National Research Council indicated that they would consider teaching grades seven and above. The report of this study, *Attracting PhDs to K–12 Education* (www.nap.edu/books/030908427X/html/), proposes the creation of a fellowship program to prepare Ph.D.s in science, mathematics, and technology for teacher certification. The purpose of this book is not to discourage such laudable careers, but there are obvious limits on what can be included here.

We have also decided to focus on those who complete the doctoral degree in chemistry, because the Ph.D. is required for most college and university appointments. There are, however, many faculty members at two-year colleges who have terminated their formal education at the master's degree level. In the great majority of these institutions, teaching experience and aptitude are more important than extensive research experience. Some of the suggestions that follow should be useful to those who decide to complete an M.A. or M.S. degree and seek employment in the two-year or community college sector. Similarly, although the book does not specifically address all the concerns of Ph.D. chemists who might be interested in changing employment from the nonacademic sector to an academic position, much of the information presented here should be relevant.

Life in Academe

Jaimelee Iolani Cohen beautifully captures the "wonderfully rewarding satisfactions" of the academic life in her statement (see p 3). The motivations to seek such a career are many and varied. Some professors of chemistry and chemistry-related fields report that they decided on an academic career while they were undergraduates. Often they were influenced by stimulating teachers, mentoring faculty, undergraduate research, or their enjoyment of campus life. It is not uncommon for graduate students to aspire to careers in colleges or universities similar to those from which they received their bachelor's degrees. But the most immediate environmental influence on all graduate students is the university at which they are pursuing their advanced degrees. Most research professors understandably think their jobs are interesting and important, and many are eager to replicate themselves. Therefore, they may encourage their students, especially their best students, to seek similar jobs in similar institutions. Obviously, the most highly rated research universities have a limited number of positions, and the competition for these positions is fierce. Moreover, not all Ph.D.s are equipped with the talent, temperament, interest, or motivation to work at such institutions. For this reason, graduate students would be well-advised to at least explore other employment options, including faculty positions at two- and four-year colleges; at tribal colleges; at other minority-serving institutions, such as Historically Black Colleges and Universities and Hispanic-serving institutions; and at comprehensive universities. Minority-serving institutions provide the opportunity to work with students from a wide variety of backgrounds to significantly increase diversity in the chemical sciences.

The differences among the various categories of colleges and universities and within any of these groups can be vast. Therefore, generalizations are especially dangerous. However, there are some fundamental commonalties. Academe is probably unique in coupling almost absolute freedom with a high degree of job security. In most other professions, freedom and flexibility come at the price of high risk—consider a dot-com entrepreneur or a rock star. On the other hand, military and other civil service occupations generally provide great job security but limited independence. Academics have it both ways—at least after they get tenure.

Academe is probably unique in coupling almost absolute freedom with a high degree of job security.

Those who are drawn to academic careers because they think a secure job with no supervision and a long summer vacation promises a cushy sinecure will be badly and sadly mistaken. Most faculty members work far more than 40 hours a week, and their work follows them home. Indeed, a common complaint of academics is that the demands of the job, often self-imposed, interfere with family and other obligations. Given the realities of biology, the pressures of society, and the importance of mentoring students, such constraints often affect women, underrepresented minorities, and people with disabilities disproportionately. But members of both sexes, as well as members of underrepresented minority groups and people with disabilities, need to develop survival strategies that will permit them to thrive in a demanding academic environment. Approaches are offered in various parts of this book.

In spite of the special challenges, it is important that more women, underrepresented minorities, and people with disabilities seek academic jobs. The number of people in these groups earning doctorates in chemistry has increased significantly over the past two decades, but overall, members of these underrepresented groups are still found in disappointingly low numbers in the country's chemistry departments. Such underrepresentation means that talent is underutilized and role models for students who are female, underrepresented minorities, or people with disabilities are in short supply.

The need for African-American, Hispanic, and Native American chemistry professors is particularly acute. If your heritage places you in any of these groups, you should very seriously consider an academic career, because your contributions to society and to chemistry can be profound. Gloria Thomas offers some thoughtful advice for prospective

An Academic Career: Patience, Tolerance . . . and Chemistry

Jaimelee Iolani Cohen
Assistant Professor of Chemistry
Pace University
New York, NY

As I write this statement in late August 2002, a new academic year is about to begin. I can hardly believe that I've completed my first year as an assistant professor. If the saying is true, "Time flies when you're having fun," then I must have had a yearlong party! In all honesty, I have experienced an extreme of circumstances and all the emotions that come along with them—from excitement and eagerness to anger and astonishment.

I am certain that many of my experiences as a new faculty member are common to others, but the uniqueness of my situation was the September 11 tragedy. You see, 9/11 was to have been my third day of teaching organic chemistry at Pace University, which was located just five blocks away from the World Trade Center. Being so close to the attack made me feel quite vulnerable and affected me as a teacher, a scholar, a friend, a mother, and a human being. Once classes resumed three weeks later, I had to learn how to deal with not only my own day-to-day routine but also with my students. They looked to me for reassurance and guidance as "the one with answers" in a world then completely in chaos.

It was so strange to me that just two months prior I was defending my own thesis and looking for reassurance and guidance in my mentor; suddenly I was looked upon to answer questions and give hope and solutions to others. As a new faculty member I felt prepared to answer questions about mechanisms, reactions, and theories, but nothing could have prepared me for this. As a graduate student, however, I was taught the value of patience, tolerance, and commitment. Of course, patience was mastered through the completion of each and every experiment, including those that had failed. Tolerance was achieved because there were quite a few of us in our laboratory (grad students and undergrads) all fighting over hot plates, rotovaps, and high-vacuum pumps. Commitment was developed along the way while writing up my never-ending thesis. These learned traits became some of my greatest assets as a new faculty member. I was not directly taught these traits, nor did others tell me how important they would be toward my professional academic career; I was to learn this all on my own.

Of the three traits, the one I had the most difficulty with was patience. I couldn't understand why I had to review the same mechanism over and over again with the students. Initially, I thought that it was more important to cover all the topics in each chapter in incredible detail. There were only good intentions on my part, as I wanted all of my students to do well on their MCATs and be accepted into the medical schools of their choice. This, of course, meant that I had to lecture fast and furious in order to get through all the material on my syllabi. This approach led to frustration for both my students and me.

I must say that I learned a great deal from my student course evaluations. Because the evaluations are anonymous, each student was frank about what he or she thought about the course and about me. I changed what wasn't working for them. The first thing I took care of was the amount of material I covered. I found it works best to cover the more important topics in detail and

leave the lesser topics for them to read on their own. Another issue was the use of PowerPoint slides and overhead transparencies. My students expressed in their evaluations how they strongly disliked the use of PowerPoint and transparencies in lectures. They said that using those technologies allowed me to fly through lectures, leaving them with little time to ingest the new material. That was enough for me; both were out. I reverted to the "old-style chalk talk." The majority of the next set of course evaluations I received gave me rave reviews! My students noted how they appreciated my flexibility and my consideration of how they wanted to learn and what worked best for them. I felt completely overwhelmed by their written comments. That was definitely a proud moment in my career that I will not forget.

Another proud moment that stands out in my mind is when my undergraduate researchers gave oral presentations of their work. I sat in the audience in awe and later in tears. Watching my three students develop into researchers enforces the fact that I made the only career choice for me: academia. It is only here in the university setting where I can educate students, learn from them, and have the freedom to conduct any interesting research I wish. It is here in the academic life where I can continue to grow mentally, utilizing my unlimited imagination.

As I enter my second year as assistant professor of chemistry at Pace University, I once again look into my future with excitement and eagerness, and with two very different emotions—anticipation and acceptance—leaving far behind any anger and astonishment that plagued me just a year ago. I so look forward to meeting my new organic chemistry students and sharing my knowledge with them, working with new undergraduate researchers, and continuing to learn along with my research group.

These are but a few of the wonderfully rewarding satisfactions I have experienced as a new professor and some of the many fewer frustrations that I encountered during my first year. It is my hope that all graduate students considering an academic career path prepare themselves for what should be in store for them: constant interaction with students, teaching them and learning from them, and an enormous feeling of gratitude and reward. All the best!

minority professors in her statement on page 67. Among other things, she suggests attending workshops for minority faculty. Deon Miles, whose statement ap-pears on page 7, offers his inspiring perspective for seeing an academic career as a member of an under-represented group in a larger context. Many foreign-born chemists have also found stimulating and productive careers in American colleges and universities. The discipline and the nation are stronger for their presence.

Likewise, people with disabilities develop unique skills by overcoming varied challenges of many descriptions. The resulting ability to approach problem-solving creatively, not to mention providing an all-too-rare role model for students, enriches research and teaching, the department, and the educational institution as a whole. On page 51 Karl Booksh shares some of his personal experiences with academic life. The Committee on Chemists with Disabilities (CCD) has published an excellent resource, *Teaching Chemistry to Students with Disabilities,* that provides information about everything from disability laws and services through assistive technology and mentoring to universally accessible design; please see page 54 for additional resources.

The image of a professor dressed in a threadbare tweed jacket and living in genteel poverty is not entirely accurate. Nevertheless, the 2002 ACS salary survey indicates that median salaries for Ph.D. chemists in industry and government are significantly higher than those of their academic counterparts (Table 1). Table 2, which focuses on academic institutions, indicates that the lowest salaries are paid by colleges and universities that do not grant doctorates. Moreover, the salary range from assistant through full professor is considerably more compressed at primarily undergraduate schools than at research universities. Interestingly, some of these differences are reduced for faculty on 11- to 12-month contracts. Summers enable faculty members to supplement their income with research stipends (usually externally funded), summer school teaching, or employment outside of the home institution.

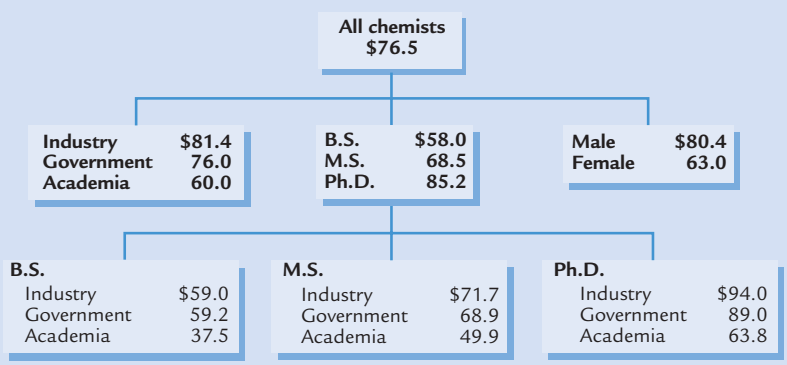
Job seekers are well-advised to consult other sources of information about compensation at specific institutions. The American Association of University Professors issues an annual survey (in April) that lists average salaries at most American colleges and universities, and *The Chronicle of Higher Education* publishes similar information. *The Chronicle*'s annual *Almanac* edition is a good source. In general, private Ph.D.-producing universities pay best, followed by public Ph.D.-granting universities, other public four-year institutions, other private four-year institutions, and two-year colleges. Mechanisms for setting salaries vary from those that are strongly merit-based to those that are fully controlled by collective bargaining agreements.

Few, if any, professors have become immensely wealthy from their normal academic compensation, but some have supplemented their

TABLE 1

MEDIAN SALARIES

Ph.D. chemists earn about 50% more than those with bachelor's degrees



Note: Median base annual salary in thousands of dollars for chemists employed full time as of March 1, 2002.
Source: *Chem. Eng. News*, **2002,** *80* (31), 38.

TABLE 2

ACADEMIC SALARIES

Top rewards come to full professors

	9- TO 10-MONTH CONTRACTS		11- TO 12-MONTH CONTRACTS	
MEDIAN SALARY,[a] $ THOUSANDS	NON-PH.D. SCHOOL	PH.D. SCHOOL	NON-PH.D. SCHOOL	PH.D. SCHOOL
Full professor	$67.0	$95.0	$96.0	$115.5
Associate professor	50.8	61.2	70.0	78.0
Assistant professor	44.8	54.0	45.8	60.0

[a] As of March 1, 2002.
Source: *Chem. Eng. News*, **2002,** *80* (31), 13.

regular salaries with proceeds from consulting, textbook writing, patents, or new companies. Many colleges and universities offer benefits not generally available in industry, such as sabbatical programs, travel grants, and tuition remission for dependents.

An effective and successful faculty member is not motivated primarily by money, the stick of probationary appointment, or the carrot of tenure. Effort seldom flags after the award of tenure. It is naïve to suggest that reputation, prestige, grants, awards, and honors do not drive scholars and teachers. However, the most compelling motivation is internal—curiosity and the desire to learn and to share your learning with others. If you are not self-motivated and at least a little obsessed, an academic career is probably not for you. In this day of frequent shifts in jobs and employers, the concept of a "vocation" or "calling" may sound hopelessly old-fashioned. However, effective professors seem to have something of that motivation. They possess generosity of spirit, personal integrity, and dedication to seeking and transmitting the truth. They are enthusiastic, patient, and adaptable. The standards they set for themselves are at least as demanding as their expectations of others, and they show respect for students and colleagues. Bassam Shakhashiri of the University of Wisconsin, a highly regarded national leader in science education, characterizes the best teachers as being "competent, committed, and compassionate."

One of the great pleasures of the academic life at just about any college or university is that it involves a wide range of activities and responsibilities—teaching, mentoring, advising, carrying out research, writing proposals and papers, lecturing and presenting professional talks, managing budgets and supervising people, serving on committees and in professional societies, and so on. A successful chemistry professor must have skills in experimental design, instrument repair, laboratory technique, mathematics, computation, curriculum development, oral and written communication, and human relations. To be sure, not all of us are equally talented in these various areas. Perhaps you have been taught by professors who are brilliant lecturers but uncomfortable in one-on-one situations. You may know others who are very good at explaining complicated concepts to small groups of students but not very stimulating in the lecture hall. Others shine in the laboratory or are superb research mentors. There's probably not a single "academic type."

Carnegie Classification of Colleges and Universities (2000)

Institution Type	Number
Doctoral/Research—Extensive (award at least 50 doctorates per year across at least 15 fields)	151
Doctoral/Research—Intensive (award at least 10 doctorates per year across 3 or more fields)	110
Master's Colleges and Universities—I (award at least 40 master's degrees per year across 3 or more fields)	496
Master's Colleges and Universities—II (award 20 or more master's degrees per year)	115
Baccalaureate Colleges—Liberal Arts	228
Baccalaureate Colleges—General	321
Baccalaureate/Associate Colleges	57
Associate Colleges	1669
Specialized Institutions (includes some schools of medicine, engineering, law, etc.)	766
Tribal Colleges	28

Source: www.carnegiefoundation.org/Classification/index.htm

Because we all possess different skills and interests, it is fortunate that not all colleges and universities have the same expectations of their faculty. In trying to decide whether you should seek an academic job, it is important to know something about the variety of institutions and what they typically value. If you find what seems to be a comfortable fit between your own strengths and the expectations of a particular type of institution, that's where you should concentrate your search.

Your quest is complicated by the fact that there are several systems for classifying the 4182 institutions of higher education in the United States. The Carnegie Foundation for the Advancement of Teaching uses the 10 categories displayed in the box, some of them based on the number of degrees awarded. *U.S. News & World Report* uses its own system in its annual ranking issue. Other descriptors include "comprehensive colleges and universities," which offer a broad range of subjects and often award master's and professional degrees. Academic institutions can also be classified as public or private, or nonprofit or for-profit.

The huge state universities with their powerhouse athletic teams and the highly pres-

Defining Yourself

Deon T. Miles
Assistant Professor of Chemistry
Sewanee: The University of the South,
Sewanee, TN

Being a professor at a small liberal arts institution comes with a good deal of responsibility. Aside from the rigorous teaching and research demands, there are countless service commitments that must be kept. Committee work, while sometimes quite arduous and boring, is an important responsibility that improves the institution as a whole. To have committees that are a good representation of the institution, diversity is desired, and the factors used to compose a committee can include discipline (sciences, humanities, and social sciences), tenure (assistant, associate, and full professors), sex, and/or race. It is usually not difficult to create a faculty committee that is representative by discipline and tenure. However, since most institutions have a predominantly white male faculty (as reported in a recent ACS survey), attempts to make committees that are representative by sex and race are more challenging. If you are the lone faculty member of color at your institution, you may become a popular person for faculty committees. Because the first year as an assistant professor is stressful enough without the added responsibility of committee work, I made it a point not to serve on any faculty committee during that year. Since then, I have also been rather selective when considering serving on particular committees. I have learned to say no when necessary so that I am not overburdened by committee work. Self-preservation is key!

Consider the following people: George Washington Carver, Edward Alexander Bouchet, W. E. B. Dubois, Mary McLeod Bethune, St. Elmo Brady, Marie Maynard Daly, James Meredith, Autherine Lucy, Vivian Malone, and James Hood. All of these people have one thing in common. They are considered to be pioneers who broke down barriers for African-Americans in colleges and universities. While contemplating my position as an African-American in higher education, I came to the realization that I am not a pioneer like the aforementioned people. There have been a number of black professors at predominantly white liberal arts institutions like Sewanee, and there are other black professors that have been at my institution for a number of years. I am not breaking down barriers like Dubois and Meredith. I am only reaping the benefits from their hard work and countless sacrifices as they overcame the obstacles before African-Americans in colleges and universities. Nevertheless, I do have an obligation to these pioneers. Remembering how hard it was for those before me to earn their place in higher education, I must honor them by working every day to be the best professor that I can possibly be. I must also accept my position as a role model and inspiration for the future generations of African-Americans. I had several mentors while growing up, and two African-Americans in particular (ironically, an elementary school music teacher and a high school English teacher) were instrumental in my development as an educator. Without their examples as successful African-American educators, it is highly unlikely that I would be a professor today. Likewise, I must be aware that my example can motivate my students as they consider their future as contributing members of society.

Though I believe my heritage, background, and ethnicity add an important dimension to my work, I am not limited by the description of just a "black professor." As is true of my colleagues, I am first a professor, and there are several adjectives that can be used to clarify the type of professor that

I am. Sewanee administrators may choose to describe me as a chemistry professor, an assistant professor, or an untenured professor. I choose to believe that my students may describe me as a funny, great, or tough professor. In general, I may be described as a young professor, a Christian professor, and yes, a black professor. How do I describe myself? I cannot use just one adjective to capture who I am, for there are many sides to my personality. I am (in alphabetical order) an assistant, black, chemistry, Christian, funny, great, tough, untenured, and young professor. I should emphasize that there is nothing wrong with embracing your culture and racial heritage. However, you should not be limited by your ethnic background either. As a faculty member of color at a liberal arts institution, it is important to express and celebrate all of who I am while allowing all parts of me to contribute to the institution.

My primary responsibility as a faculty member at a small liberal arts institution is to teach my students well. In my mind, it does not matter whether I am teaching an African-American, Hispanic, or white student. In the same respect, I hope that my students understand that the material that I teach could just as easily come from a professor of a different ethnicity. When it comes down to it, each of my students must know the same material as exam day approaches, regardless of my or their race. As I stated earlier, my African-American students may come to see me as a role model or an inspiration. Ultimately, my hope is that all of my students see me in the same light.

tigious private universities attract a good deal of attention, but small colleges attract a lot of students—a few at a time. Two-thirds of all colleges have fewer than 5000 students, and almost 40% have fewer than 2000. Approximately 44% of all undergraduates are enrolled in two-year colleges, which means that community colleges play an important role in teaching general and organic chemistry. Many of their students transfer to four-year institutions, and some complete chemistry majors and go on to graduate school and/or jobs within the discipline.

As we mentioned earlier, the nation's many minority-serving institutions (MSIs) offer numerous opportunities to people seeking employment. The MSI designation includes the group of institutions comprising the 105 Historically Black Colleges and Universities (HBCUs), 187 Hispanic-Serving Institutions (HSIs), and 35 Tribal Colleges and Universities. As you would imagine, these institutions span the gamut in terms of size, admissions selectivity, entering students' profiles, research facilities, academic reputation, and the demands placed on their faculty. However, at all MSIs, minority students constitute a significant percentage of the enrolled students.

Working at an MSI presents special opportunities, challenges, and rewards. MSIs offer many special grant opportunities for faculty as a result of the national effort to increase the diversity of the chemical workforce. Additionally, MSIs have designed numerous programs to attract more minorities into science. Such programs provide special scholarships and research support for minority students pursuing science degrees. Furthermore, agencies such as the National Science Foundation, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration often provide special funding for research performed at MSIs.

Working in many—but not all—MSIs can involve certain challenges. They may include a lack of state-of-the-art laboratory facilities and instrumentation, institutional infrastructures that are not well developed to support scientific research efforts, and students who may not be as well prepared as their counterparts at other institutions. Additionally, the teaching loads at MSIs may be quite heavy, as often the number of chemistry faculty in these institutions is lower than that recommended for the size of the student population.

Although faculty positions in MSIs pose challenges, they come with considerable rewards. Many faculty find it especially satisfying to work with students who have an interest in and aptitude for science but who may come from backgrounds in which exposure to science was limited. The faculty members in this situation are able to spark an interest in chemistry in their students, nurture them to success throughout their undergraduate years, and contribute to their development into productive members of the chemical enterprise. If you would like to be in an environment that gives you the opportunity to mentor and encourage minority students to pursue studies in chemistry, a position at an MSI may be just right for you. You can find information about MSIs at a variety of websites, including www.va.gov/dmeeo/minserv.htm, www.hacu.net, www.aihec .org, and www.nafeo.org/index15.html.

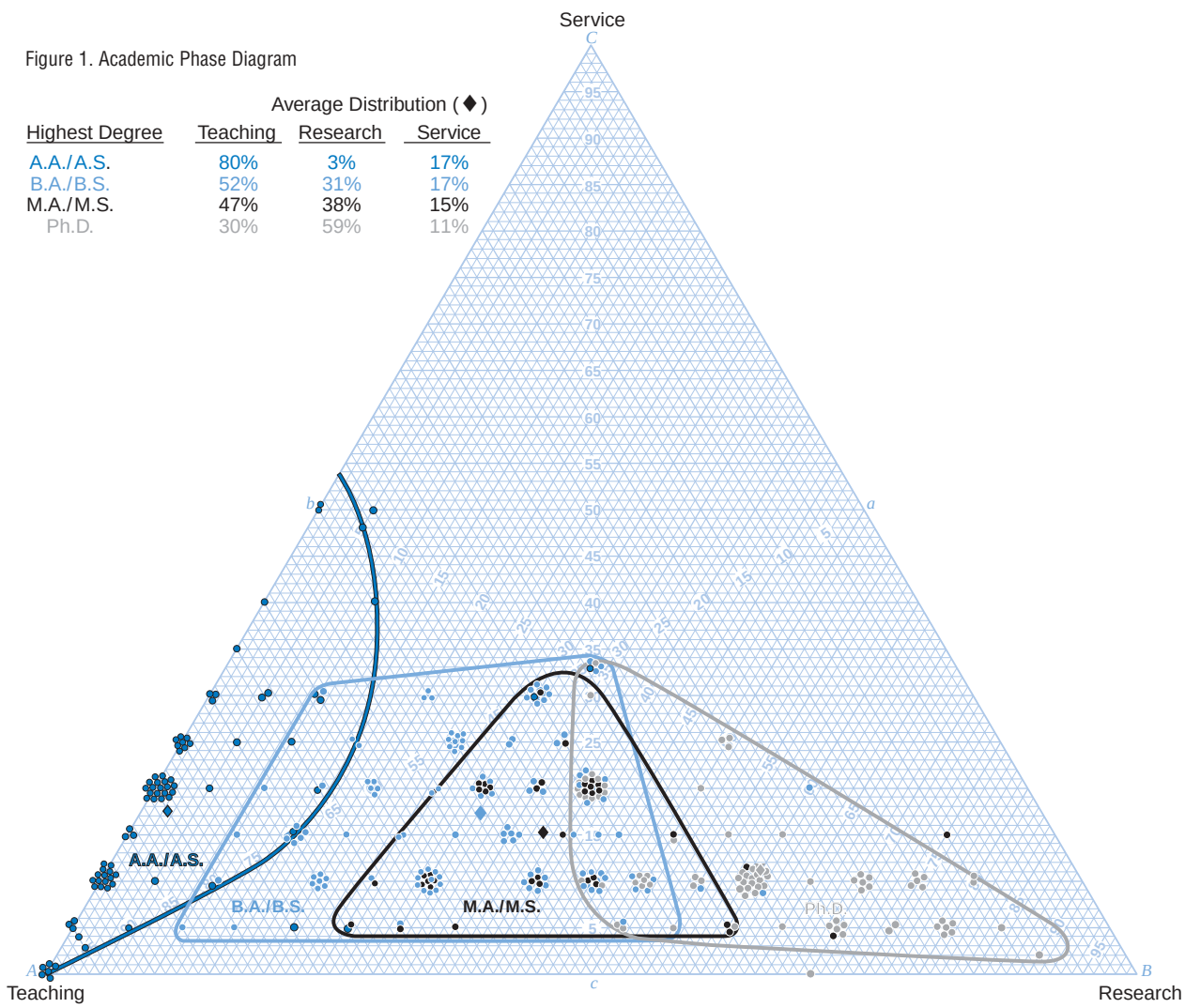
The Academic Phase Diagram

Once more, physical chemistry can help you analyze the academic marketplace. You may remember the experiment in which you determined a phase diagram for a three-component system. In the pre-OSHA/days, we did the water-chloroform-acetic acid system; you may have investigated a more benign system. In any case, recall the diagram. Each corner of an equilateral triangle represents a pure component, the sides correspond to mixtures of the two components represented by the terminal vertices, and any point within the body of the triangle corresponds to a mixture of all three components. The coordinates of the point indicate the relative concentration of the three components. The closer a point is to one of the corners, the greater the concentration of that component. Remember?

A phase diagram can also be used to represent the expectations that a college or university has of its faculty members. The three "components" at the vertices of the triangle are teaching, research, and service; academic life inevitably involves a mixture of all three. The relative weights attached to these three responsibilities determine the position on the diagram. Where in this phase diagram you will be expected to spend most of your time depends on the institution. For the sake of simplicity, the areas in Figure 1 are identified by the highest degree awarded in chemistry: Ph.D., M.A./M.S., B.A./B.S., and A.A./A.S. Of course, the diagram is an oversimplification, but it is based on experimental evidence. In the questionnaire sent out to gather information for this book, chemistry departments were asked to indicate the approximate percentage of importance attached to teaching, research, and service in making tenure and promotion decisions. Data from the responses are plotted in the figure. Many departments and institutions do not have a prescribed weighting distribution, and even if one nominally exists, the interpretation and implementation may not conform to the official policy. Moreover, criteria for tenure and for promotion to full professor are often different; institutions typically expect a greater involvement in service from full professors. Nevertheless, the phase diagram does provide a reasonably reliable representation of the expectations of a wide range of postsecondary

Figure 1. Academic Phase Diagram

Highest Degree	Average Distribution (♦) Teaching	Research	Service
A.A./A.S.	80%	3%	17%
B.A./B.S.	52%	31%	17%
M.A./M.S.	47%	38%	15%
Ph.D.	30%	59%	11%



educational institutions. It also correctly indicates that the differences among the institutions within any classification can be great and that areas overlap considerably.

The most consistent response was from two-year colleges. In such institutions, the major emphasis is on teaching, with some service required; but little research is expected or, in some places, even possible. The average distribution for the 88 responding colleges was teaching, 80%; research, 3%; and service, 17%. The most frequently cited ratio was 80% teaching, 0% research, and 20% service, and fully 75% of respondents reported that research productivity was not considered in tenure or contract renewal decisions. Although 10% of the two-year colleges stated that excellence in teaching was the only criterion, the community college member of our editorial board indicates that some institutions and systems make it clear that no multiyear contracts will be issued without evidence of service. Also note that service can and often does include service to the discipline.

Not surprisingly, Ph.D.-granting universities are skewed toward the vertex labeled "research." However, teaching is more heavily weighted than popular perception might predict. The average distribution in the institutions that responded (coincidentally, again 88) was teaching, 30%; research, 59%; and service, 11%. This corresponds almost exactly to the most common weighting, reported by 17% of the departments. The percentage attached to teaching ranged from 8% to 50%, and the most frequently cited service expectation was 10%. A number of respondents indicated that tenure would not be granted without a productive research program but that teaching also had to meet departmental standards.

A total of 123 four-year colleges responded to the survey, with an average distribution of teaching, 52%; research, 31%; and service, 17%. However, these baccalaureate institutions cover the greatest area on the academic phase diagram, indicating great diversity. On one extreme are highly selective liberal arts colleges with research facilities and expectations that equal or exceed those of some Ph.D.-granting universities. A few of these colleges report valuing research more heavily than teaching. At the other extreme are colleges in which research apparently carries no weight in tenure and promotion decisions. Given this wide distribution, if you are considering primarily undergraduate institutions (PUIs), you should carefully determine where on the diagram they fall.

Most of the 37 master's degree–granting departments surveyed fall between the baccalaureate and doctoral institutions. Teaching typically carries more weight than research. Averages are teaching, 47%; research, 38%; and service, 15%. Incidentally, the responses included some chemistry departments that are housed in Ph.D.-granting universities but award only master's degrees. These departments have expectations that closely resemble those in M.A./M.S.-granting institutions. Similarly, departments that only award bachelor's degrees, even though the university grants master's degrees, resemble departments in four-year colleges. At least in these cases, the department seems to be more significant than the institution in establishing criteria for promotion and tenure.

In planning an academic career, it is important to determine where you most comfortably fit in the academic phase diagram and then identify an institution that has similar expectations and opportunities. Your graduate and possibly postdoctoral work has given you experience in a research university, and you may have studied in a two- or four-year college or a comprehensive university. If not, you can familiarize yourself with such institutions by reading their promotional materials, visiting them, talking with their graduates and faculty members, and, ideally, spending some time on campus as part of a Preparing Future Faculty (PFF) program. We return to this topic in greater detail in the following two chapters.

Probably the most important question to ask yourself and potential employers is, "What do you wish most to contribute, new knowledge or educated human beings?" To

be sure, all institutions of higher education value research and teaching, but it makes a big difference whether educated people are the byproducts of a research program or whether new knowledge emerges from the educational enterprise. Don't allow the easy way out by accepting "both" as an answer. Sooner or later, you and the institution will have to decide how time and resources are allocated. If you want research to be your greatest professional legacy, you very likely belong at a university where research is the highest priority. If you didn't get as much satisfaction from your research as you did from your assignments as a teaching assistant, you should explore two-year colleges. If you love both research and teaching and want a career that involves significant amounts of both, concentrate your job search on comprehensive universities and four-year colleges that encourage or require research for the master's or bachelor's degree. You'll have the opportunity to woo both of your loves and the challenge of keeping them both satisfied.

Probably the most important question to ask yourself and potential employers is, "What do you wish most to contribute, new knowledge or educated human beings?"

Research and Scholarship

In applying the phase diagram model to academic institutions, it is important to keep in mind that what counts as research or scholarship varies considerably between and within institutional sectors. Universities with strong research programs expect a high degree of productivity of original and innovative papers published in prestigious journals, an active research group of graduate students and postdocs, and major external funding. To truly succeed in such an environment, you are expected to become a national if not international expert in your area of specialization. This is what Ernest Boyer of the Carnegie Foundation called the "scholarship of discovery" in his book, *Scholarship Reconsidered: Priorities of the Professoriate*.

Opportunities for involvement in the scholarship of discovery are almost always fewer in comprehensive universities and four-year colleges, in part because teaching assignments are typically greater. Without a Ph.D. program, the level of research productivity is lowered and certain limits are imposed on the nature of the research problems addressed. For example, it is more difficult to compete in a "hot" field, and state-of-the-art instrumentation may not be available. However, most comprehensive universities and selective liberal arts colleges do expect their faculty to be involved in research with master's degree students or undergraduates. The definition of scholarship at these institutions is often more flexible than at research universities. One or more of Boyer's other categories—the scholarship of teaching, integration, or application—may count toward tenure and promotion. Thus, textbooks and published articles describing new courses or new pedagogical strategies may be acceptable evidence of professional involvement. For the most selective liberal arts colleges, external peer review is essential. Other institutions may regard internal contributions to educational innovation, such as the design of new courses and experiments, as sufficient. Any institution worth teaching at encourages some sort of professional participation, and any chemist worth employing is committed to it.

Professors in small departments can be intellectually isolated. However, small colleges often provide considerable opportunity for interaction with colleagues from other disciplines. Indeed, multidisciplinary teams often provide the best environment for solving complex problems. In addition, funding agencies often support external collaborations with other academic institutions that may prove quite beneficial.

Teaching

Teaching responsibilities also vary widely among colleges and universities. One obvious difference is the number of contact hours. Research universities may require only one or

two courses a year, often one graduate and one undergraduate offering. Even when lecturing in an introductory course, research faculty members are seldom directly involved in supervising the associated laboratory sections; this responsibility is usually assigned to laboratory instructors and/or teaching assistants. Other institutions expect that instructors will devote 9–15 (or more) contact hours per week to teaching, frequently divided between the classroom and the laboratory. ACS's Committee on Professional Training (CPT) specifies that in order for a department to be considered for CPT approval, the number of weekly contact hours cannot exceed 15. The guidelines also stipulate a minimum of four full-time chemistry faculty members. The CPT standards represent a model for undergraduate education in chemistry and are influential both with institutions that have approved programs and those aspiring to gain approval. The 623 approved programs constitute a shopping list of desirable employers. The CPT website, www.chemistry.org/education/cpt, is a valuable resource for those seeking academic positions.

Institutions also differ in the nature of teaching assignments, and potential faculty members should know what to expect. Obviously, universities with doctoral programs provide opportunities to teach advanced courses and seminars to graduate students. Master's degree programs offer some similar assignments in one's area of expertise. But in PUIs, the availability of upper-division courses can be limited. A critical mass of chemistry majors and chemistry faculty is necessary to support such offerings. Job seekers should realize that the stimulation of teaching advanced courses can be a powerful motivating factor for keeping current and engaged. The demand on faculty to become generalists is inversely related to the size of the department. Simply covering the introductory courses in general, organic, analytical, and physical chemistry may consume all the teaching time of a two- or three-person department. In some small departments, even some of these fundamental courses may be offered in alternate years, and it is not unheard of for individual faculty members to teach courses in more than one of the major subdisciplines. Some of these problems are avoided in two-year colleges, where typically only general and organic chemistry are offered, though often in several different versions. The price paid by two-year faculty is the inability to teach upper-level chemistry majors.

Fortunately, excellent undergraduates appear everywhere, but the average extent of academic preparation and intellectual ability is greatest at highly selective private research universities and liberal arts colleges. Teaching such students can be a stimulating intellectual challenge. As Cinzia Muzzi indicates in her statement, teaching first-generation college-goers in an open-admissions, two-year public institution presents another sort of challenge and provides another set of rewards (see p 18). Here the students are typically older, more mature, more diverse, and often motivated by a desire for career change or enhancement. Perhaps the greatest challenge to a professor is teaching a class in which there is a wide disparity of ability and interest and successfully meeting the educational needs across this broad spectrum.

Interviews with students about their previous experiences in chemistry courses often reveal that teachers emphasized memorizing definitions and formulas. In addition, the examinations might have been composed of "plug and chug" problems, in which students would substitute numbers into a formula to calculate a result that meant little to them. Furthermore, the day before a test, some of their teachers might have conducted a review of the test material, which consisted of going over the types of problems that would appear on the test.

When students accustomed to such classes take their first chemistry course in college, they receive a rude awakening. They approach the material convinced that they can

PFF: Swimming for the Future

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Being an early fellow in one of the original five institutions to adopt an ACS Preparing Future Faculty program gives me a unique perspective. The program's effect on my career choices has been immense. I learned many things as a PFF fellow, but most important, PFF gave me the confidence to select the correct career path for me. This confidence came through the knowledge gained regarding the options and environments available in the world of higher education.

Since my first tutoring session as a sophomore at Eastern Oregon State College, I knew that teaching was for me. As I progressed through my four years of undergraduate study in chemistry, I realized I also wanted a Ph.D. This brought me to graduate school at Arizona State University with the goal of becoming a college professor. A pure coincidence brought me to PFF. I received the application letter for the program and my Younger Chemists Committee newsletter the same day in the mail. In the newsletter was a small article on this promising new program for graduate students, PFF. I decided then and there to fill out the application, and the rest is history.

After leaving Arizona State University, I accepted a visiting lecturer position at the University of Illinois at Urbana–Champaign to gain teaching experience. PFF helped influence this choice. It gave me the desire to experience teaching at different levels of institutions. While I had my sights set on a four-year college, I also desired the experience of leading the large classes in a university setting. My position at UIUC has proven to be invaluable. While teaching a class of over 350 mostly freshmen students, I have learned tremendous amounts about the administration of such a large course. PFF and my graduate school experiences had given me an idea that this was coming, so I felt prepared to logically attack decisions.

My position as a visiting lecturer in a large university has had many pluses and minuses. The position has allowed me to develop not only my teaching and decision-making skills but also my maturity. Having to deal with student complaints and questions and having the final say on course policy were in a new realm of higher education for me. It was exciting! The large classes also taught me that I don't really care for teaching large classes. The lack of one-on-one contact with a great number of my students conflicts with my teaching philosophy of learning as much from my students as they do from me. Also, keeping 350 students on the same page (even though most days I would settle for the same chapter) causes an enormous amount of structure and inflexibility in the course as a whole. I am unable to change my teaching significantly on a whim to better benefit groups of students. Overall, my experience at UIUC has been very beneficial, but now as I look to move on, I fall back on my PFF knowledge in finding the right job for me.

Where do I go next? The one statement for PFF that is cemented in my mind after all these years is "only take the right job." In other words, you and your employer will only be happy if you take a job that you feel 100% about doing and doing well. This has led me to think about what I want for my life as a whole. As I get older and start to consider having a family, there are a few qualities that I am looking for. These include flexibility, stability, location, salary, and most importantly, enjoyment of the work. I love to teach, so the idea of looking for a four-year college or

community college has come to the top of my list. Traditionally, these types of institutions are more heavily teaching-focused and less research-focused. This appeals to me. While research is a vital part of chemistry, teaching is a vital part of education. PFF brought to light that faculty members must balance teaching, research, and service according to a particular institution's philosophy to be successful. The PFF program made me realize that the best fit for me would be a place where teaching takes the spotlight while research plays the supporting role. For these reasons, I have decided to head out in search of a smaller school. The smaller school will lead to smaller classes, more individual student contact, and therefore a more fulfilling work environment.

The PFF program provided one large stepping stone for my career. It made me leave the world of graduate work and enter the "real" world of academia with knowledge and confidence. I wasn't left treading water but was able to hit the pool of faculty applicants swimming for the future.

begin studying—memorizing a few formulas and terms—one or two nights before the exam (the equivalent of the high school review the day before the test), and still do well. Thus the chemistry professor must spend some time and effort teaching students how to learn chemistry. Fortunately, several excellent references can help faculty learn to do this. You will find some of them in the Bibliography under "Teaching Philosophy" on page 78.

Class sizes in two- and four-year colleges are generally quite small and can offer much opportunity for close faculty–student contact. Such interaction is often highly beneficial for the student and richly rewarding for the instructor. Mentoring of this sort may contribute to the disproportionately large number of students from predominantly undergraduate colleges who enter doctoral programs. Observing and contributing to the intellectual and personal development of a student is one of the greatest satisfactions that a teacher can have. Most professors at large universities do not get to know undergraduates very well, certainly not in lecture sections of 300 or more. More intimate acquaintance may come when students enroll in smaller upper-division courses or participate in undergraduate research. Research at any level is based on the apprentice–mentor model, one of the most effective methods of education, and is best expressed in doctoral programs. The collegial relationship between a research mentor and his or her graduate students and postdocs is an unquestioned benefit of a research university.

Observing and contributing to the intellectual and personal development of a student is one of the greatest satisfactions that a teacher can have.

Scientific Teaching

Working as a teaching assistant or even with a mentor in a Preparing Future Faculty (PFF) or other faculty development program may leave you with the impression that teaching is a seat-of-the-pants profession, more art than science. Although this may have been the case in the past, it is certainly not true today. There now exists a substantial literature and research base for a more scientific approach to teaching, which you can use to your own and your students' advantage. Most of this research emphasizes student learning and approaches that enhance it. "Scientific teaching involves active learning strategies to engage students in the process of science and teaching methods that have been systematically tested and shown to reach diverse students" (*Science*, **2004,** *304,* 521–522). Students seated in a classroom dutifully taking down what you have written on the board or in your PowerPoint presentation are almost never intellectually engaged with the subject matter; they are too busy taking the notes. Similarly, students following the detailed write-up you have prepared to direct their work in a laboratory exercise, verifying some concept, are not engaged in the process of scientific inquiry; they are focused on the steps, not the reasoning.

You can do better as a scientific teacher, and there are a large number of resources available to help you, beginning with the article mentioned above, the references cited therein, and extensive on-line supplementary material. The research conveys the message that engaging students in discovery and the processes of science improves their ability to both acquire and retain knowledge. In almost all cases, methods that engage students take more time than traditional "information transmission" techniques, thus reducing the coverage of specific content. However, the content that is uncovered by students who are actively engaged in their learning appears to be deeper and more readily applied to new situations and problems; furthermore, performance on standardized exams does not suffer. If you are fortunate enough to teach in an institution where faculty are using active learning methods, take advantage of this resource to enhance your repertoire of teaching ideas. If you do not have readily available role models, acquaint yourself with the literature in this area, take advantage of sessions devoted to these methodologies when they are held at meetings you attend, and begin to network with their practitioners.

Service

In most institutions, service is the least well-defined of the three criteria for academic success. It can involve service to the department (especially in large universities), the institution (more common in small colleges), the discipline, or the larger community. Committee work is its most common manifestation. There are probably no trustworthy generalizations about what constitutes service in different types of institutions, and there are many differences among institutions. For most people, expectations for service will not be a significant influence on whether or not to seek an academic career or even a specific job. Any college or university can provide opportunities to gain administrative experience. Chapter 4 includes some suggestions for negotiating the academic phase diagram once you get on it. For the moment, the warning is not to get too close to the service corner during your first years in a faculty position.

Phase Changes

The phase diagrams of institutions can change with time; for example, when a comprehensive university seeks to transform itself into a research university, a former teachers' college introduces graduate programs, or a liberal arts college significantly raises its research expectations. Such changes can cause serious internal upheavals, especially when the goals of the administration no longer conform to those of many long-time faculty members or when new and older faculty differ greatly in their values and orientation. Such dissent is something to watch for on an interview visit. A related problem arises when the support and facilities provided do not keep up with institutional aspirations. Limited instrumentation and laboratory space, inadequate library holdings, poorly prepared graduate students, excessive teaching responsibilities, and a lack of a critical mass of colleagues can seriously inhibit the ability of a new appointee to establish a viable research program, no matter how devoutly the administration might wish for it.

Where individual faculty members position themselves on an institutional phase diagram often changes as interests alter with age or experience. Some professors get more deeply involved in education as they get older. Those who develop an aptitude for administration may move toward the service corner as they become department chairs, deans, or even college presidents. If a university or college values the contributions of a faculty member, efforts will be made to accommodate such changing interests. Sometimes moving to a new position elsewhere is in the best interests of all concerned. But all of that will be far in the future for most readers of this book. The more immediate issue is how to decide on a compatible institution, how to prepare for a job in it, how to get the job, and how to keep it.

Serving the College and the Community

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So, how does one become a community college chemistry instructor? Well, the paths that lead to this profession are many and varied, but most people who teach at such an institution probably have at least one thing in common: They undoubtedly have a strong desire to interact with people, within both the college and the community.

I knew by the end of my graduate career that the ideal place for me would be a community college. When I applied to graduate school at the University of California at Davis, my intention was to obtain a doctorate in chemistry and perhaps later attend law school to become a patent attorney. I knew enough about myself to realize that I would never be happy in a job where I didn't regularly interact with people. Moreover, I had a very strong undergraduate liberal arts background with a major in Spanish as well as chemistry, and I wanted to be able to combine these two aspects of my education. I also needed to feel that the work that I did benefitted society, at least in some small way. But after interning with a patent attorney's office and the Yolo County District Attorney's office, I found that my desire to combine science with law had waned. I had spent most of my time interacting with paper, not people. So I continued my graduate studies in chemistry and settled for the idea that I would end up in industry. Fortunately, two very great friends and mentors pointed out the obvious. These professors noted that I always received excellent evaluations as a teaching assistant and generally spent a good portion of my free time helping students. I held extra office hours and review sessions, and I mentored an undergraduate student in an independent study course. When I thought about it, I recognized that I had been teaching all my life, in one way or another, from high school through graduate school. My professors suggested that I consider the possibility of a career in academia rather than industry.

The fact that I was attending a university that offered exploratory courses for graduate students made it possible for me to investigate this option. I enrolled in a chemistry graduate course designed to help students explore various careers within academia. Through this course I met faculty from all different types of institutions and began to piece together the responsibilities required for each position. Later I signed up for a faculty-mentored course of study entitled the Program in College Teaching. Here I gained experience that ranged from using different assessment techniques to accommodating diversity in the classroom. With a professor in the chemistry department, I co-instructed my first college-level course. I met many more faculty members from other institutions, and I interviewed several women at research institutions and two-year colleges. I was very interested in how these women managed to balance their careers and their home lives. Later I taught a summer organic chemistry course, and I also agreed to team-teach an introductory chemistry course with another UC–Davis professor.

Through all these endeavors I found that I really wanted to teach at a community college. I concluded that faculty members in such institutions have more one-on-one interaction with their students. I spoke with many community college instructors who described the very diverse and non-traditional student populations they taught. Students include working moms and dads, university

transfers, and students who are still in high school but qualify to take college-level courses. Most students work 20–40 hours a week and commute to evening courses. Many are the first members of their families to ever attend college, some are underprepared, and most are very worried about succeeding at the college level. These students need passionate teachers willing to go the extra mile.

As a graduate student, I also learned firsthand about the difference between teaching large and small classes. My lab or discussion sections enrolled about 30 students; however, while I was an instructor for a summer organic chemistry course, my class consisted of approximately 100. At lecture every day I saw a sea of faces. Of course, I knew the five teaching assistants who worked with me, but by the end of the semester I didn't know the names of more than two or three of my "A" students who regularly showed up during my office hours. I felt that I could have just as easily taught the course via teleconferencing. As an undergraduate at a large university, I had been on the other side of the demonstration bench, sitting in classes of 250–500. I had taken one summer school course at a community college, however, and I always wondered why I enjoyed it so much more than I did my courses at the university. I realized in graduate school that small class size and the interaction that it affords with the instructor and other students were important contributors to my learning success.

Although I was in the part-time pool at several local colleges, I never managed to teach at a community college during my graduate career. Despite this drawback, I still was certain that I wanted to teach at this type of institution. I knew that community college course sizes were ideal for the type of interaction that I like to have with students. I also knew that my sole responsibilities would be teaching and community service. But the challenges facing two-year college instructors seemed enough to keep me interested in the profession for a very long time. After graduate school I applied for community college positions and received a tenure-track spot at Truckee Meadows Community College in Reno, NV.

All the information that I had learned from community college instructors proved to be absolutely true. Teaching at such an institution does require a special talent. Faculty have to be willing to spend most of their days with students in classes or labs, holding office hours, or working on community service projects. The teaching loads are very heavy; every semester I teach three courses that total 18 contact hours. Each course consists of an hour-and-15-minute lecture twice a week and a 3-hour lab once a week. I have the privilege of teaching all of this in addition to holding 5 office hours per week. Moreover, I do all of the grading myself. Very rarely are teaching assistants available to assist in grading or teaching. Although this creates a heavy workload, I see firsthand what my students understand and what they misinterpret, well before the scheduled exam.

In addition to teaching responsibilities, community college faculty are expected to serve on institutional committees and local community boards and committees. Almost every faculty member regularly performs local outreach activities, which can range from science demonstrations at local schools to scientific research during the summer. Many instructors also write grants and work on improving courses and curricula. All of these activities do require a large time commitment, but, unlike colleagues in four-year institutions, community college faculty are not under pressure to "publish or perish" or to bring in large research grants. The academic year for community college instructors is very hectic, but many of them enjoy the fact that they often have the summers free to pursue different forms of professional development or other interests. I personally still enjoy teaching during the summer!

PREPARING FOR AN ACADEMIC CAREER

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Deciding whether to seek an academic career and preparing for one go hand in hand. The best way to see if teaching suits you is to try it. Some chemists get their first taste of teaching as undergraduates—correcting homework, tutoring other students, assisting in the stockroom, or helping to provide laboratory instruction. It's a great work-study assignment that pays off in more than money. Many undergraduate assistants discover that teaching is a wonderful way to learn. Almost all chemistry graduate schools offer similar opportunities by requiring their students to serve as teaching assistants. Even if you have a fellowship that would ordinarily excuse you from such duties, you would be well-advised to do some TA work. It is an excellent means of testing your aptitude for a permanent teaching position.

The Life of a TA

Graduate chemistry departments seem to differ somewhat in how they use TAs and the extent to which these students are prepared, supported, and supervised. TAs play very important instructional roles. They know their students far better than the lecturers do, and they have considerable influence. A few years ago, the University of California at Berkeley tried out a new pedagogical approach and text in the general chemistry course. A follow-up study showed that the attitudes of the students toward the course strongly reflected the opinions of their TAs. Those who were enthusiastic about the approach transmitted that enthusiasm to their students. Those who were skeptical and resistant engendered similar responses in their charges. Indeed, the close association between TAs and the students in their laboratory and recitation sections to some extent mirrors the relationship between teachers and students in PUIs.

There is, of course, tension between your teaching responsibilities as a TA, your course work, and the demands of your research. You have to write a quiz for your recitation section, you have an exam coming up in organic mechanisms, and your research supervisor expects you to spend 15 hours a day in the lab. How well you handle those conflicting demands is a pretty good indicator of how you might fare in an academic career, because the life of a professor always involves establishing priorities. If your TA assignments consistently come in last on your priority list, you probably won't be very happy in a job that requires a lot of teaching. If you use your teaching responsibilities as an excuse not to go to the lab or the library, that also conveys a message. But it doesn't necessarily guarantee that you will be a brilliant teacher. It is

quite possible to devote too much time to your TA duties.

If you have enjoyed your time as a TA, you might consider requesting an additional assignment, in the same course or a different one. Some departments have head TAs for certain courses. Being appointed to such a position will provide opportunities for closer interaction with the professor and may include responsibilities for training other TAs. As you become more expert in your subdiscipline and research topic, your research supervisor or some other faculty member may invite you to give a guest lecture when he or she is out of town. This is great experience, so grab it. Just about everyone has been a TA, but employers look for classroom experience that goes beyond the regular requirements. Special teaching responsibilities and awards can help a job candidate. So can volunteering to do class visits, demonstrations, or tutoring with local elementary and secondary school students You might wish to explore other sources of practical teaching information as well, such as workshops provided by professional organizations like ACS and the American Society for Engineering Education (ASEE).

The best way to see if teaching suits you is to try it.

Occasionally, a graduate student will seek additional teaching experience (and income) by moonlighting at some other institution. This is almost always a bad idea, unless it is encouraged or at least positively received by the dissertation adviser. Graduate students in chemistry have the great advantage of receiving research stipends, something quite rare in the humanities and social sciences. You are being paid to do research, as well as to get an education. You have an obligation to your mentor, the department, the granting agency, and yourself to concentrate on the project. If you try to teach in night school or elsewhere while supposedly devoting appropriate efforts to your research, you will very likely do badly at both the teaching and the research. And if you try to keep the outside employment a secret from your research supervisor, you are committing professional suicide. It is equally important to discuss participation in the PFF program with your adviser (see p 23).

Of course, research in chemistry does not proceed at a constant rate. Experimentalists sometimes encounter periods when essential equipment is being used by another researcher or awaiting repair. Make the most of these moments by using them to get some additional teaching experience or to develop research projects and proposals.

Getting Ready for Research

Most chemistry departments do a good job of preparing their graduate students for research careers. Indeed, it sometimes seems that the point of all chemistry education is to train the future faculty for Harvard and CalTech. That's a pretty small tail to wag a very large dog. But it's also fair to say that this rigorous preparation in research methodology can be valuable in many other institutions, including industrial laboratories and all sorts of colleges and universities. Perhaps the most important lesson of graduate school is learning how to learn, and that's wonderful preparation for life. Unfortunately, some aspects of traditional graduate education may not be ideal for those who seek employment in PUIs and community colleges. As already noted, such institutions often need generalists on their faculties.

The reduced emphasis on required course work and the generally increased research expectations over the past several decades have meant that many fresh Ph.D.s emerge with highly specialized but very narrow expertise. A career focused on such specialization is viable only at a research university. Graduate students who are seriously considering other academic institutions can increase their versatility by taking a few courses in addition to the minimum required for the doctorate. Even better is participation in an interdisciplinary research project at the Ph.D. or postdoctoral level. Yet another strategy for the academically bound is to take a course or two in the education department or in the subdivisions of chemical education that exist in some graduate chemistry departments.

The choice of a research project has consequences for subsequent employment, but that is seldom a major consideration when students choose an area of specialization, a project, or a thesis supervisor; nor should it be. Curiosity should be the most important criterion. Chemistry departments need all sorts of chemists, and it is difficult to anticipate market trends. There are more "organikers" than any other kind of chemist, but there are also more jobs available. Currently, analytical chemists seem to be in short supply and high demand. Whatever your subdiscipline, you should realize that projects requiring expensive, high-tech, state-of-the-art equipment will transfer with difficulty to institutions with limited resources; and it may be hard to do complicated research projects with undergraduates. Typically, such issues become more important when a would-be faculty member prepares a research proposal. Chemistry departments that require one or more research proposals as part of the Ph.D. process provide a great service and very useful experience for their graduate students. Such requirements can be viewed as opportunities to test ideas that might be part of future investigations. Actually submitting proposals is generally deferred until the postdoctoral appointment or later.

Research supervisors differ in their approaches to writing papers. Some write them all themselves, others ask their graduate students and postdocs to prepare first drafts, and still others assign the major writing responsibilities to their younger colleagues. The more you can be involved in writing papers and the more conference presentations you personally give, the better your preparation for an academic career.

Graduate school also provides opportunities to practice the educational aspects of research. Presentations in group meetings or journal clubs are valuable training for any job, and all advanced graduate students help teach those who are just entering the research group. In some groups, advanced graduate students have opportunities to supervise undergraduate research. This is excellent experience for those contemplating an academic career, especially in PUIs. It is a challenge to select limited and well-defined research projects that will afford the students some chance of accomplishment in the limited time available. There are also dangers in providing too much or too little supervision for undergraduates. They should be treated as more than hired hands and allowed to help plan the specifics of the research, even though their contributions might result in some mistakes and reduced productivity.

It goes without saying that anyone seeking an advanced degree in chemistry should be a member of the American Chemical Society. No matter what your career goals, ACS membership is a mark of your professional commitment. ACS journals report the intellectual content and progress of the discipline, and *Chemical & Engineering News* is an important weekly chronicle of the state of the science. Local, regional, and national meetings are forums for the exchange of information and ideas, and the various professional services provided by the Society can be invaluable in advancing your career.

PFF Programs

One of the best ways to test your interest in and aptitude for an academic career is by participating in a formal Preparing Future Faculty program. This project was launched in 1994 by the Association of American Colleges and Universities and the Council of Graduate Schools (AACU/CGS). Funding has come from the Pew Charitable Trusts, the

National Science Foundation, and a private donor. At least 45 doctoral degree-granting institutions have provided PFF opportunities for their graduate students who elect to participate. More than 250 partner institutions and 4000 graduate students and postdocs have been involved.

The participation of the American Chemical Society in PFF dates from 1998, when ACS received a grant from the National Science Foundation. ACS, in turn, awarded funds to five universities: Duquesne University in Pennsylvania, Queens College of the City University of New York, the University of California at Los Angeles, the University of Massachusetts at Amherst, and the University of Michigan at Ann Arbor. Each of these grantees identified a number of collaborating cluster institutions, including two- and four-year colleges. Unfortunately, the NSF grant for the ACS program was not renewed, but other opportunities exist.

Although the details vary among the specific PFF programs, all share the goal of providing an introduction to the academic profession through exposure to the full range of professional responsibilities. Many of the participating research universities offer special seminars, courses, forums, or workshops on teaching, learning, and academic careers. Some of these are cross-disciplinary sessions in which students can experience multiple perspectives and pedagogical strategies.

In this book, two recent PFF participants reflect on their involvement. Jennifer Firestine (see p14) calls it a "large stepping stone for my career." Sherri Weers Hunt (see p 25) is still weighing her career options but credits her PFF participation as providing "valuable knowledge and experience that will be helpful no matter what I choose." Both of these young women praise the internship component. Student participants are paired with a faculty mentor from the home institution or, more commonly, from one of the partner institutions. A cluster of colleges consists of a variety of institutions. Hence, a PFF participant can arrange an internship in the sort of college that he or she is considering as a potential professional home. Typically, the mentee is asked to teach some well-defined segment of a regular undergraduate course—perhaps a chapter from a text to be presented over a week of classes. After observing the way in which the mentor teaches the course and studying the syllabus and textbook, the mentee prepares a teaching plan. These plans are usually critiqued by the mentor. The mentor also attends the classes taught by the PFF participant and provides feedback. Sometimes, a representative from the participating research university also observes the mentee's teaching. To make the teaching assignment as authentic as possible, graduate student participants may be expected to assign and grade problem sets, write and correct examination questions, lead discussion or review sessions, and/or supervise laboratories.

If you participate in an academic internship, try to experience the range of responsibilities faced by a college or university professor.

If you participate in an academic internship, try to experience the range of responsibilities faced by a college or university professor. Tour the facilities and visit with other members of the department. Learn what you can about supervising undergraduate research and other aspects of faculty life. Sit in on committee meetings. Ask about procedures for hiring new faculty and the institutional expectations for tenure and promotion. And keep in contact with your mentor after your formal association is over. Your mentor can be a useful source of letters of recommendation.

Some PFF participants report that their research supervisors were less than enthusiastic about their involvement. While one might deplore such attitudes, graduate students should be prepared for a negative reaction. If you encounter it, perhaps the best response is to explain why you consider participation to be important to your career and then to demonstrate that your research productivity is not adversely affected.

As noted previously, fewer than 50 Ph.D.-granting universities (out of more than 500) have participated in the AACU/CGS Preparing Future Faculty program, though others may offer similar opportunities. The point is that if your graduate school does not have a formal program for exploring academic careers, you can create your own. Begin by doing some research on the chemistry departments in colleges and universities in your

Still Weighing the Options

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Like many students entering graduate school, my initial goal was to become a professor at a liberal arts college. As an undergraduate, I attended a large state university that offered a wide range of degrees and was more affordable than a private college. As I neared the completion of my degree, I knew that I loved teaching and was excited and energized by its challenges. On the basis of my experience working in a lab, I did not think I would enjoy a research career. Therefore, I determined that my ideal job would be to work at a small undergraduate college, where teaching is the focus and research is not necessarily required. I had visions of a secluded campus community with students eager to learn. In order to reach my goal, I began the Ph.D. program in the chemistry department at the University of Minnesota. During the first few years, research was primarily a distraction for me while I focused on gaining as much teaching experience as possible. I was happy to be a teaching assistant for labs and recitation sections, I gave lectures for my adviser when he was out of town, and I tutored privately. I also enrolled in the Preparing Future Faculty program offered by the graduate school.

The PFF program at UMN included two classes that focused on learning styles, teaching methods, curriculum development, responsibilities of the faculty member, and the academic job search. Because this was an interdisciplinary course, some of the teaching techniques and topics discussed were not applicable to a physical science classroom. However, it was a great opportunity to interact with graduate students from a variety of fields and to talk about teaching with people who were not scientists. I found discussions of teaching and learning styles with colleagues in other disciplines quite interesting. Understanding their point of view was helpful to me in considering how to reach a wider range of students, particularly in introductory classes. In addition to classes, the PFF program included working with a faculty member in a mentor relationship.

During the PFF class, I learned that an undergraduate experience at a liberal arts college is desirable in candidates for faculty positions at these institutions. Because I did not have this experience, I was hopeful that a relevant mentorship would be effective in convincing a recruiting committee that I was well suited for a position of this kind. Therefore, I chose to work at Macalester College, a well-respected liberal arts college located near UMN. For me, this mentorship was the most valuable part of PFF. I was paired with Professor A. Truman Schwartz. Because my goal was to become a professor at a similar institution, I was eager to learn more about the position and environment. The mentorship included exploration of a variety of teaching issues with my faculty mentor, an opportunity to gain teaching experience with informed feedback, and exploration of faculty roles outside of the classroom. Additionally, in order to provide a service for the host institution, I developed a laboratory activity appropriate for the course with which I worked.

During the mentorship, I continued to enjoy teaching, and as expected, I found both the students and the atmosphere of learning appealing. The environment differed from the one I had experienced as an undergraduate in a large research-oriented state university. At Macalester, classes were more structured, and students expected and received more personal attention from professors. However, I also became aware of the challenges and responsibilities of a faculty member and realized the degree to which research is encouraged, even at an undergraduate institution. By this time I was

beginning to enjoy scientific research, which made the idea of directing my own lab at a small school exciting, if somewhat daunting. Seeing the facilities and participating in several discussions with faculty members, I learned of the difficulties of conducting research in that environment. There are fewer physical and financial resources available and a limited number of colleagues with whom problems and ideas may be discussed. Topics must address interesting questions, yet they must also avoid competition with the work of groups at larger institutions. Additionally, because a primary goal is providing an opportunity for undergraduate students to experience research, projects must be divisible into segments in which these students can participate and produce results in a relatively short time.

Finally, through direct contact with my mentor and other faculty members, I came to understand how time-consuming such responsibilities as writing grant proposals and papers and serving on committees could be. Attending an interdepartmental meeting made me aware of the particularly large burden on women in the sciences. Because women are in the minority, committees and groups of all sorts require more of their time.

After participating in the PFF class and mentorship, I had a more accurate idea of what life would be like as a college professor. Realizing that it includes more than the idealized vision I once had, I began to wonder if this was still what I wanted. Would the enjoyment of teaching and growing in this environment be worth the long hours spent in other, less rewarding activities? I wondered if I might find just as much fulfillment in a research career. With these new questions in mind, I decided to work as a postdoctoral researcher after completing my graduate degree. If I chose to continue to pursue an academic career and become a professor, more research experience would certainly help me develop a research plan suitable for an undergraduate college. This experience would also increase the breadth of my knowledge of chemistry. My work as a graduate student involved studying systems using microwave spectroscopy, which included difficult analysis and required an expensive home-built instrument. Knowing that this might not be practical at a smaller school, I decided to shift my focus to atmospheric chemistry, as its environmental implications are likely to appeal to a broader range of students, including those without a firm background in chemistry.

As a postdoctoral researcher, I am focused on learning a wider variety of techniques using standard instruments. With an awareness of the financial limitations at an undergraduate institution, I am considering projects that can be done with equipment that may already be owned by a department or with new equipment that could be used not only for my research but also in teaching labs. Furthermore, additional experience will help me determine whether I should pursue my original goal or a career in research. While I grew to enjoy the laboratory environment, I began to wonder if I truly liked the work or if I was simply comfortable in the role of a senior graduate student surrounded by a good group of people. By moving to a significantly different area of chemistry and joining another group of researchers, I hope to better answer this question. While I am still uncertain of what path I will take, the PFF program and the mentorship provided me with valuable knowledge and experience that will be helpful no matter what I choose.

immediate geographical area. Get to know some of the professors of chemistry and chemistry-related fields, perhaps through ACS local section activities. If you find an institution and an individual that seem inviting, propose an internship. Meet with the potential mentor and discuss arrangements. You will probably find that the faculty member will be flattered and happy to take on the assignment without remuneration. Even in the formal PFF programs, the stipend for the mentor is only a few hundred dollars that can be applied to professional expenses. Professors don't become mentors for the money.

A final note about leaving graduate school without a doctorate: People do it all the time for a variety of reasons, some good and some not so good. Leaving with a master's degree does not preclude a satisfying career in a two-year college. But given the realities of the job market, community colleges are hiring more Ph.D.s, especially if they have good teaching experience. Few four-year colleges will even consider appointing chemists with M.A. or M.S. degrees to permanent positions. Nor are ABDs ("all but dissertation") likely to get academic jobs. Chemists rarely leave graduate school with the research complete but the thesis unwritten. This practice was once common in the social sciences and the humanities, where young faculty struggled to finish their dissertations while teaching full time. But today these disciplines are flooded with Ph.D.s, and there is no need to hire someone who has not completed all the doctoral degree requirements. To be sure, chemists with master's degrees work as staff members and laboratory instructors at many universities, but generally they lack regular faculty status.

Postdocs

For a graduate student, being awarded a Ph.D. is a major milestone. But this happy event is more than the culmination of years of study and hard work; it raises a significant question: "What's next?" Indeed, you should start looking for an answer to that question well before you get your hood and diploma. Studies indicate that 40–50% of fresh Ph.D.s in chemistry take up postdoctoral appointments. Of those who do not, 65–70% enter industry and 18–21% accept faculty positions. What you decide to do will depend on your interests, career goals, and opportunities. It is not an irrevocable step, but it is one of those branch points that deserves your careful consideration because of its subsequent influence.

If you are seriously considering a career as a faculty member in a research university, a postdoctoral appointment is essential. Seek the strongest research group you can, consistent with your preparation and interests.

Some answers are easy. If you are seriously considering a career as a faculty member in a research university, a postdoc is essential. Seek the strongest research group you can, consistent with your preparation and interests. It is generally advisable to broaden your expertise by leaving your Ph.D. mentor and your Ph.D. university; but moving too far from your dissertation research could temporarily reduce your rate of productivity. However, if you wish to move into a non-traditional chemistry department—environmental science, materials science, or toxicology, for example—a postdoc can provide the bridge from a traditional chemistry graduate program. In any case, it is particularly important to select a postdoctoral position that will give you an opportunity to mature as an independent investigator. Future employers will be looking for your ability to initiate and implement ideas, plan research, and get the grants to support it.

A traditional research postdoc not only keeps open the option of a career in a research university; it can also be excellent preparation for those who will ultimately accept positions in colleges and universities without doctoral programs. Such institutions can have high expectations of scholarly productivity, and the maturation afforded by additional research can be very valuable in establishing one's own research program. Sherri Weers Hunt describes how her choice of a postdoc was in part influenced by her desire to learn skills and develop projects that would be appropriate in an undergraduate setting (see p 25). The added breadth acquired from a postdoc can also be valuable

at two-year colleges, especially if it is coupled with some teaching experience.

Postdoctoral appointments can provide a variety of teaching opportunities that go beyond TA experience. Postdocs may be called on to give guest lectures in undergraduate or graduate classes, supervise undergraduate research students, and help administer the research group—all excellent preparation for an academic career. In some instances, temporary vacancies will occur, and postdocs may be invited to assume teaching responsibilities for an entire course.

Some postdoctoral positions are specifically designed to include significant teaching as well as research components. You might teach an upper-class seminar or a section of an introductory chemistry course and help supervise undergraduate research. Two years in such a program can provide a good taste of academic life in institutions of the type represented by the host college. In our survey, many PUIs expressed a preference for candidates with such training. You would experience the multitasking demands of the profession, become accustomed to the academic preparation and expectations of undergraduates, and learn how to design and implement undergraduate research. If you have a strong interest in undergraduate instruction, you might consider such a teaching and research postdoc. In his statement, Matthew Mio describes the very beneficial effects of such an appointment (see p 31). The *C&EN* classified section is a good source of information about these opportunities.

In one teaching and research fellowship program funded for several years by the Camille and Henry Dreyfus Foundation, almost 90% of more than 150 postdoctoral fellows subsequently accepted tenure-track positions at PUIs. However, you should realize that some of the most selective liberal arts colleges prefer to hire candidates who have completed traditional research postdocs in high-prestige groups. Some respondents to our questionnaire argued that teaching skills are easier than research skills to acquire on the job.

Skipping a Postdoc

Some fresh Ph.D.s with a strong interest in teaching decide to seek an academic appointment without doing a postdoc. If you want a position in a two-year college, the absence of postdoctoral experience will not be a liability; but it may be in a bachelor's or master's degree–granting institution. To be sure, every year new Ph.D. chemists are appointed to academic positions, but very likely, your options will be more limited without a postdoc. Colleges and universities that may be willing to offer temporary teaching positions to newly minted Ph.D.s will often favor candidates with postdoctoral experience when it comes to filling tenure-track openings. Sometimes temporary positions get converted into tenure-track slots, but this doesn't mean that the visiting lecturer will suddenly be transmuted into a permanent professor. National searches are almost always conducted, but the temporary incumbent can certainly apply for the vacancy and may have some advantage, provided he or she has done well.

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The dilemma looks a bit different for engineers holding Ph.D.s in the chemical sciences. Chemical engineers, materials engineers, and certain environmental engineers may not necessarily need postdoctoral experience before applying to a research university. In engineering, it is not additional teaching experience that might be weighed against a postdoc. Rather, innovative ideas to develop a vibrant, externally funded research program would probably render a postdoc unnecessary.

Non-engineering Ph.D.s who are simply considering the merits of further teaching experience versus a postdoc might bear in mind that a full-time temporary teaching position at a high-quality college or university can be valuable preparation for an academic career. This holds especially true if the individual has taught a variety of courses, done some curricular innovation, and carried out some research.

It is almost impossible to accomplish this in a single year; at many institutions, temporary teachers are overworked and underpaid. But a two- or three-year appointment at one institution can increase the value of the job. In a sense, such a visiting position substitutes for a postdoctoral appointment. However, the nature of the two experiences and the benefits derived from them are quite different. Paul Fischer, who had a three-year temporary teaching appointment before gaining a tenure-track position at another college, offers particularly instructive comments in his statement on page 49.

Even for someone with a strong commitment to teaching, the choice between a temporary teaching position and a research postdoc is not an obvious one. If you are confronted with such a decision, carefully weigh the costs and the benefits. Teaching experience will increase your attractiveness to many colleges that stress undergraduate education. On the other hand, master's and bachelor's degree–granting institutions that expect significant research productivity will probably favor applicants with postdoctoral experience.

Another question that deserves serious consideration is, "How many postdocs and temporary faculty positions are too many?" We return to this issue in chapter 3.

What Really Counts?

Of course you can't do everything as a graduate student, postdoc, or visiting instructor. The results of our survey of chemistry departments might help you establish priorities in preparing for an academic position. We asked the following question: "In seeking new faculty members, chemistry departments and institutions variously weigh factors and attributes of candidates. Generalizations are difficult, but please indicate how heavily the following are usually weighted at your institution." Sixteen variables followed, and respondents were asked to rank them as 3 = very important, 2 = moderately important, or 1 = minimally important.

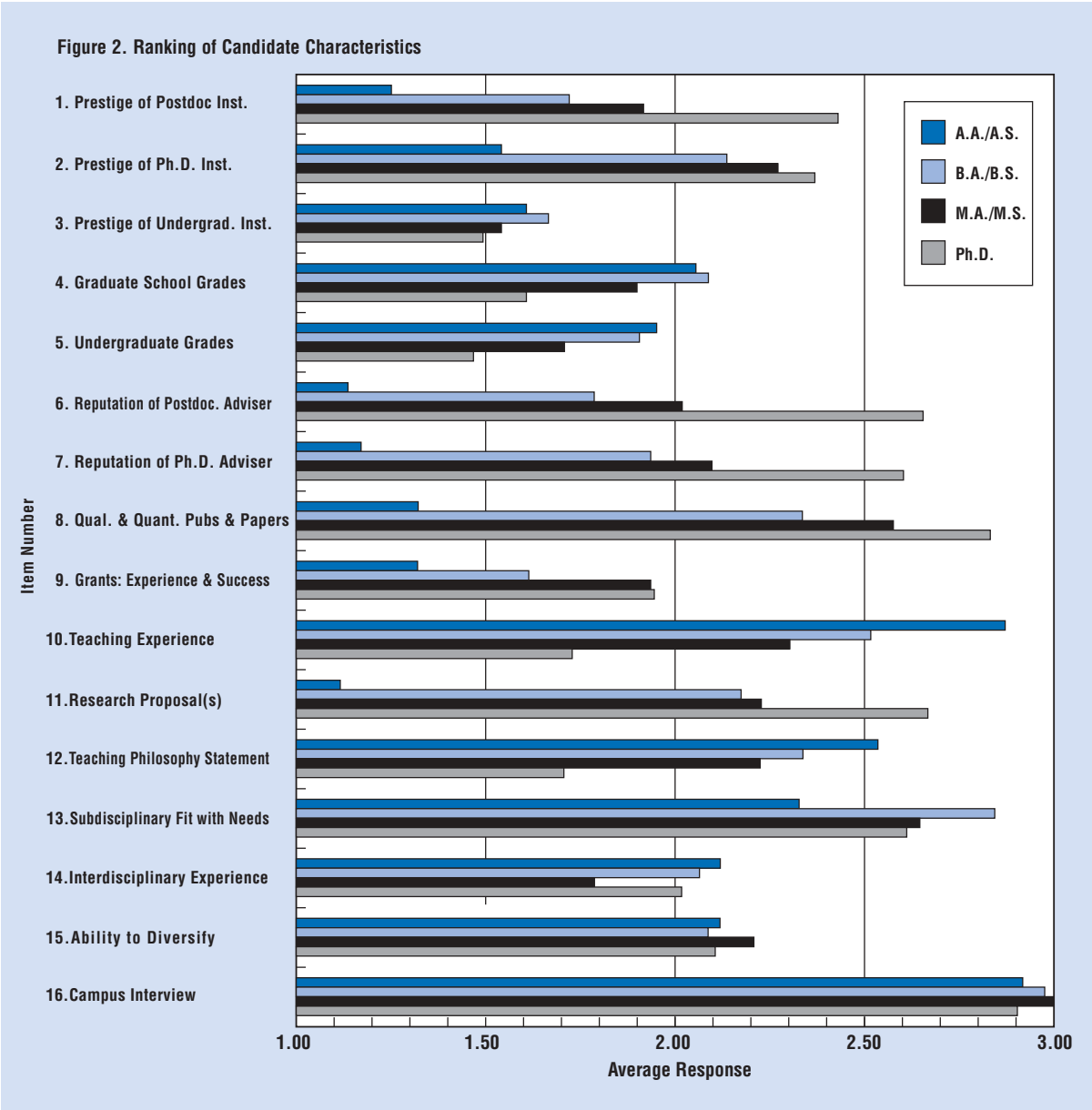
Table 3 and Figure 2 present the results for the four categories of academic institution, again based on the highest degree awarded in chemistry. The number of responses in each of the three rankings is listed for each factor (not all respondents ranked each variable), and the weighted averages are also given. The higher the average, the greater the importance attached to the corresponding variable. The results yield no great surprises.

TABLE 3

RANKING OF CANDIDATE CHARACTERISTICS

Highest Degree	A.A./A.S.				B.A./B.S.				M.A./M.S.				Ph.D.			
Ranking	**3**	**2**	**1**	**Avg.**	**3**	**2**	**1**	**Avg.**	**3**	**2**	**1**	**Avg.**	**3**	**2**	**1**	**Avg.**
1. Prestige of Postdoc Inst.	3	18	71	1.25	16	56	51	1.72	9	30	13	1.92	57	60	5	2.43
2. Prestige of Ph.D. Inst.	7	36	50	1.54	33	74	16	2.14	17	32	3	2.27	48	71	3	2.37
3. Prestige of Undergrad. Inst.	7	43	43	1.61	9	64	50	1.67	1	26	25	1.54	6	48	68	1.49
4. Graduate School Grades	20	59	14	2.06	32	73	21	2.09	7	33	12	1.90	18	39	65	1.61
5. Undergraduate Grades	13	62	18	1.95	21	73	32	1.91	6	25	21	1.71	13	31	78	1.47
6. Reputation of Postdoc Adviser	1	12	79	1.14	21	56	47	1.79	12	29	11	2.02	87	29	6	2.66
7. Reputation of Ph.D. Adviser	1	14	78	1.17	25	67	32	1.94	14	29	9	2.10	81	34	7	2.61
8. Qual. & Quant. Pubs. & Papers	2	26	65	1.32	54	60	11	2.34	31	20	1	2.58	105	14	3	2.84
9. Grants: Experience & Success	4	23	65	1.32	14	50	61	1.62	12	25	15	1.94	29	58	35	1.95
10. Teaching Experience	83	9	1	2.88	73	44	8	2.52	23	22	7	2.31	14	61	47	1.73
11. Research Proposal(s)	0	12	80	1.12	44	58	22	2.18	19	26	7	2.23	90	24	8	2.67
12. Teaching Philosophy Statement	58	27	8	2.54	59	48	17	2.34	19	26	7	2.23	13	61	48	1.71
13. Subdisciplinary Fit with Needs	45	34	14	2.33	107	17	1	2.85	36	12	2	2.65	73	35	4	2.62
14. Interdisciplinary Experience	28	48	17	2.12	31	72	22	2.07	6	29	17	1.79	25	75	22	2.02
15. Ability to Diversify Dept.	28	49	15	2.12	29	82	17	2.09	16	21	5	2.21	39	58	25	2.11
16. Campus Interview	86	7	0	2.92	122	3	0	2.98	52	0	0	3.00	113	5	3	2.91

Results of a survey of chemistry departments, grouped according to highest degree awarded. The 16 variables are ranked according to the following scheme: 3 = very important, 2 = moderately important, 1 = minimally important. Averages are weighted.



Teaching Experience (Item 10) and the Teaching Philosophy Statement (12) are most highly valued by two-year colleges. These institutions attach relatively little importance to the research-related variables. At the other extreme, Ph.D.-granting universities put a high premium on the Quality and Quantity of Publications and Papers (Item 8), the Scientific Reputation of Postdoctoral and Ph.D. Advisers (6 and 7), and the Research Proposal(s) submitted by the candidate (11). It may come as a relief to some readers that graduate and undergraduate grades do not carry a tremendous amount of weight and appear to be least significant in the more research-active institutions. Respondents from all of the institutions surveyed give their highest ranking to Item 16, the Campus Interview.

You Can Go Home Again: Study Groups, a Caring Adviser, and a Teaching Postdoc

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My first and totally unplanned experience as a teacher of chemistry came in my sophomore year at the University of Detroit Mercy in a self-assembled study group for the organic course. Every Thursday my dorm room was the site of bustling meetings of almost 10 classmates, all rehashing the week's topics and reviewing the finer details of organic chemistry. In a sense I was the leader there, but I could hardly say I was the brightest of the bunch. I was a coordinator and arranger, and sometimes that's all you need to get true education off on the right foot. One thing was for certain: All members of our group were at the top of the class, and they rightfully credited our study practices. As finals week drew to a close, the professor of organic chemistry found me in the hall and pulled me aside. He had heard of our study sessions and wanted to congratulate me on "teaching." I related to him that my only contribution was the time and a place, but he pushed further. "If you like doing this," he said, "you can make a career out of it." I very much enjoyed the study sessions, especially when people had direct benefits from them. His advice was to check out the bench side of things and begin undergraduate research in his labs. After three years of laboratory work, chemical course work, and ACS Student Affiliates involvement, I was a B.S. chemist with his eyes on graduate school. It was almost a foregone conclusion—I loved teaching so much and got so much out of it. It truly made me happy, as trite as that may sound. Grad school was the logical next step, both to satiate the hunger for more knowledge and hone my skills as an educator.

I enrolled in the organic chemistry program at the University of Illinois at Urbana–Champaign and immediately made my aim known to my adviser. I had enjoyed my stay at UDM so much; it only made sense to set the goal of teaching and research at a primarily undergraduate institution (PUI). From the very start, my adviser fanned this fire in me. He warned of the hurdles that lay before me and described how I could clear them or avoid them. He detailed the things my Ph.D. would be about and the knowledge he would not let me leave without. He pointed out stars in the PUI field; people who were getting scholarly work done with only undergraduates. He let me into the deepest corners of his educational philosophy and allowed me to teach with him directly. Put simply, I was very lucky to have an adviser who was in tune with my desires and pushed me to become the best grad student I could be to achieve them.

At the start of my third year at UIUC, I was intrigued by the title of an upcoming seminar. The speaker was not from a university whose name I recognized. Being at that glorious point in my graduate education where I could attend seminars for my own enjoyment, I chose to attend the talk. Right beforehand, though, I was invited to have lunch with the speaker. My adviser said that the visitor was the epitome of all that I was striving to attain and that I could learn much from discussing my future with him. After having lunch and hearing the talk, I was convinced of the significance of what I had just observed: important, scholarly, published work with a "kicker" at the end—all the work shown was done by undergrads. This was what I wanted to do and be. And this is what the educational process is all about—further honing and formulating one's vision for oneself. How to realize that vision, I did not know. But I had a dream.

Several months passed, and it was time to hammer out some serious plans for after grad school. I knew that while postdoctoral study was not mandatory for working as a professor at a PUI, I could use the experience. Traditional postdocs are all about flexing your intellectual muscles and showing how

versatile your training in critical thinking is. This appealed to me, but what I really wanted was a rarer bird. I wished for the chance to learn at the bench of someone who was doing what I wanted to do. I wanted to directly observe the PUI professor in action and learn the dos and don'ts of teaching and research at this level. I didn't even know how to phrase my desires or how to search out an appropriate position, so I deferred to my adviser. "This is the sort of thing that requires a lot of timing, a lot of serendipity," he said. "You'll have to sniff around until you find something, and this can take a long time—better get to work." I did, but after what seemed like a million leads and pieces of hearsay, I had nothing. In a last-ditch effort, I e-mailed the professor who had given that talk I liked so many months before. Two weeks passed, and I received no response. At that point, I had been trying to dig up a "my-style postdoc" for a few months, and I thought it time to turn my search over to my adviser and request a more traditional postdoctoral placement. He had the connections and the reputation; all I needed was to have interest in the research group. I could have gone anywhere, really. That's what the postdoc is all about—being adaptable. Yet, what about my desire to do something with a greater teaching element? Was the beast of timing going to slay my dream?

The phone rang. It was the professor who had given the seminar I so enjoyed. We chatted. He was in transition, moving from one college to another very close by. He apologized for not getting back to me sooner. He said he had just read my message. He said he was, right at that moment, typing out an advertisement for a postdoctoral position that would have a teaching component as well as an undergrad research side. He was afraid he wouldn't find anyone who would fit into the job he'd have available the next year. I thought of my grad adviser's words and the lecture on timing. I explained my situation. The professor listened and asked to talk to my adviser. We hung up, and minutes later, the professor called back to make an offer. I accepted it almost immediately. Truly, there was much serendipity involved in these events, but do not let dumb luck or opportunity pass you by, either! I had to accelerate my research and writing in order to satisfy the expectations of my adviser and to meet the starting date for the postdoc. Six days after I received my Ph.D. I was in St. Paul, Minnesota, at Macalester College to begin my postdoctoral work.

My experience at Macalester is the only reason I am doing what I do today. There were so many other paths I could have taken, but I had chosen a career in a PUI because it was really what I enjoyed. I entreat all who read this to not take away from my tale a narrow view: Broader morals can be gleaned. If there's something you want from your doctorate, go for it early and do everything you can to prepare for it. Pick an appropriate research adviser and group that will help you reach your goal. Make it easy for your dreams to become plans and, in turn, reality. My postdoctoral work proved to me that I had made the right choice in my life. I helped arrange undergraduate summer research programs, assisted students with their work at the bench, supervised organic laboratory sections, and taught an advanced topics course. Every moment of my postdoc, I was moving in a continuum of undergraduate chemical education. Whether in the lecture hall, teaching lab, or research lab, students were there to learn about chemistry. This is what excites me most about my chosen career: the chance to enhance lives by planting a seed and watching it grow. Here I was, able to do just that 24 hours a day, 7 days a week. It was a perfect match.

As my postdoc neared its end, another serendipitous event occurred: a chance to return to my undergraduate alma mater and become a faculty member. But in a sense, this is what I had planned for from the very first moment I knew I wanted to teach chemistry. The degrees and experience I had acquired along the way gave me the chance to come back to the city and school where I began those studies. I write this only a few months after my return, but I can easily say that I made the right choice.

What I have described here does not apply to everyone planning an academic chemical career, but I hope that those reading can learn something about how to plan from my experience. The bottom line for me was the placement, timing, and circumstances of my postdoc. To those thinking along similar lines, I say, search them out! The less traditional postdocs are out there, but only if you ask!

SEARCHING FOR AN ACADEMIC POSITION

3

Let us assume that you have carefully considered the pros and cons of an academic career. You have tested your interest through your TA assignments, additional teaching opportunities, and perhaps participation in a PFF program. Your postdoctoral experience, if any, has further convinced you to seek a faculty position. How do you go about getting that ideal job?

What's Available?

The classified section of *C&EN* is the best place to find academic openings in chemistry. *Science* is also worth checking, although most of the positions listed there are in the biological rather than the physical sciences. The Career Network section of *The Chronicle of Higher Education* is full of announcements of academic vacancies in all disciplines.

Many chemistry departments send form letters to other departments announcing job opportunities. Very likely, the university where you are doing your graduate or postdoctoral study has a file of such letters. Your research supervisor may as well. It is not uncommon for chemists to write to friends and colleagues, requesting recommendations for specific positions. An enthusiastic endorsement from your mentor may open some doors and ensure that your application will be seriously considered, but it will not guarantee an offer or even an interview.

Job announcements typically come out in the fall semester for faculty positions to be filled the following academic year, but keep checking the listings every week. Getting your application in early may indicate your eagerness and will probably mean that it will be read early, but that may not be a significant advantage.

Once you have scanned the field and determined what is available, you need to compare the expectations of the institutions with your own expectations. This assumes that you have narrowed your search to one or two areas of the academic phase diagram. Such self-knowledge is advisable; sending blanket applications for all the vacancies listed in *C&EN* is not. Miami Dade College and MIT are both fine institutions, but they are not at all likely to make job offers to the same individual. One of the greatest disappointments is to aspire to a career in a certain type of institution, fail to get such an appointment, and accept a job at a place you regard as much inferior. You will very likely be happier and more successful teaching at a community college if you want to be there than if you are there because you were unable to get a job at a research university. To be sure, chemists who initially and unsuccessfully applied for one sort of position have had rewarding careers in a place that was not their first choice. Similarly, there are many happily married people who were dumped by an earlier love.

It's a good idea to do a little research on the colleges and universities you have identified as potentially appealing. Read their entries in the *Directory of Graduate Research* or the *Directory of the Council for Undergraduate Research.* These might not be current, so also check institutional websites and talk to faculty and friends who might have first- or second-hand knowledge. Of course, deciding where to apply involves more than the institution and the position. Other considerations include geographical location, urban or rural setting, proximity to family and friends, local lifestyle, and employment opportunities for a spouse or partner. Once these factors have been evaluated, you can refine your list and begin the actual application process.

An application package typically includes a cover letter, a curriculum vitae, a research proposal, a statement of teaching philosophy, transcripts, and letters of recommendation. All are important, and all will be individually addressed in the brief sections that follow. Note that a handful of institutions, including Montgomery College in Maryland and the Channel Islands campus of California State University, require online applications for faculty and staff positions. This is still an extremely rare practice. Although you will undoubtedly use electrons to communicate about your applications, the medium of choice remains carbon on cellulose.

Cover Letter

Very likely, the cover letter will be the first part of your application package to be read. It may be the only part read. The letter is your introduction to the selection committee, and you want it to be memorable. A vacancy in a four-year college can generate more than 100 applications. Every faculty member can describe cover letters that immediately terminated any further consideration. Some are simply blanket one-size-fits-all introductions that make no reference to the institution or the specific opening. Mention the college or university, but mention the right one. Avoid the embarrassing ills that word-processing programs are heir to, such as mixing up parts of letters intended for different audiences. It is discouraging for the search committee at Michigan State to receive a letter that asserts, "I have long admired the chemistry department of the University of Pennsylvania." Use the spelling and grammar check programs, but don't be afraid to override them when they don't understand what you are trying to say. Other cover letters reveal a colossal ignorance of the institution; for example, letters to strictly undergraduate colleges that claim "I look forward to working with research students in your doctoral program." The point is, do your homework about the institution and the opening, and tailor the cover letter accordingly. This advice is particularly apt for international applicants who have little familiarity with the American educational system. For example, the liberal arts college is an almost exclusively American institution with few counterparts elsewhere in the world. If you are applying to such a college, be sure you know what to expect. The cover letter is the place to briefly describe how your qualifications fit the job description. Your research proposal and statement of teaching philosophy are the major vehicles for covering these topics, but use your cover letter to emphasize the highlights relative to the needs of the department. In most instances, the connection will be pretty obvious: The department is looking for a synthetic organic chemist, and that's what you've been trained to do. If your teaching experience is just what is being sought, make a note of that fact in your letter. And if your research would offer a nice synergy with the work of one or more of the faculty at the university or make use of some specialized equipment available there, mention that, too. But keep it all within two pages.

Do your homework about the institution and the opening, and tailor the cover letter accordingly.

In some instances, it may be appropriate to reach beyond your subdiscipline and postgraduate training. As mentioned earlier, analytical chemists are currently in short supply. Some experimental physical chemists can legitimately claim to be able to teach

and do research in analytical chemistry. Sometimes achievement and potential will trump a closer formal subdisciplinary fit. Certain job descriptions state a preference for someone with research and/or teaching interests in a new or interdisciplinary field, such as environmental science or neuroscience. If you have such interests, and especially if you have related experience, mention the fact in your letter. But it is obviously a mistake to claim too much knowledge in representing yourself as an ideal candidate. Your excessive claims will probably become evident during your interview or—even worse—on the job.

The final comment concerning cover letters addresses the style to adopt. Approaches range from the diffident to the huxterish. You are certainly selling yourself, but how hard should the sell be? Remember that most chemists are fairly conservative, and it is probably poor strategy to promote yourself like a used car or a Vegematic. Chemists are trained to look for evidence, not accept assertions. Your readers will be most influenced by the evidence provided by your record, curriculum vitae, research and teaching statements, and letters of recommendation. That said, there's nothing wrong with indicating your enthusiasm, your eagerness to learn more about the position, and your expectation that you will receive an acknowledgment of your application. Unfortunately, you may not. There are too many stories of shoddy behavior on the part of selection committees. But behave courteously and hope you get similar treatment.

Curriculum Vitae

Curriculum vitae is Latin for "course of (one's) life." A CV is an account of what you've been up to, tailored to suit the circumstances. For a job application, you want to emphasize those events and activities that relate to your personal and professional qualifications for employment. The same CV will usually be suitable for any position you are applying for in any college or university; there is no need to customize it. Typically, you will want to include the following: personal information, education, research and teaching experience, other employment and experience, other professional activities, honors and awards, publications, presentations, proposals submitted, and the names of several referees. Often these components are presented in the indicated order or something close to it, but there is no standard sequence. Listings may be in chronological or reverse chronological order. You can devote a lot of time to creating a fancy format, but it won't compensate for weak qualifications. However, a messy, disorganized CV can detract from an otherwise strong background. Specific comments on various parts of the CV follow.

Personal Information

Include your name, work and home mailing addresses and telephone numbers, and e-mail address(es). Give your date of birth and your marital status if you wish, but neither is required, and potential employers are legally forbidden to take these into account in making personnel decisions.

Education

List the colleges and universities attended, degrees and dates awarded, and Ph.D. dissertation title (typically with the name of the research supervisor). Also list the titles of your master's and/or undergraduate theses. Applicants educated in foreign universities should identify the American degree equivalencies if they are not obvious.

Research Experience

If you have had a postdoctoral appointment, list it here. Also include brief descriptions of projects not already mentioned, such as research work done during summers or temporary employment. Some candidates describe their experience with various scientific instrumentation and computers. Note any special responsibilities you have had within your research group.

Teaching Experience

List and describe, as needed, the nature of your teaching experience. Don't forget tutoring or assisting done as an undergraduate, graduate TA assignments, and any special instructional responsibilities you have had. If you have done a teaching and research postdoc, participated in a PFF program, or had any full-time teaching appointments, describe those experiences here.

Other Employment Experience

List part- and full-time jobs that are relevant to your academic search. This would not include flipping burgers at McDonald's, but it might include managing a branch of Starbuck's or clerking at Barnes & Noble—it's a judgment call.

Other Professional Activities

Perhaps you have been active in an ACS Student Affiliates Chapter, an ACS local section, or a graduate student committee. Don't forget to mention it. If you are a member of a minority ethnic or racial group and have not disclosed that information earlier, you can probably reveal it here. Colleges and universities are understandably eager to hire individuals who will diversify the faculty. People of color are still significantly underrepresented in academic careers, and search committees will pay special attention to applications from underrepresented minority chemists. Be sure to note your membership in any relevant minority organizations, such as the National Organization of Black Chemists and Chemical Engineers (NOBCChE), the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), or the American Indian Science and Engineering Society (AISES).

Honors and Awards

You'll certainly want to include fellowships and honors accumulated during and after your graduate study, but undergraduate awards are also appropriate—especially those of an academic nature. Ask your adviser or another senior faculty member if in doubt.

Publications

Give complete citations, including authors, title, and journal reference. Sometimes it is helpful to indicate the nature and extent of your involvement, for example, "conducted all the laboratory research and wrote the first draft of the paper." Papers identified as "in progress" are acceptable as long as they really are.

Presentations

Presentations are made in various venues—national, regional, and local meetings and conferences as well as university seminar series or colloquia (at the home institution or elsewhere). All should be included. Entries should identify authors, presenter, title, and venue and indicate whether it was an oral or a poster presentation.

Proposals Submitted

Most fresh Ph.D.s and many postdocs will not have submitted research proposals, but if you have, definitely report the fact—even if your funding request was rejected.

References

An application CV usually includes the names and addresses of three or four individuals who have agreed to write letters of recommendation. Some potential employers request that such letters be sent at the time of the initial application. Others ask the candidate to initiate the transmittal of letters of recommendation after the applicant has been placed on a short list that is receiving serious scrutiny. Yet another approach is for the selection committee to request the letters directly from the referees. It is important that you know the procedures and expectations of each institution and respond accordingly. Don't ask your referees to write unwanted and unnecessary letters.

The evaluation of your doctoral research mentor and your postdoctoral supervisor (if you have one) will carry a good deal of weight with the selection committee. These people know you, your demonstrated abilities, and your potential. Sometimes professors in advanced courses or members of your thesis committee can provide insightful evaluations. If you are eager to establish your skills and commitment as a teacher, ask for a letter from a faculty member who supervised your TA assignments. If you have worked for a time in industry or government or held a temporary teaching position, request a letter from someone who knows your accomplishments in that environment. The appraisal of one of your undergraduate professors can be valuable, especially for teaching positions in primarily undergraduate colleges. Each referee you choose should have firsthand knowledge of your capabilities.

Before approaching your referees, ask your adviser or someone else who will be constructively critical and totally candid to review your entire application package—sample cover letter, CV, research proposals, and statement of teaching philosophy. Take the suggestions seriously, and modify your documents accordingly. Then ask your potential referees if they are able and willing to write on your behalf. The question "Can you write a strong recommendation for me?" seems a bit brazen and naïve. If you aren't sure of the answer, don't request a recommendation. Give the referees copies of your package, and again solicit comments. Discuss your career goals and ask for advice. The referees will be flattered, and you might learn something useful. A good letter of reference will reflect your goals and be tailored to suit the particular position and institution. Providing addressed, stamped envelopes is a nice gesture, but because of different practices in different searches, this may not be generally appropriate. Addressed mailing labels might be the most useful.

Research Proposals

Essentially all four-year colleges and universities will expect some sort of research proposal or statement of research interests. You should begin work on your statement well in advance of your job application. A good way to do this is to draft a formal proposal to a funding agency at the same time. Obviously, you can use much of the same information in the two documents. In fact, they will probably be very similar if you are applying for a position with a research university. Even if the proposal has not been submitted, the fact that you have written one will suggest that you are serious about research. Moreover, once you land the job, you can fine-tune the proposal and send it off quickly.

In writing your research proposal, it is reasonable to build on your doctoral and/or postdoctoral experience, but your proposal must show evidence of your own creativity and your promise of becoming an independent investigator.

In writing your research proposal, it is reasonable to build on your doctoral and/or postdoctoral experience, but your proposal must show evidence of your own creativity and your promise of becoming an independent investigator. Remember that most of your readers will not be experts in your specific area. The description of your proposed research should be at a level accessible to a well-educated chemist. It should be clear, well written, and supported with appropriate references. The proposal should reflect both the specific aspects of the problem and its general significance. One or two carefully researched areas of concentration are probably sufficient; too many suggest a lack of focus. These areas can be broken down into specific descriptions of possible student research projects. Also note sources of funding and the journals in which you hope to publish your results. Instrumentation and equipment needs should be spelled out, and an approximate start-up budget is not inappropriate. The ideal length of a research proposal will vary with the target department and the nature of the position; 5–15 pages is common.

The emphasis in a research proposal and very likely the problems described therein will differ according to the type of institution. Projects that require large research groups,

the sophistication and time commitment of graduate students and postdocs, and expensive state-of-the-art instrumentation and apparatus will generally be possible only at research universities. Undergraduates have limited formal preparation and seldom more than 10–15 hours a week to devote to research, and then only for a term or two. The resources available at predominantly undergraduate institutions are often limited, and the faculty have significant teaching responsibilities. In order to give undergraduate researchers a sense of meaningful participation, projects must be divisible into pieces that promise short-term success. The rate of productivity is inevitably lower at four-year colleges than at research universities. Hence, it is very difficult for faculty at PUIs to compete in "hot" fields. Anyone applying for a position in such an institution must realize these limitations and give evidence of that recognition in the research proposal. Specific comments on equipment needs and the involvement of undergraduates will be viewed as helpful. Departments that award master's degrees but not Ph.D.s will typically require an approach somewhere between the extremes described here.

If you apply to different types of institutions with different research expectations and opportunities, one version of your research proposal will not be suitable for all. It must be customized for the corresponding area of the academic phase diagram. Two-year colleges seldom, if ever, require research proposals. Richard Jones, who has 25 years of teaching experience at Sinclair Community College, Dayton, OH, observes that even including a research proposal in the application packet to a two-year college can have negative consequences. It raises doubts about the seriousness and commitment of the candidate.

Statement of Teaching Philosophy

Even research universities, somewhat unfairly characterized as largely indifferent to teaching, usually require a statement of teaching philosophy as part of the application package. Colleges and universities that view their mission as primarily instructional weigh these statements more heavily than do institutions at the research end of the spectrum. In any case, applicants are well-advised to take them seriously.

A common failing is that a statement of teaching philosophy emphasizes too much philosophy and too little teaching. It is easy to cull a few clichés about education from some convenient source and string together a page or two of generalizations. Currently "student-centered learning," "discovery laboratories," "Web-based instruction," and "cooperative learning" are trendy. They are also important. But if you don't demonstrate that you know something about the strengths and weaknesses of these instructional strategies, your statement will not be very compelling.

The best statements of teaching philosophy are very personal. View your statement as an opportunity to describe your motivation and preparation for a teaching career.

The best statements of teaching philosophy are very personal. View your statement as an opportunity to describe your motivation and preparation for a teaching career. It should reflect your experience as a learner and a teacher. What stimulated and excited you in your undergraduate and graduate classes? What teaching strategies did you use as a TA or visiting professor? Which ones worked, and which ones didn't? What new methods do you hope to try?

List the courses you are currently prepared (or nearly prepared) to teach, knowing of course that you will be learning on the job. Also suggest other topics that you might enjoy teaching in the future. Here is the place to suggest advanced courses in your area of expertise or perhaps interdisciplinary topics that interest you. Do your homework and try to suggest topics and courses that complement those already being taught. It is a good idea to spread your interests across the curriculum, from first-year general chemistry to upper-division courses and, if available, graduate seminars.

Other Enclosures

The position announcement may request a copy of your graduate and/or undergraduate academic transcripts. You may be able to enclose these yourself, or it might be university policy to send official transcripts directly to the desired destination. Generally, copies of papers, course syllabi, teaching evaluations, or other supporting materials are not expected at the application stage. If there is something in your record that you are particularly proud of, you might consider sending documentation.

Telephone Interviews

Let's assume that your application package proved so appealing that you get a phone call from the chair of the search committee, indicating that the committee is definitely interested in your candidacy. At this point you may be requested to initiate the transmittal of letters of recommendation and, in unusual circumstances, to provide additional information. You may also be asked to undergo a preliminary screening in the form of a telephone interview.

Telephone interviews are often frustrating for both the person being interviewed and those doing the interviewing. It is difficult to communicate much of substance, and many phone interviews are little more than dubious tests of personality and articulateness. If you are to be subjected to such an interrogation, try to find out in advance what to expect. Prepare by reading the job description; checking the institutional and departmental websites; and reviewing your CV, research proposal, and teaching statement. Have the last three in front of you during the interview. A useful tactic is to make a list of questions and specific points you would like to leave with your interviewer(s). These can be introduced into the conversation at appropriate times and in uncomfortable silences.

You may well be facing a conference call involving all the members of the search committee or, in a small department, the entire chemistry faculty. If you get into such an annoying and artificial situation, do the best you can. Write down the names of the interviewers as they introduce themselves and try to keep track of what they say. You might even be able to direct questions to specific individuals. And be prepared to suggest a date or dates for a campus visit in case you are asked to do so. The main point of the call will probably be to determine whether you should be on the list of finalists. No institution of any substance will make a job offer on the basis of a telephone interview.

The Campus Visit

You will recall that in our survey of chemistry departments, the campus visit was the most highly ranked factor influencing a faculty appointment. Once you get on campus, your foot is literally in the door. Your job is to pry it open deftly. Most campus visits follow a fairly predictable schedule, and the common components will be individually discussed below. But be sure to get a clear understanding of what will be expected of you, particularly with respect to formal presentations. If it's a week before your visit and you haven't received a schedule, make a polite call to the departmental secretary.

Be prepared to respond promptly to an invitation. A specific date or dates will probably be proposed, and you may not have much advance notice. Try to accommodate the wishes of the department, even if it requires changing other plans. Although you will be reimbursed for your travel expenses, you will very likely have to make travel arrangements on your own. This means charging your airfare and having a sufficient financial cushion to pay for it if the bill is due before the reimbursement check arrives. The institution will appreciate efforts to save money, but short notice and midweek interview dates may mean that you will be charged full fare. Very likely someone will meet you at the airport or at your hotel. The host institution should arrange for your lodging and provide all or most

meals during your visit. You may be asked to pay for your hotel bill and submit a copy of it and all other expense receipts for reimbursment.

Individual and Group Interviews

A typical campus interview visit is one or two days in length. You will meet many people, but the most important will be the members of the chemistry department. They want to learn about you, and you should learn all you can about them. In a large department you will spend the most time with the members of the search committee and the faculty of the subdivision with the job vacancy. In a small department you will meet with the entire chemistry faculty. Individual meetings, each a half-hour to an hour in length, can get tiresome. You will be asked over and over again the same questions about your preparation, research plans, teaching interests, and career goals. Presumably your answers will be consistent.

You should also ask a series of questions of all the professors you meet, and their answers might not be consistent. Find out about research opportunities and expectations, typical teaching responsibilities, the preparation and motivation of students, the support of the administration for the department, and the health of the institution. Open-ended questions about the greatest strengths and needs of the department or significant sources of satisfaction and dissatisfaction sometimes elicit a range of responses. Pay attention to the answers you get from younger and older faculty; do they have a common vision? Extreme diversity in the ways in which faculty members describe the department and the institution sometimes signals internal dissent. Does the department seem cooperative and collegial? Is morale high or low? Is the personal as well as the professional chemistry right? Group meetings, such as a dinner with the entire faculty or some subset thereof, can provide evidence of departmental relationships.

You may also meet departmental staff members—laboratory instructors, service personnel, secretaries, and administrative assistants. If not, at least ask about the extent of support available. Some selection committees have student members, and you will certainly meet them. Even more valuable are meetings with groups of undergraduate or graduate chemistry majors. Such sessions are sometimes scheduled over lunch. Student opinions about the strengths and weaknesses of the department can provide useful insights. And the students, in turn, will probably be asked to evaluate you. Other people you might meet on a campus visit include nonchemist members of the selection committee, faculty in other science departments, and deans or other administrators.

In these various conversations, it is important to learn what will be expected of you if you are offered the position and you accept it. What will be your teaching responsibilities during your first several years? How much choice of courses will you have? How large are your classes likely to be? What are the expectations for starting a research program, and what is the procedure for attracting graduate and undergraduate research students? Ask about the process for the awarding of tenure and recent tenure decisions in the department and the institution. Specific questions about compensation and benefits are probably premature during an initial visit, but you can certainly ask about recent ranges of starting salaries and start-up funds. Usually the department chair is the best source for this information.

You will undoubtedly be given a tour of the department and the campus. Pay particular attention to the laboratories, stockrooms, instrumentation, computing facilities, and library—all will influence your effectiveness as a teacher and researcher. It is appropriate to ask to see the office and laboratory space that has been designated for the new appointee. If your research requires remodeling of facilities, note that.

Some colleges and universities also arrange for tours of the town or city, including residential areas; however, these are often reserved for a return visit after an offer has been made.

The Research Presentation

Essentially all institutions except two-year colleges require a job interviewee to make a research presentation. This is a key component of your visit. Here is your chance to demonstrate your skill as a scientist and your effectiveness as a teacher. Remember that you will be talking to a mixed audience of faculty members, undergraduate chemistry majors, and, in many institutions, graduate students. You can assume that your listeners are familiar with the fundamentals of chemistry, but most of them will not know the details of your area of specialization or the specifics of your research. The knowledge gap will probably be greater at an undergraduate college than at a research university. You can be more high-powered at the latter than at the former.

In any case, start slowly by providing a description of the relationship of your project to more general chemical principles. Some comment on the practical significance of the work can stimulate interest. Describe your experimental strategy and the instrumentation used if the latter is not familiar. Explain complicated computations and concepts. As you progress through your presentation, it will no doubt accelerate and become more detailed, but help your audience keep sight of the larger issues. Common mistakes include trying to deliver too much information, going too fast, and using visual aids that are too complex to aid anyone. Some of the most effective presentations incorporate a bit of drama, as the speaker reveals something of the thrill of the search and the satisfaction of a successful experiment.

Be sure to highlight your contributions, taking credit where it is due, but not claiming to have done more than you actually did. End with a summary of what you have accomplished and what needs to be done. The latter can be particularly important if you propose to continue the work. Be sure to acknowledge sources of funding and the contributions of others. Leave enough time for questions. If you don't get any, it's a cause for concern. A presentation that seems to stop abruptly or overwhelms the audience with mountains of arcane information is likely to be followed by a deadly silence. On the other hand, a stimulating presentation will provoke (sometimes plant) questions that you should be prepared to answer. If the question is one you haven't thought about, either offer a reasonable response or honestly admit that you don't know the answer.

It goes without saying that you should be impeccably prepared for your presentation. You should be well informed and well rehearsed. Make sure your visual aids are clear and legible. If you use PowerPoint slides, it's not a bad idea to bring along overhead transparencies or 35-mm slides as backup. The style you adopt has to be natural and comfortable, but if you are totally bereft of enthusiasm and humor, you might have a very tough time as a professor. Above all, strive for clarity. A truly successful researcher is able to explain his or her scholarship to a variety of audiences—fellow researchers in the field, colleagues in the discipline, students, academic administrators, funding agencies, and the general public.

A truly successful researcher is able to explain his or her scholarship to a variety of audiences—fellow researchers in the field, colleagues in the discipline, students, academic administrators, funding agencies, and the general public.

The Research Proposal Presentation

Many research-intensive departments are even more interested in the research that an applicant proposes to do than in the work that he or she has already done. The research record is certainly an indicator of what the future might bring, but research proposals and their defense weigh heavily in many hiring decisions. Therefore, it is common for universities to require a formal research proposal presentation in addition to the research seminar, often immediately following it. If you find yourself in such a situation, you probably will be asked to start with a description of your research plans, but very soon you will be interrupted with a barrage of questions from your faculty audience. Be prepared not only to describe your research proposals but also to explain how and why your intended

work is significant, promising, feasible, and original and how it distinguishes you from your mentors and colleagues. A young physical chemist who recently went through the process at five research institutions describes it as the most demanding part of his campus visits. From his current perspective as an assistant professor at one of those universities, he reports that the research proposal presentation is of great importance in determining whether or not an offer will be extended.

Teaching a Sample Class

Some predominantly undergraduate institutions expect visiting job applicants to teach a sample class in addition to giving a research presentation. The procedure works something like this. When the candidate is invited for an interview, he or she is also asked to prepare to teach a class in an existing course. Some options may be offered, but typically the course will be in the subfield in which the vacancy exists. The applicant will receive copies of the syllabus, the course outline, and, if necessary, the textbook. The assignment is to fit into the fabric of the course—a not inconsiderable challenge.

If you are confronted with such a prospect, telephone or e-mail the instructor of the course and discuss it in some detail. Learn about the students and how the course is being taught, but don't necessarily attempt to emulate the style of the regular teacher. Read the chapter, paying special attention to the sections that precede and follow your assigned segment. Consider introducing examples, illustrations, and information to enrich the text and clarify the concepts. Some candidates prepare overhead transparencies and handouts, bring models, or even do simple demonstrations. Plan to pitch your presentation at what you believe to be the appropriate level for the course and the student body, recognizing that you may need to make adjustments in the classroom. Many applicants assume too much previous knowledge. Asking questions and inviting questions are good strategies, but don't embarrass the students (and their professor) by asking about topics you think they should have already learned. Your teaching methods should be suitable for the size of the class and, of course, comfortable to you. Using student-centered cooperative learning activities may be difficult because you don't know the students.

A teaching assignment of this sort is much more challenging than giving a research presentation. Preparation is difficult. There is something artificial about stepping into someone else's course and classroom. You can never be exactly sure of what to expect, and you need to remain flexible and unflustered, enthusiastic but composed, and friendly but in control. Work toward an instructional goal, but don't be so determined to demonstrate effective teaching that you have unrealistic expectations of student responses. Your teaching will be closely observed by the students, who will be asked to evaluate it, and by the professors who will undoubtedly be in the audience. Students are generally supportive, and if you convince them and the faculty of your teaching ability, you will have scored a great triumph. Indeed, in the institutions that use this method of evaluation, the sample class may be as important as the research seminar.

In a variant of this practice, candidates are asked to present a "typical" first-year chemistry lesson to faculty and a select group of students, usually upper-division undergraduates and graduate students. Here, integration in an existing course is not an issue, but many of the considerations mentioned in the previous paragraphs still apply.

Exit Interviews and after the Visit

By the end of the visit, you should have formed some opinions about the position, the department, and the institution. If you are reasonably observant and introspective, you will probably have a sense of how things went. The comments of the chair or dean may

give you some hints, but generally the interviewers will play their cards close to the vest. Before you leave, you should have a clear understanding of the procedures and timetable for making the hiring decision and extending the offer. Practices vary, but a number of steps must be taken before an offer can be made. The search committee typically makes a recommendation to the entire faculty of the department, and the faculty decision is often passed on to a dean. In some cases, the dean requests a rank ordering of the finalists. Sometimes, none of the finalists is broadly acceptable and the search may be re-opened or aborted until the next year. You are justified in asking how many candidates will be interviewed and how far along the interviewing process is. The institution should also inform you of when the offer is likely to be made. By the same token, the college and its representatives will want to know when you will be prepared to accept an offer.

After the visit, send a statement of your expenses, a note of thanks, and any additional information that might have been requested. If you feel very strongly that there is no way on earth that you would accept the position even if it were offered with a munificent salary, the honorable and honest response is to withdraw your candidacy. Otherwise, you wait while doing your research and/or teaching, writing papers or your dissertation, making other applications, and planning other interview trips. The department has a responsibility to keep you informed of its deliberative process, especially if it extends beyond the target time for a decision. If that time passes and you have heard nothing, send a polite inquiry. Such contact is especially important if you have received another offer or offers. In that case, contact the department chair and inform him or her of that fact. Ask about the status of your candidacy and when you can expect a decision. This news may prompt some action. It is, of course, desirable to have a choice between (or better yet, among!) attractive options.

The Offer

One day the phone rings. It's the chair of the chemistry department at the University of Scientific Knowledge or the dean of Veritas College. She is calling to inform you that the institution is prepared to offer you a tenure-track position as an assistant professor of chemistry. The details will be in a letter that you should be receiving shortly. Congratulations! A little celebration is in order, but don't have the big party until you've read the small print. In fact, Daryl Eggers suggests that you get all the conditions of your employment in writing (see p 44).

One of the first things to determine is when an answer is expected. If you have other irons in the fire, perhaps at various temperatures, be forthright about it. You don't need to identify the competition, but if you have another offer in hand, you can name names. If you are waiting to hear from your dream school, you can ask for a reasonable extension, but it is unfair to keep your suitors waiting too long while you attempt to better your lot.

In weighing the offer, you must consider many important details. Length of initial appointment, teaching responsibilities, research opportunities, salary, benefits, summer support, start-up money, and space allocation are fairly straightforward and may be negotiable, within limits. In some departments such negotiations are carried out before a formal letter of appointment is issued. Annual tabulations of salaries published in *C&EN*, *The Chronicle of Higher Education*, and *Academe* (the journal of the American Association of University Professors) will give you some idea of how your offer compares with other starting salaries, but you should also check it against the pay scale at the institution. Start-up funds can range from a few thousand dollars to $50,000–$100,000 at prestigious liberal arts colleges and several hundred thousand dollars at research universities. The average start-up package at major research institutions is reported to be $450,000.

Other considerations are much more personal and difficult to quantify: the quality of the institution, department, faculty, and student body; opportunities for advancement; location and living conditions; and employment opportunities for a spouse or partner. Does the department feel comfortable? Are the goals of the college or university

Some Advice for Academic Job Seekers: Get It in Writing

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I first attended the ACS-sponsored Preparing Future Faculty course as a postdoctoral fellow at the University of California, Los Angeles, two years prior to actively seeking a faculty position. At the time, I had already decided to pursue an academic career because I desired both the research freedom and the rewards of teaching that one can obtain only in a university setting. Before taking this class, I had gained teaching experience during two consecutive summer sessions at UCLA.

The PFF course was invaluable to me in three important respects. It clearly laid out the choices and issues facing new faculty today, it prepared me mentally for all phases of the application process, and it gave me the opportunity to question in person faculty from other schools who had served on selection committees. Another key benefit that I obtained from the PFF course was the experience of writing my first statement of teaching philosophy. This exercise caused me to more carefully examine my inner motivations for teaching, and my early (pitiful) attempt at a teaching statement served as a starting point for countless revisions before my first job application was mailed.

During the course of my recently completed faculty search, I sent out 36 applications in response to advertised positions. From this pool, I received seven campus interviews and two firm job offers. One of my chief frustrations with the interview process was the long delay in having my travel expenses reimbursed (three to six months!). I warn future candidates to have some money in the bank and, whenever possible, have the university pay the airline and hotel expenses up front.

Although I was successful in obtaining a position in which my teaching and research responsibilities are split nearly 50/50, I believe such ideal positions are relatively rare. Beware, future candidates! In oral communication, many institutions may stress research and teaching equally and/or state that the two carry equal weight for tenure decisions. But the time allocations are not proportional. Some schools will try to assign you a full teaching load and, at the same time, expect you to supervise a vigorous research lab. This is not good for your physical and mental well-being. I know of people who abandoned academia simply because they did not have enough time to devote to either aspect of their job. If you should be so fortunate as to be promised a reduced teaching load by the chair or dean of a potential employer, be sure to have the details written into your final appointment letter before you accept the position.

compatible with your own? Does it inhabit a region of academic phase space where you want to spend your career? Above all, do the wave functions for what you *want* to do and what you will be *expected* to do have a high overlap integral?

The best way to get answers to some of these crucial questions is to return for another visit. If the institution wants you, it will be happy to bring you back, perhaps with your spouse or partner. Such a visit also affords opportunities for in-depth discussion of duties, financial negotiations, and housing and job searches. Sometimes the institution can provide temporary housing in college-owned property and help a spouse apply for a suitable position in the college or elsewhere. The specific case of shared academic positions is treated below under Special Considerations. (Incidentally, the research departments surveyed indicated that competition from other institutions, start-up money, and finding jobs for spouses were the greatest obstacles to making desired hires.)

Obviously, if you have more than one offer, you will do a very careful comparison before reaching your decision. To some extent you can use competing offers as part of your bargaining strategy, but there is a danger of alienating everyone concerned if you push too hard. Institutions have been known to cool off quickly in response to what were deemed as excessive demands. Once you have made a choice and accepted a position, you have a responsibility to inform the competition as soon and as politely as possible. No one's career has ever been hurt by honorable, courteous behavior.

Remember, when you accept a job, you are making a minimum commitment of one academic year. The institution may offer a contract that includes a two- or three-year appointment, contingent on satisfactory performance. But an offer is not necessarily a lifelong commitment—by either party. You will learn far more about your employer once you get on the payroll, and your employer will learn far more about you. If it turns out not to be a match made in heaven, either of you has the right to dissolve the relationship.

Special Considerations

Occasionally, events may create pressures to postpone starting a new job. For example, a graduate student may accept a faculty position in anticipation of completing his or her doctorate by the start of the next academic year. Unexpected complications slow down the process and make it impossible for the individual to meet that deadline. The hiring university may agree that it makes sense for the chemist to complete the research and thesis before joining the faculty. It is almost invariably better for the new faculty member (and the department) to defer starting for a semester or even a year than to struggle in an ABD status. In some instances, institutions have been so eager to hire a fresh Ph.D., possibly because of the expertise or diversity that he or she would bring to the department, that they have issued a contract with the understanding that the new hire would spend a year doing postdoctoral research before assuming the position. Some years ago, Macalester College made an offer to a young postdoc who had informed interviewers that he had applied for a highly prestigious NATO international postdoctoral fellowship. He accepted the offer and subsequently was awarded the fellowship. Although the new hire was willing to decline the fellowship, the department and college recognized the value of the fellowship to the individual and the institution. Therefore, a year's deferral was granted—a decision that proved beneficial to all concerned. If you find yourself in such a circumstance, by all means raise the possibility of postponing your starting date.

Two-career couples complicate the process of finding suitable employment. Fortunately, anti-nepotism rules are largely relics of the past. Many faculties include spouses, often in different departments but sometimes in the same department. In some chemistry departments, both husband and wife hold full-time tenure or tenure-track appointments. Young chemist couples who set out to find such twin appointments have little to choose from, because it is unusual for one department (especially a small one) to have two simultaneous vacancies in the appropriate subspecialties. Only very few institutions will be willing and able to create a job specifically for your spouse or partner. It is probably easier for one of the partners to get a job first and for the other to apply when another vacancy occurs.

It is difficult to make a move from a below-average college to a first-rate one, even with an excellent record of research and teaching. And remember that the working conditions at the below-average institution might not enable you to establish an excellent record.

Shared academic appointments have become more common over the past two decades. The spouse or partner pair applies for a single academic position, goes through the interview and selection process together, is offered the job, and accepts it. Details of contractual agreements differ, but typically tenure can be awarded to the couple sharing a position or to either member of the pair. In the latter instance, the full-time position will be occupied by the individual who is granted tenure. Those who hold shared positions value the flexibility the arrangement affords for teaching and research schedules and for domestic duties such as child care. Coupled careers are often complementary, with collaborative research programs, shared laboratory facilities, and joint responsibilities for advising research students. Drawbacks include the single salary and the almost inevitable tendency for the employing institution to conclude that two halves should equal more than one. Shared appointments are almost always a good deal for the college or university, and they may also be ideal for the couple involved. If you and your partner are interested in pursuing such an arrangement, you would be well-advised to seek out couples who have relevant experience. Make sure that the contractual terms are equitable and acceptable; the institution may have no experience with such appointments. Also consider what will happen to the position and its incumbents in the event of a divorce.

Difficult Decisions

You still have the job offers from Veritas College, the University of Scientific Knowledge, and several other better-known institutions of higher learning. You are now faced with a difficult decision. This book can't tell you what to do but can call your attention to some of the choices you might have to make and suggest some consequences of your decision.

If the options are tenure-track positions in excellent institutions that all conform to your ideal place of work, you may have a hard time making a choice, but you are at least choosing among equals or near equals. Under such happy circumstances, nonprofessional considerations may carry considerable weight and details may loom large. But often there are significant differences between the job offers, and they don't necessarily make the decision easier. What if you have a tenure-track offer from a mediocre college or university and a two-year visiting appointment from your dream institution? Both appointments carry risks and benefits, and the job you choose depends on your risk tolerance. The potentially permanent position provides the prospect of greater job security, but that's the bad news as well as the good news. You have an opportunity to establish your career as a teacher and a researcher without the immediate uncertainty of future employment. Your intention may be to use this base as a launching pad for propulsion to a more desirable department. But what if the propellant doesn't ignite or the distance to the intended target is beyond the rocket's range? It is very difficult to make a move from a below-average college to a first-rate one, even with an excellent record of research and teaching. And remember that the working conditions at the below-average institution might not enable you to establish an

excellent record. Moreover, personal and family circumstances may make a move difficult. And so you spend the rest of your working life stuck in a place you'd rather not be. Of course, people adapt; they discover delights they were not initially aware of. Places grow on you, and new allegiances develop. So the tenure-track offer may be the best decision after all, but it involves more of a risk than you might think.

What about the temporary position at the prestigious institution? This one offers some unquestioned advantages. In your two-year appointment, you will be associated with excellent colleagues and students, and you will learn a good deal from both. You will have firsthand experience with a department that is a model of excellent research and education. If you perform well, you should get some strong letters of recommendation that will carry a good deal of weight in your next job search. Thus, the visiting position might help propel you to a permanent one at a comparable college or university. After all, few professors ever had their academic careers ruined by not getting tenure at Harvard. And it's possible that a permanent slot might open up and you would have an inside track. Incidentally, that inside track might be less advantageous than you think. If you've spent a year or two in a department, your colleagues know your weaknesses as well as your strengths. CVs, letters of recommendation, and interview visits are designed to hide weaknesses and highlight strengths. When it comes to job hunting, being too well known to potential employers may be a handicap. Search committees are sometimes more comfortable with first impressions and high hopes.

A visiting position, even at an excellent college or university, does have some disadvantages. Paul Fischer's positive experience at St. Olaf is not universal (see p 49). Ascertain in advance your teaching responsibilities and your access to laboratory space, instrumentation, and students. Even under optimum conditions, you won't get as much research done as you had hoped. You may feel like an outsider and be treated that way by some of your colleagues. And you'll have to keep one eye on the job market. It is, after all, a temporary position, and there is no guarantee that it will lead to a tenure-track dream job. It may simply lead to another choice between less-than-ideal options—perhaps another visiting appointment elsewhere or a less-than-optimum permanent post.

A somewhat more secure position is that of the full-time adjunct faculty, individuals who are in but not quite of the academy. Of the roughly 1 million faculty members in this country, about 200,000 fall in this category. The title depends on the institution: lecturer, instructor, academic career specialist, faculty specialist, visiting faculty, or adjunct faculty. The duties and terms of employment vary as well. In chemistry departments, adjunct instructors may lecture in general chemistry, teach laboratory sections, or maintain and run specialized equipment such as NMR spectrometers or X-ray diffractometers. Some positions involve renewable one-year contracts, others carry multiyear appointments, and still others come very close to offering the job security of tenure. At Western Michigan University, some adjunct instructors with specialized expertise are now eligible for tenure and are not required to do research to earn it. Adjunct appointments vary greatly with respect to minimum and maximum salaries, fringe benefits, rights and responsibilities, employment security, eligibility for merit pay increases, and opportunity for advancement. Therefore, if you are offered such a position, be very careful to learn what it does and does not include. And be aware that it may involve second-class citizenship in the eyes of some regular faculty.

As you consider your options, how long should you hold out for the ideal job? Anyone who has screened job applicants has read CVs that chronicle the lives of 45-year-old chemists who have held a string of temporary teaching positions and/or postdocs. Unfortunately, the chances of such a person gaining a tenure-track academic position are almost vanishingly small. One of our editorial board members suggests that more than three years of postdoctoral experience is a "highly negative" factor. Reports from our survey indicate that two postdocs, two temporary teaching positions, or one of each may be the practical upper limit. If a tenure-track position is not gained at that stage, it probably never will be.

Some people are so intent on pursuing academic careers that they persist until

they are fated to occupy temporary appointments in a succession of institutions. It is not uncommon for these "gypsy scholars" or "roads scholars" to hold simultaneous part-time positions in several colleges. They are usually underpaid and overworked with no job security, few employment benefits, and practically no chance to do scholarship. The academy is notorious for its exploitation of this faculty subclass. It is a rare individual who has so great a love of teaching that he or she is willing to put up with such working conditions. An article in the Jan 6, 2003, issue of *C&EN* (pp 34–37) described "The Plight of Part-Time Faculty," and ACS has published *A Guide to Classroom Instruction for Adjunct Faculty*.

Transitions

Every year many chemists leave one academic job and accept another. Such transitions can occur for many reasons and at any time—before a tenure decision is made, after failure to gain tenure, or after having achieved tenure. Although the subject of job change is tangential to the main thrust of this book, it does deserve brief comment. Not surprisingly, most of these moves are between colleges and universities near each other on the academic phase diagram, although not necessarily in geographic proximity. But some of the transitions are between different types of institutions. Some professors at research universities find that they would like to devote more time and effort to teaching than they can in their present positions. Therefore, they switch to comprehensive universities or four-year colleges. The reverse move, from a B.A./B.S.- or M.A./M.S.-granting institution to a Ph.D.-granting university, is rare, even if the faculty member has an excellent research record. Occasionally, a professor at a primarily undergraduate college is hired by a research university to direct the undergraduate or general chemistry program. Alternatively, some professors leave universities or four-year colleges for successful careers at two-year institutions.

Anyone interested in changing jobs should be prepared to explain the reasons for the switch. Search committees are especially suspicious of the motives of someone who is seeking to make what appears to be a major career shift. Their concern is that an individual with extensive experience in one type of institution may not fit in well at a significantly different one. The faculty of a research university may question the scholarly productivity of someone from a comprehensive university. A liberal arts college may worry that a professor from a research university is looking for a job that will permit him or her to "retire" to the classroom or that the individual will be an ineffective teacher. The point is that if you accept an academic job that proves less than you hoped for, there are other opportunities. But they require that you use the job search strategies discussed in this chapter plus a few others specific to your individual circumstances.

Temporary Teaching Position or Traditional Postdoc: Pros and Cons

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Serving as a visiting professor in an undergraduate college can be extremely valuable preparation for a chemist interested in securing a tenure-track appointment at a similar institution. However, this activity is inherently different from a traditional research postdoc. Therefore, it is important to weigh the potential benefits of these activities to determine which experience will most effectively promote the professional development required to ultimately meet the challenges of a permanent position.

As a teaching assistant in graduate school, I greatly enjoyed working with undergraduates and being engaged in chemical education issues. My mentors suggested that my talents and outlook made me an excellent candidate to teach at a small liberal arts college. While I was excited by a career possibility that featured continuous interaction with undergraduates, I was also apprehensive. I had earned my bachelor's degree from a large public university. My personal experience with private liberal arts institutions was extremely limited and largely anecdotal. It was therefore important for me to personally verify the advice of my mentors by experiencing firsthand the liberal arts college environment.

It was with this perspective that I sought a visiting assistant professorship as I neared completion of my Ph.D. My search resulted in an appointment in the St. Olaf College chemistry department. My ensuing three-year experience at this institution was outstanding: It provided strong affirmation that I was a good fit in a liberal arts college atmosphere. My temporary appointment also provided numerous benefits that have subsequently assisted my transition to a tenure-track position at Macalester College.

First and foremost, a visiting assistant professorship provides indispensable classroom and laboratory teaching experience. Since an instructor's perspectives and approaches to teaching are truly shaped only through personal experience, there is no substitute for being responsible for every aspect of a class—something not available to a teaching assistant. A temporary teaching position allows one to experiment with different classroom and laboratory methodologies since student evaluations will not be used for tenure decision purposes. To maximize one's development, it is beneficial to teach specific courses multiple times during a temporary appointment; this facilitates refinement of techniques and curricular ideas. The greatest incremental development probably occurs when teaching a course for the second time. It is valuable to teach introductory and advanced classes and laboratories, courses with varying enrollments, and different curricular schedules (semester, interim, etc.). At St. Olaf College, I taught General Chemistry I and II, a month-long structure and bonding course for first-year students, and Advanced Inorganic Chemistry. I also had the opportunity to teach general, organic, and advanced synthesis laboratory sections.

Another great benefit of a temporary teaching position is interaction with experienced faculty members. A supportive department will permit visiting faculty to observe senior colleagues in their classrooms. At St. Olaf I attended an entire semester of Advanced Inorganic Chemistry taught by the author of the textbook that was used. I now use that same text in my own course, and I profited from the experience of seeing its author at work. I also visited classes in general and organic chemistry, and I had many useful discussions with the professors I observed. These conversations were instrumental in my formation as a chemical educator. For example, my St. Olaf experience permanently altered the way I think about teaching undergraduate thermodynamics and molecular orbital theory. In addition, many of the chemical demonstrations that I currently use are ones that I first witnessed while visiting classes during my temporary appointment. Experienced faculty members have a great deal to offer. Therefore, I encourage prospective visiting faculty candidates to inquire during the interview about the department's openness toward such interaction.

On reflection, my view of chemical education upon receipt of my doctorate was relatively narrow. As a graduate student, I worked as a TA only in general chemistry. This experience enriched my view of one portion of the chemistry major sequence. However, it is valuable for a prospective professor to learn how to structure courses that are subtly (or not so subtly) interconnected. My visiting appointment afforded me a broad view of chemical education and the important considerations for designing a curriculum. The design of an exceptional

major curriculum is an ongoing process that is collectively developed by a department. It is useful to learn about these curricular considerations and, perhaps more importantly, the departmental dynamics that accompany this decision-making process. These insights prepare a visiting professor to contribute to a department's curricular "conversation" at the outset of a tenure-track appointment. This perspective also helps one frame undergraduate academic advising in a broader context.

The art of designing a meaningful research program that is suitable for undergraduate participation is a critical skill for tenure-track faculty. The prospects of a visiting appointment to facilitate growth in this area vary considerably. At St. Olaf, I mentored two students over two summers on a research project. The department was supportive of these efforts: It provided suitable laboratory space, stipends for my students, and modest funding for supplies and chemicals. It is important to learn about what research opportunities and support would realistically be available to a temporary professor. It is challenging to conduct research in this situation, because substantial laboratory infrastructure usually cannot be established and dedicated space for equipment isn't feasible due to the nature of the appointment. However, the benefits of supervising undergraduate research (e.g., obtaining preliminary results for documentation in a research proposal, gaining experience with mentoring undergraduates, and developing ideas regarding how a future laboratory could be designed) definitely outweigh the inherent limitations.

Although my temporary teaching position was a valuable experience, a traditional postdoctoral appointment provides other important benefits for a potential academic. Obviously, a research postdoc increases one's breadth and facilitates intellectual independence from one's graduate work. Postdoctoral researchers have more time to formulate and even initiate research projects that can be continued during a tenure-track position. They undoubtedly gain more experience with scholarly writing and the demanding process of drafting research proposals—skills that are critical for success in a tenure-track position. An individual who chooses the visiting assistant professor path must be prepared to meet these professional challenges at the outset of a tenure-track position, just as a postdoctoral research associate must immediately meet teaching challenges. Regardless of the research opportunities afforded by the host department, it is important for a visiting professor to stay involved in research activities (e.g., by staying current with the literature and generating research project ideas).

One challenge that I faced on starting a tenure-track appointment after completing a visiting position could be classified as a "mode of operation" issue. The modes of operation required for excellent teaching and conducting scholarly work are fundamentally different. Teaching is an activity that inherently requires extensive interpersonal interaction. This activity also creates its own timetable: Exams and other course materials need to be written, lectures prepared and reviewed, homework evaluated, demonstrations readied, and student questions answered promptly. Teaching is conducted during relatively short, intense increments of time: 1 hour in front of class, 15 spontaneous minutes to enlighten a student in the hallway, 10 minutes to address a student question via e-mail. In contrast, scholarly work requires peace and quiet to permit careful deliberation and reflection. It is challenging to do serious scholarship during the hour that separates class meetings or in between student office visits. One needs blocks of uninterupted time.

As a tenure-track professor, one is called on to vigorously engage in teaching and scholarly activity simultaneously. One must continuously "shift gears" between these different modes of operation. It is also important to note that either endeavor could easily consume all of one's time. A delicate balance must be achieved. The intensive teaching focus and reduced research expectations associated with a visiting assistant professorship permit one to comfortably function within primarily one mode of operation. In this way, this experience doesn't readily develop the skills required to balance the teaching and research expectations of a tenure-track appointment. My observation is that research postdoctoral associates face a comparable challenge, transitioning from a predominately research mode of operation to the balance required at an undergraduate college.

Most fresh tenure-track professors in liberal arts colleges are hired with either postdoctoral research or visiting professorship experience. These post-Ph.D. development activities offer valuable and distinct opportunities for professional growth. Both experiences can serve as precursors to successful academic careers. The key is to understand the likely benefits of each experience and select that which best meets your needs.

Playing the Disability Card: Thoughts for All Aspiring Faculty

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First let me get my credentials out of the way. The day after my 19th birthday I broke my neck in a pickup football game and became disabled. I know this because I received a letter from the government saying so. Ten years later I arrived at Arizona State University and became a college professor. I know this because I received a letter from the government saying so.

Now eight years into my faculty career, I feel that I have been successful by most standards. I received tenure in due course. I've published a few papers and bring in enough grant support to maintain a research group. My teaching reviews are above average. What is most important to me, the students passing through my lab seem to be on their way to happy and successful careers. While the majority have pursued industrial careers, three have taken up the cause and become assistant professors themselves!

One of my graduate school lab mates prophesied my future success. "Surely you will get a position," he chirped, "you have disability points!" I know that he meant to be encouraging and supportive. I think, or at least like to think, he meant to say, "You have overcome more than most to rise to your level of performance; such heroic and inspirational actions will surely be recognized and rewarded by the great men and women of science who gaze upon your CV." But what came out was "Don't worry, society will float you. Always has, always will."

In my weaker moments I do think about the connection between having a disability and being successful. In the final analysis I realize that it is a self-destructive catch-22. The logic goes like this: If I am successful because I'm being floated by these mythical "disability points," then my job is a joke and I am the uncomfortable punch line. On the other hand, what if I did achieve this level of success based on my aptitude and hard work? Then, if I weren't encumbered by being disabled, I would be that much more successful. Consequently, I'm doomed to never reach my potential."

The key to escaping such a catch-22 lies in the definition of "disability." I looked up the word in nineteen online dictionaries. The relevant definitions fell into two categories:

1. Inability to pursue an occupation because of physical or mental impairment.

2. A disadvantage or handicap; something that hinders.

If you are a teaching assistant, research assistant, postdoctoral associate, faculty member, or otherwise employed as a chemist right now, the first definition does not apply. On the other hand, almost everybody is hindered in performing his or her chosen occupation by some disadvantage. For some it may be a vision impairment or loss of hearing. For others it may be a personality problem, difficulty with organizational skills, lack of a creative spark, or a myriad of family or personal issues dating back to childhood. I know I'm being glib, but think of how many people you know who would be better off if they traded three of their intangible problems for having their left leg bitten off at the knee by a shark.

OK, now you have the right to print yourself out a disability card to play whenever and wherever you want to help climb the academic ladder. Following are five guidelines that I use to play

for maximum benefit. Oh, and always remember, you do play your cards every day, in everything you do, whether you intend to or not.

- *Recognize the difference between what you need and what you want. The basic tools and accommodations you need to perform your job must never be negotiable. If you compromise on these you are setting yourself up for failure. Luxuries and niceties, however, can be traded and bartered as you build up political capital. (You will never have more political capital than when they are trying to hire you or you have another offer!) For example, to do my job, I needed a dark room large enough for a wheelchair and an optical bench. I wanted a hard walled, semi-permanent modification to an existing lab; the department wanted to just hang very heavy curtains that create dark spaces. The curtains met my minimum needs and I could tell during the negotiations that there were other personal desires where the department would be more flexible. However, six years later I had an offer to interview at another university; part of my agreement not to take the interview was to have my lab remodeled with the hard-walled darkrooms. This guideline applies to everything from the size of your NMR to access to the glass shop to the amount of secretarial support you have.*
- *Try to see the world from other people's point of view. How do you sell yourself to a skeptical buyer, especially if he or she is inclined to think you are damaged goods? While this problem might sound particular to those within the disability community, really everybody has to address these concerns at one time or another. Perhaps you lack the pedigree that some schools value or teaching experience in a particular discipline or setting. Expand the question to a broader context: How do you convince your students to work harder, your administration to grant you more resources, or your colleagues to support your ideas? By understanding the other party's background, motivations, and concerns, you can then craft your proposition in such a way that he or she has a reason to agree. That is, help the other person find a way to say yes. The wrong course of action is to repeat your arguments with increasing emphasis. If someone does not buy into your rationale after two tries, you need to attempt another approach. In general, most people you meet in academia are very intelligent and well reasoned. They really want to find a win–win situation where everybody can walk away from the dialogue better off. This is true for deans, program managers, and students alike. If you do encounter an individual who is self-serving, recognize this as part of his or her motivation and craft your proposal accordingly.*
- *Build a network of friends. Eventually you will need help. Everybody does. Cultivate a group of compatriots whom you trust and who trust you. There was a study about 20 years ago tracking the success of recent graduates in science and engineering. All had graduated with honors. The greatest factor that determined success was the ability to form a network. Those without a network spent more time searching for answers and becoming bogged down by small problems. Those with a network called friends who had encountered and solved similar issues. Be generous with your time and gracious in your interactions. As much as we want to think that success in academia is based purely on technical excellence, human interactions play a large role in determining who is put in place to succeed. The postdoc you dismiss at a conference might be reviewing your NSF proposal in three years. You would be deluding yourself if you believed that reviewers did not find ways to inflate the scores of people they liked and nitpick at people they disliked. If you develop a reputation of being unpleasant to work with, the best students and collaborators will look elsewhere.*

- *Play to your strengths; complement your weaknesses. There is a strain of politically correct thought that refers to people with disabilities as being "differently abled," not "disabled." This logic applies universally. In any circumstance, everybody brings a unique set of skills to the table. The most highly valued individuals have a finely honed skill base that is not easily reproduced. Identify and enhance these skills. For example, in my experience I have found two reasons why my inability to easily perform bench chemistry has not had a negative impact on my career. One, truly interesting projects are bigger than any one or two people. In graduate school I specialized in things that I could more readily do (theory, designing experiments, and data analysis) and left the wet chemistry to people who could get around the lab more easily. Two, as my career progressed, I've become more of a manager and less of an experimentalist. When you have a 10-person research group, there really is not much time to be in the lab yourself. The larger projects require expertise spanning, possibly, multiple disciplines of chemistry, biology, engineering, and mathematics. Offer your aptitudes to the project and collaborate with or hire people who have complementary skills.*

  In a broad sense, academia is a team sport. It requires teaching, research, and service; no single person can excel in all three. Know where your interests and aptitudes lie and become the best that you can be in that area. The right university will respect and value you for those particular extraordinary skills. However, don't ignore the other functions. While it is unreasonable to expect to be an all-star in every aspect of an academic career by the time the tenure decision rolls around, you definitely should not be a liability in any area.
- *Most importantly, never compromise yourself. Do not be afraid to take a principled stand if you know you are right. Don't let yourself be trampled or mistreated by others. Yes, there may be short-term consequences, but those of your colleagues who matter will respect you for it. Your students will remember and learn from it. What message would you be sending otherwise?*

  Don't overwork or overextend just to make the team. While this is a particular concern for people with disabilities, I think that it is an issue for everybody in academia. The quest for tenure is often stressful and demanding. Administrations are asking for more productivity while providing fewer resources. You should be aware of your limits before you begin to compromise the quality of your life. You might well be a superhero, but even superheroes have their kryptonites.

  Seek a department and university that value you for your abilities and contributions. Trying to make a department into something it is not feels just as frustrating as constantly feeling the pressure of a department trying to make you into something you are not. Life offers a constant string of Faustian bargains. However, you control which side you take.
- *And the last guideline: Always be inspirational. It is your job, Professor.*

Information Resources

AMERICAN CHEMICAL SOCIETY

The Women Chemists Committee (WCC) serves the membership of the American Chemical Society. It's mission is to be a leader in attracting, developing, and promoting women in the chemical sciences. http://membership.acs.org/W/WCC/

The Committee on Chemists with Disabilities' (CWD's) mission is to promote opportunities—educational and professional—for people with disabilities who are interested in pursuing careers both in chemistry and in fields requiring the knowledge of chemistry, as well as to demonstrate the capabilities of those persons to educators, employers, and peers. http://membership.acs.org/C/CWD/

The Committee on Minority Affairs (CMA). Increasing underrepresented minority participation in the chemical sciences is a major focus of the American Chemical Society. Many of the activities and programs to encourage the participation and leadership of minorities are under the purview of the CMA and are administered through the Minority Affairs Program. Information about these activities can be found at www.chemistry.org/portal/a/c/s/1 /acsdisplay.html?DOC=minorityaffairs\maabout.html

The Younger Chemists Committee (YCC). The American Chemical Society's Younger Chemists Committee was formed to identify the needs and concerns of younger chemists and to develop programs responsive to their needs. For more information about the YCC, please see http://membership .acs.org/Y/YCC/

UNDERREPRESENTED MINORITIES

AIHEC, American Indian Higher Education Consortium. www.aihec.org/

AISES, the American Indian Science and Engineering Society. www.aises.org/

GEM, the National Consortium for Graduate Degrees for Minorities in Engineering and Science. http://was.nd.edu/gem/gemwebapp/gem_00_000.htm

HACU, the Hispanic Association of Colleges and Universities. www.hacu.net/hacu/Default_EN.asp

NOBCChE, the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers. www.nobcche.org/

QEM, the Quality Education for Minorities Network. http://qemnetwork.qem.org/CAREER.html

SACNAS, the Society for the Advancement of Chicanos and Native Americans in Science. www.sacnas.org/

SREB's (the Southern Regional Education Board's) State Doctoral Scholars Program Compact for Faculty Diversity. www.sreb.org/programs/dsp/dspindex.asp and www.sreb.org/programs/dsp/ publications/ facultydiversity/main2.asp

The Journal of Blacks in Higher Education. www.jbhe.com/ Check out their listing of Jobs and Opportunities at www.jbhe.com/jobs.html

CHEMISTS WITH DISABILITIES

Working Chemists with Disabilities The Expanding Opportunities in Science website includes profiles of chemists working in educational institutions, government agencies, and private industry. The website also features a Resources section that includes many useful links. http://membership.acs.org/C/CWD/workchem/start.htm

DO-IT (Disabilities, Opportunities, Internetworking, and Technology) seeks to promote assistive technologies to support people with disabilities in academe and in careers. This website offers a rich variety of resources on such topics as assistive technology, postsecondary education, and mentoring. www.washington.edu/doit/

AHEAD (Association on Higher Education and Disability). This association offers training, publications, and resources to promote the "full participation of people with disabilities in postsecondary education." www.ahead.org/

Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs provides a valuable source of practical information for promoting the full classroom and laboratory participation of students with disabilities. Prepared by scientists who themselves have excelled in chemistry despite physical disabilities, as well as by experts on disability issues, the book is noted for its sensitivity to the underlying desires common to almost every student with a physical disability. The manual can be accessed as a PDF file at http://membership.acs.org/C/CWD/TeachChem4.pdf.

To obtain a free print version of this publication, please contact: Office of Society Services American Chemical Society, 1155 Sixteenth Street, NW, Washington, DC 20036

You can also call 800-227-5558 or e-mail cwd@acs.org to receive a copy of this book.

Strategies for Women

Although the gender gap in science has diminished during recent decades, disparities do remain.[1] Whereas women today earn approximately 30% of the Ph.D.s in chemistry, only 13.6% of the total chemistry faculty in all schools offering advanced degrees in chemistry and chemical engineering are women[2,3]. An annual survey[4–7] showed that, in 2004, at the 50 most research-active chemistry departments, women accounted for just 8% of full professors and 19% and 20% of associate and assistant professors, respectively.[7] Factors contributing to these low numbers are complex, but clearly, lack of mentoring, various family issues, the accumulation of disadvantage, and other forms of subtle discrimination play key roles[7,8]. To engage and inspire the broadest range of talents in the chemical workforce, it is imperative that we involve chemists of all races and genders. Given that faculty—as teachers and mentors—wield the greatest influence on the career choices of new chemists, it is important that the chemistry professoriate reflect the nation's diversity.

Two organizations that are working to increase the number of women in chemistry departments around the country are COACh (the Committee on the Advancement of Women Chemists), and the Women Chemists Committee (WCC) of the American Chemical Society. Through its PROGRESS program, WCC has conducted invaluable research into the factors leading to the slowness of women's progress in academic chemistry departments[2].

COACh, founded in 1998 (http://coach.uoregon.edu/) and sponsored by the National Science Foundation (NSF), National Institutes of Health (NIH), and Department of Energy (DOE), has focused its attention exclusively on increasing the numbers and success of women faculty in chemistry departments around the world. As described in *Chemical & Engineering News,*[9] COACh has been very effective in assisting women chemists in pursuit of their academic careers. According to Geraldine Richmond, professor of chemistry at the University of Oregon and founder and chair of COACh, "One of the primary efforts of COACh has been to develop programs for women academic chemists that (1) enhance their professional and communication skills to help them attain their professional goals, (2) provide a forum for networking with other chemists, and (3) offer professional strategies for changing the culture of chemistry departments and institutions to make a more welcoming environment for women, minorities, and all faculty."

One of COACh's most visible programs offers skill development workshops to women chemistry faculty.[10] More details can be found on the COACh website. Topics covered by these workshops include effective negotiation and communication strategies and successful leadership techniques for women academic chemists. Originally targeting tenured women professors, COACh quickly opened the workshops to junior faculty members. More recently, it has held workshops for postdoctoral associates in which much of the emphasis is placed on how to negotiate the initial appointment parameters of that first academic position.

All faculty can benefit from enhanced negotiation skills. However, such skills are even more valuable to women and minority faculty, who often lack mentoring. A good mentor can assist a faculty member in achieving success when negotiating issues that might otherwise become obstacles or hamper career progress. COACh teaches that "everything is negotiable" and provides a list of examples of negotiable items in that first job offer (see http://coach.uoregon.edu/coachfiles/workshops2.html). A subset of these negotiables[11] is listed below, along with some of the negotiating tips that are taught and discussed in the COACh negotiation workshops. Further reading material on this issue is given in the Resources section below.

NEGOTIABLES

- Appointment title or titles (all special titles are typically renewable after five years rather than being permanent)
- Starting date (January 1, September 1)
- Starting salary (options: bonuses, additional time off for consulting, additional contributions to retirement account)
- Benefits (health care, dental and medical coverage, other insurance, maternity leave, additional time off)
- Spousal job opportunities
- Reimbursement of moving expenses (may be capped at 10% of salary)
- Travel budget (including travel for attending professional meetings)

- Facilities/Space (amount and nature of the space commitment. For a joint appointment, generally expect only one office. Candidate should check the average allocation of space in the unit, which is often a matter of public record)
- Office furniture and computer equipment
- Staff support (direct and indirect)
- Nine- or twelve-month appointment (or a variation)
- Research support or continuing research support (amount, fungibility—the degree to which money can be used for different purposes—and source of start-up funds. Specify length of time during which start-up funds must be used, e.g., first three years)
- Research equipment
- Research staff (full-time)
- Graduate student fellowships
- Postdoc support
- Normal teaching duties in the unit(s) (option of selecting courses)
- Particular teaching expectations (for joint appointment, clarify distribution of teaching responsibilities among units)
- Number and source of summer ninths (number paid from general fund)
- Number of course releases (and any temporal constraints on this)
- Center or Institute affiliations
- Service expectations (committee duties)
- Sabbatical (any recognition of sabbatical equity accrued elsewhere, can take the form of a Duty Off Campus Leave rather than early sabbatical)
- Date by which candidate should respond

NEGOTIATING TIPS

- Identify the negotiating style that works best for you.
- Differentiate between "positions" and "interests."
- Determine in advance what is your "best alternative for a negotiated agreement."
- Understand the importance of data and use the data in the negotiation.
- Learn the benefits of collaborative negotiations from which everyone leaves feeling like a winner.
- Recognize positive and negative tactics in a negotiation and work to use the positive tactics.

RESOURCES

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Young, Female, and Faculty: Complexities of Chemistry

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As an assistant professor in a department of chemistry and biochemistry, I have faced a lot of complexities—many involving what you might call interpersonal chemistry. As a woman working in what has traditionally been a male-dominated field, in some ways I automatically introduce a new element simply by being there. And sometimes I get unexpected reactions. Fortunately, I haven't had to work out my experiments in learning to communicate and to make effective contributions by myself. Many invaluable friends, mentors, and colleagues have willingly shared their own experiences, support, and conclusions to help me get good results.

One frequently receives recommendations to develop a network system. In my case, a support system has been equally important. Sometimes the two overlap. My first experience of finding mentors occurred during graduate school, while I was working on a project in a different area of expertise from that of my faculty adviser. I preferred to discuss questions directly and therefore would look up papers and often phone individuals all over the world. This helped me understand my project and started an important element of my career: developing a support system. By the time I earned my Ph.D., I had attended three Gordon conferences and found a group of people from numerous universities who were supportive of my career. In addition, I had started to get to know a group of colleagues from other institutions who had reached the same point in their academic careers. This early communication has developed into a great support network in which my friends and colleagues give advice and encouragement that are particularly helpful during the tenure process.

Gordon conferences provided my primary source for mentors. Through them, I developed a good support system and friendships. I particularly focused on talking to women. I found that some of them were inviting and understood my concerns about being a woman in academics. We sometimes discussed whether being female in this field played a role in our successes and failures. Unfortunately, this is a difficult thing to accurately measure. One part of the problem is that I have found that my dress and demeanor seem to influence my interactions with other scientists. Although it sometimes feels like personal style plays a role in achieving success in chemistry, fitting the "typical scientist" mold is not necessary. I typically dress in a feminine way and am not willing to play down this part of my style. Because my feminine appearance sometimes influences how people approach and interact with me, I find it extremely helpful to discuss various aspects of this subject with other women who have similar personalities. My advice to others is to develop strong friendships with other women who have concerns and feelings similar to your own. This helps you keep a good perspective when you break from any "typical scientist" mold.

A diverse group of female friends provides important "big picture" perspective while you learn the details of creating grant proposals, choosing study sections, and selecting reviewers. I have friends in both industry and academe. They all offer a great deal in terms of advice and approaches to

solving the multifaceted group of issues confronting a female in academe. Developing friendships with female academics from a range of schools similar to or better than your own is also important; it exposes you to a more ambitious and driven environment. This has helped me improve my science and given me the drive and energy to succeed in my current position. In addition, you will find it valuable to seek out women who have a range of experiences, from those just ahead of you in the tenure process to others who are full professors.

In addition to female mentors, I have actively searched for advice from both older and younger male faculty. I have been very lucky to find a number of supportive male faculty members at other universities. The younger ones are great at providing details about beginning to develop an independent research program—the kind you only learn from someone who has gone through the process recently. The older ones offer wonderful verbal encouragement and help me look at the big picture. Thus, I balance friendships, getting perspective on some aspects of my job through my female friends and finding support for other parts of my academic career through male faculty.

As a candid woman, I have encountered some challenges in academia. One of the most difficult is managing the discomfort caused by being a female who expresses opinions openly. Although some state that you are entitled to say anything with the appropriate tone and word choice, I would disagree. Sometimes there is no possible way to express opinions or concerns so that entrenched faculty will accept or even understand them. In addition, sometimes a strong female expressing a somewhat unpopular opinion draws more resentment than a male would. One of the best ways to handle this situation is to be confident in your opinions, express them when necessary, and gather affirmation from colleagues and friends at other universities. With them, you can commiserate over the slow rate of change and the sometimes entrenched method of functioning in your department; from them you can gather advice on successfully contributing to a program. Having experienced similar situations, your colleagues will thus provide sounding boards to tell you what are and are not reasonable expectations. In addition, their support for your ideas and opinions allows you to feel validated, and thus often more comfortable when your departmental colleagues require a compromise on various issues.

One of the most valuable lessons I have learned is that it is important to make a good impression without compromising your identity. The organic chemistry community is very small, and you are likely to see people repeatedly throughout your career. Yet you should not quell all your opinions for fear of being denied tenure. Although you need to understand that you are a junior faculty member, this is a lifetime job; you should find out whether this department respects and listens to opinions. Therefore, express your major concerns during your assistant professorship so that upon receiving tenure, you feel confident and relatively comfortable within the department.

Academics also assume the role of mentor, particularly to women and minority students. Some departments lack strength here, and large numbers of students can attach themselves to you as their mentor of choice. In addition, female students commonly seek out female mentors. Because a department typically includes more men than women, the latter often spend significantly more time mentoring students. This role can be very time-consuming, and formal obligations such as writing grant proposals and publishing papers can suffer. You have to pay particular attention to balancing your duties. Obviously it is important to mentor students. Yet, regardless of what anyone told you during your career as an assistant professor, obtaining grant money and publishing papers play the primary roles in the tenure decision. An educational institution cannot give tenure to a faculty member—no matter how many students he or she has mentored successfully—unless the person has publications and has brought in grant money.

One way to balance mentoring efforts with research is to actively involve undergraduates in the latter. I also dedicate one lecture period in my undergraduate classes to discussing my research, the career opportunities in chemistry, and the fellowships available to students. I invite those interested to talk about the fellowships, research opportunities, or both. Then I direct them to appropriate places that will help them meet their goals. Although this is a time-consuming process, it provides a worthwhile opportunity to find a match between the students and your research group. It also provides a great way to involve minority students. San Diego State University offers a number of programs targeting minorities, but it is hard to reach the minority students except through their course work. Using this method, you can effectively inform students about research, involve them in a research environment, and give them information on fellowship opportunities for research.

Being an academic has many rewards: making strong friendships and ties to other colleagues, cultivating a sense of independence, and providing a role model for future scientists. In order to enjoy all these aspects of an academic career, it is important to balance who you are versus the qualities needed in a successful faculty member. Developing a good support system outside your department is essential for learning to make the appropriate compromises required of a faculty member. Both male and female friends offer important contributions, and seeking out a diverse group of colleagues and mentors in multiple settings allows you to determine your own boundaries while keeping a reasonable perspective.

KEEPING AN ACADEMIC JOB

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Finding an attractive academic opening, getting an offer, and accepting it are reasons for rejoicing. They are not reasons for relaxing. In fact, during your first year as an assistant professor of chemistry or a chemistry-related field, you will be busier than you have ever been before. It will make grad school and your postdoc seem like a stroll in the park. Preparing and teaching the one or two or three courses assigned to you will easily consume the 40 hours of a nominal working week. Planning your research, writing grant proposals, setting up your laboratory, and recruiting research students can account for another 40 hours. And you must devote additional time and energy to departmental meetings, getting to know your new colleagues, finding your way around campus, making your house or apartment livable, and all sorts of unanticipated duties. The first year or two of a faculty appointment will be an acid test of your dedication, commitment, and fitness for the academic career you have sought so assiduously.

The Year from Hell: Allocating Time and Energy

A young faculty member in a quality liberal arts college recently described her greatest challenge as "putting limits on a limitless job." An academic position is essentially open-ended, and it can consume you. There are no time clocks to punch, and you really only need to be around for your classes, laboratories, office hours, and departmental meetings. The public hears about professors who teach 3–15 hours a week and is incensed that someone doing so little should earn so much—especially if the salary source is public money. But as you may already know and will certainly discover, formally assigned hours are just the beginning. You must juggle multiple balls, swords, and dumbbells.

One of the great joys of the academic life is that a professor is called upon to perform a variety of duties. Research, teaching, and service are all important and all worth doing well. But the frustrating feature of a faculty position is that any one of your multiple tasks could legitimately consume all your waking hours and quite a few of those when you should be sleeping. If you were responsible for giving only one lecture per week, you could devote all your working time to preparing for it. Your doctoral and postdoctoral training taught you to be careful, methodical, and thorough. Most chemists are not impulsive—at least not in the lab. It is painful not to attain perfection, but it is impossible to do so. There are too many conflicting demands on your time, intellect, and energy. Indeed, the perfect can become the enemy of the good. Effectiveness, not perfection, is the goal. Compromise is essential.

The greatest tension faced by a new professor may well be the one between teaching

and research. Ideally, the two should be synergistic and complementary. John Slaughter, former president of Occidental College and director of the National Science Foundation, once observed that research is to teaching as sin is to confession—if you are not actively engaged in the former, you eventually run out of things to say in the latter. And Nobel Laureate Roald Hoffmann has spoken and written about the stimulus his teaching has had on his research. But although integration of one's responsibilities is generally preferable to compartmentalization, in practice, research and teaching sometimes seem unrelated or even antagonistic. Efforts spent on one may take time away from the other with no obvious payoff. The trick, of course, is to teach about your research interests and to do research related to your teaching assignments. Generally, this is easier at a research university that offers advanced and graduate courses than at a predominantly undergraduate institution where greater breadth is expected. The next two sections offer some suggestions that apply in varying degrees to different institutions.

Teaching Tips

Sanity and self-preservation demand that you balance your responsibilities, but it is difficult for someone to tell you how to do so. One strategy is to place limits on the time you devote to any activity. For example, you might limit preparation for each one-hour class to a maximum of three hours, which is no doubt more than your average student will spend on it. The default is to remember how you were taught a particular subject and try to reproduce that course—even if you didn't much like the original teaching. Such devotion to tradition may be flattering to your old profs, but it's hardly a formula for progress. Like chemistry, chemistry education should be about change. You don't have to completely transform chemistry education in your first year, however. Too much reform may even backfire if senior faculty colleagues view such activities as a repudiation of their life's work. Students often resist instructional innovation, and their negative evaluations have sunk more than one academic career.

If you are teaching in a multisection course, you can learn from your colleagues. Borrow extensively from their syllabi, and ask them for ideas about how to present difficult concepts. Audit one or two of their classes. If your department has a set of semiprepared lecture demonstrations, take advantage of them instead of devising your own. Studying examinations previously used in the course can help you pitch yours at the appropriate level. Don't be afraid to follow the text more closely than you would like; innovation can come later. Some of the instructional support materials that come with the text can save time and help your students learn. So can computer-assisted instruction and electronic teaching aids, but remember that you can become trapped in the black hole of technology.

Adopt a teaching style that is comfortable, but remain flexible. Prepare thoroughly, but don't be chained to your notes. Above all, pay attention to what's happening. After each class you teach, take a few minutes to jot down what seemed to work and what didn't. Note the concepts and techniques that are particularly difficult for your students, and identify teaching ideas to help address these difficulties. If your course has graduate TAs, use them to gather such information. All of these strategies should enable you to be more effective and more efficient the next time you teach the course.

The *Journal of Chemical Education* is a superb resource for any chemistry teacher. It is a "living textbook of chemistry" and much more. Make a habit of scanning it each month and studying the annual index. The time you invest will be richly repaid. Adding a membership in the Division of Chemical Education to your regular ACS membership will bring you the *DivCHED Newsletter* and announcements of programming at ACS meetings, the Biennial Conferences on Chemical Education, and other conferences. You may not have time to attend these meetings, but you will at least be aware of developments in the profession. To keep abreast of advances in the science, concentrate on not only the research journals you regularly read but also *C&EN*. Follow up on topics that seem particularly

interesting, and use the information in your teaching as well as in your research.

Not all courses will require the same preparation time. Graduate or upper-division undergraduate courses in your area of expertise may prove less time-consuming than a section of general or introductory organic chemistry. Although it is far from a universal opinion, experienced educators believe that new faculty members should first be assigned to teach advanced courses rather than introductory ones. You come from graduate school full of fresh ideas and probably better qualified to teach upper-division and graduate seminars than many older faculty members. Teaching advanced seminars can also support your research. Preparing for the course can sometimes unearth new ideas that impact your scholarship, and the papers that you are reading in your area of specialization can be important material for your course. In contrast, those of us with more experience and less hair have more breadth as well as more girth. They probably have a better grasp of how to teach general chemistry to a less-than-eager audience.

Strongly resist pressure, whether internal or external, to teach too many different topics. Repeating courses permits you to revise and improve them and to grow as a teacher.

There seems to be a consensus that during the pre-tenure probationary period, a new faculty member should teach both introductory and advanced courses to demonstrate his or her ability to contribute across the curriculum. But strongly resist pressures, whether internal or external, to teach too many different topics. Repeating courses permits you to revise and improve them and to grow as a teacher. Teaching two sections of the same course in the same semester will save time and effort, but it can be boring for you as well as your students. You may tell the same joke twice to one class and forget to tell it to the other.

Some professors prefer to stack their teaching assignments in two or three successive hours. This scheduling leaves more uninterrupted time to devote to research or class preparation, but it can be exhausting. Moreover, you may find that a considerable barrier is erected between your section of "Chemistry for Poets" and "Advanced Quantum Mechanics." Tunneling is difficult when Δt is 10 minutes.

Feedback from your students in the form of problem sets, examinations, questions, comments, and complaints should give you some idea of how successful you have been at communicating chemistry. Assess their learning early in the semester and frequently thereafter. Your TAs can provide additional insight. Some departments and institutions require student course evaluations. Even if they are not required, some sort of formal student responses can be informative. The trouble is that most evaluations come too late in the term to be of much interest to the student or much value to the instructor. A more useful strategy is to distribute a simple, open-ended questionnaire midway through the course. Three questions are sufficient: What features of this course have promoted your learning of the subject? What features of the course have interfered with your learning? and What suggestions do you have for improving the course? Have the unsigned questionnaires collected and summarized by a secretary, colleague, or TA, or do it yourself. Share the results in class and discuss the pros, cons, and suggestions with your students. If some of the comments and suggestions have validity, make the necessary changes. If you decide not to follow some recommendations, explain why. Students generally respond positively to such midterm evaluation because they are being consulted about something that affects their lives. Moreover, they are likely to see some results. Of course, the best indication of whether or not a course was a success is your own reaction. If you learned something and enjoyed yourself, your students probably did, too.

Students also enter into the final caveat in this segment on teaching. Presumably one reason you went into teaching is that you enjoy helping young people learn. At some institutions, particularly those that charge high tuition and emphasize undergraduate education, students may think they own you. You are young and friendly and eager to please, and they can eat you alive. To be sure, you need to establish and keep office hours. You want to encourage your students to come to you for assistance. But there are limits, and sometimes you have to explain that you have other responsibilities, too.

Getting Started in Research

When you begin your new faculty position, you should be well prepared to start your research. In fact, you may have one or two research proposals ready to submit. The ACS Petroleum Research Fund, the Camille and Henry Dreyfus Foundation, and the Research Corporation are all potential sources for small starter grants. Institutional start-up funds should help you get your laboratory up and running while you are waiting to hear from the foundations. Also inquire about other internal sources for student stipends and research expenses. Presumably you already have a wish list of equipment and chemicals, but you might be able to scrounge some of those items from the department.

The department you have just joined probably has a standard protocol for soliciting graduate or undergraduate research students. Within those constraints, it is important to make yourself and your research visible. Although you recently gave an interview seminar, it's a good idea to volunteer to give another one. Use your classes, especially the advanced ones, to recruit researchers.

Collaboration with established scientists can help launch your career. For example, some of your postdoctoral research may not yet be completed, and you might be able to finish it at your new institution or by returning to the original group over a summer. This could be a quick way to get a few more publications. New collaborative projects involving your former mentor or colleagues or other researchers in the same field may emerge from your graduate or postdoctoral work. Collaboration can be especially helpful for faculty in PUIs, who can be isolated in small departments. Professors at two- and four-year colleges located near research universities have a distinct advantage. The universities can provide an active seminar program, library resources, instrumentation unavailable at the college, and faculty members who might be interested in research cooperation. Some universities even offer financial support for such collaboration.

As valuable as research collaboration can be, it is not without risks. Even at a baccalaureate institution, professors are expected to become independent scholars, and research done exclusively on someone else's projects can have negative consequences at tenure time. Faculty members at PUIs are expected to involve undergraduates in their research, and some of them arrange to take their students to laboratories in universities or other research centers. The experience can be valuable for the students and sometimes results in graduate school fellowships. For the faculty member, it may help initial paper productivity. However, most colleges prefer to have their chemists doing on-campus research in order to promote the intellectual life of the institution. Unless your research requires exotic and expensive equipment, you should strive to establish your own laboratory at your own institution. And even if it does, some of the work can surely be done at home.

Whether or not you become formally involved in collaborative research, it is essential that you become known within the profession. The best way to advance your reputation is through publication in highly regarded journals. But you should also attend local, regional, national, and—if you have the opportunity—international meetings. Try very hard to give an oral or poster paper at each meeting. Although it can be time-consuming, never pass up an invitation to review a paper or serve on a proposal panel. Remember that in six years, and perhaps as few as three years, your chair or dean will be asking external experts to evaluate your status as a teacher/scholar. You don't want the response to be, "Never heard of him!"

Several resources are available to help new faculty set up their research programs. The Nov 25, 2002, issue of *C&EN* (p 64) describes a three-day training course in laboratory management sponsored by the Howard Hughes Medical Institute and the Burroughs Wellcome Fund for their postdoctoral fellows. If you are in a PUI, take advantage of the organizations that are designed to support people like you. Two of the most useful are the Council for Undergraduate Research (CUR) and Project Kaleidoscope (PKAL). The former publishes a journal, the latter issues periodic reports, and both sponsor conferences and meetings and have rich websites. Many new faculty members are enthusiastic about CUR and PKAL. Finally, many of the symposia organized for ACS national meetings by

the Younger Chemists Committee address career development issues that are of interest to young faculty, postdocs, and graduate students.

Service

You obviously need to be a good, cooperative citizen and do to your share to serve the department and the institution. But of the trio of duties expected of all faculty members, service is the one that is generally viewed as the least important, especially for new appointees. In just about any college or university, you will be advised to start slowly in participating in committees and campus politics. If you are at a research university, the graduate admissions committee is a good place to begin, because it increases your visibility among entering students and gives you an opportunity to look over the crop.

An effective chair will try to protect you from exploitation. This can be a special problem for individuals who belong to groups underrepresented in the faculty. Some departments have few women, underrepresented minorities, and persons with disabilities; people of color are rare in most of them. Consequently, they are greatly in demand to serve on committees and task forces. If you find yourself besieged, learn to say no—politely. But don't decline every time you are asked to do something other than teaching and research. During your pre-tenure years, you need to increase your on-campus visibility, and one way to do so is by gradually increasing your involvement in governance. You will find that most academics have a love–hate relationship with campus governance. They complain bitterly about the time "wasted" in committee meetings, yet they don't trust anyone else to make decisions. Providing academic leadership is an important responsibility of all faculty members. You might even find that you enjoy it and are good at it.

You obviously need to be a good, cooperative citizen and to do your share to serve the department and the institution. But of the trio of duties expected of all faculty members—teaching, research, and service—the latter is generally viewed as the least important for new appointees.

What counts for service varies from campus to campus, and it's a good idea to find out the rules at yours. In some schools the chief emphasis is on institutional service of the sort described in the previous paragraph. Advising students is considered vital service in many four-year colleges, and it can consume a good deal of time. In other colleges and universities, participation in professional societies such as ACS is judged as evidence of service. Still others value volunteer involvement in service clubs, nonprofit organizations, schools, or religious organizations. In any case, one hopes that a person's commitment to aid others and society at large is not motivated primarily by the prospect of a favorable tenure decision.

Coping Strategies

Many new faculty members report that they struggle under high levels of job-related stress. One way to cope is to find a mentor or mentors. Typically, a mentor will be a senior faculty colleague from the chemistry department or elsewhere who takes an interest in you and your career. A formal commitment is not necessary; you just need to identify someone with whom you feel comfortable. Experience with the system is essential; wisdom is nice but a good deal rarer. If you find a colleague you can freely talk with, you can bring him or her your questions about teaching, research, departmental and institutional expectations, balancing the demands of your life, and whatever else is troubling you. An effective mentor will provide information and advice but won't expect you to follow all the suggestions offered.

Some institutions have faculty development offices or teaching and learning centers that serve as matchmakers between mentors and mentees. It might be better to find your own, but realize that such centers can be helpful to all faculty, young or old. Their servic-

es include seminars on teaching strategies, information about granting agencies, and assistance in preparing proposals. Take advantage of these resources.

One of the greatest benefits of an academic career is the friendship of stimulating colleagues in a variety of disciplines, even including friends in other institutions, as Shelli McAlpine points out (see p 57). A support group of other recently appointed professors can be extremely helpful. You are all more or less in the same boat, and an important survival strategy is to get together periodically to question the navigation system, complain about the captain, and worry about the lifeboats. It may keep you from jumping overboard. You can share not only ideas, but pizza, beer, childcare, and the periodic moving of personal effects. And don't forget to keep in contact with your friends from graduate school and elsewhere.

Among other things, you and your colleagues probably face similar challenges of balancing the demands of job, family, and friends. Ironically, the balancing act is particularly difficult when you love your job about as much as you love your family. If you don't give a damn about your job, there's no contest. You won't be tempted to work until midnight every night, seven days a week. You also don't belong in the academy. "Type A" personalities and workaholics have gotten a bum rap lately. People who are obsessed with their work are the ones who often accomplish great things. The admonition "Get a life!" fails to recognize that work should be an important part of a rich and full life. There is no need to feel guilty about enjoying your job and the time you spend at it. Likewise, there is also no reason to feel guilty about spending Sunday afternoon with your kids. You need to find a set of equilibrium conditions that are appropriate for you and the people you care about. But don't forget that even a system in equilibrium readjusts in response to various perturbations.

People who are obsessed with their work are the ones who often accomplish great things. The admonition "Get a life!" fails to recognize that work should be an important part of a rich and full life.

Although advances have been made recently in reducing gender inequalities, some biological facts cannot be altered. Mothers not only bear and nourish their children, they often play the major role in nurturing them. Colleges and universities have not always been supportive of the special needs of female faculty with children, but on-campus childcare is sometimes available. The experience, example, and advice of other professional women can help those who seek to balance an academic appointment with motherhood. Moreover, as you will see in the next section, options are sometimes available on the path toward tenure.

Working Toward Tenure

Tenure seems to be an employment arrangement that is unique to the academic sector. This is not the place to discuss its historical origins or its strengths and weaknesses. The fact is that most institutions of higher education operate under a tenure system. The major exception is some two-year colleges, which offer a series of renewable term appointments of three to five years, sometimes increasing in length with time of service. Because tenure is so common and in a way represents the final stage in an academic job quest, it is appropriate to offer a few suggestions on how to attain this ideal state. Some of these ideas may also apply to earning renewed appointments in community colleges.

In many ways, your provisional appointment is a period of preparation and a testing ground for the ultimate tenure decision. The first checkpoint on that trajectory often occurs in the third year. At that point, many institutions require faculty members to go through a review, which can range from a strictly internal assessment to a mini-tenure trial. It goes without saying that you should be well informed and well prepared, with the necessary documentation at hand. This will include at least an updated CV and copies of your published papers, grant proposals, course syllabi, and student evaluations. You may also be asked to recommend external evaluators who know your work, and your chair may

Joy, and Pain: The Life of an Assistant Professor

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Being an assistant professor is rough—for anyone! There's no way around it. Conducting an academic job search; balancing (or juggling as the case may be) research, teaching, and service; navigating the tenure process…these are no simple tasks. And for minorities, all of the challenges above apply, plus more. But hear me out: While the challenges facing underrepresented minorities entering academe are unique, the rewards can also be uniquely fulfilling, even greater than those offered in either industry or government.

How have I come to this conclusion? Well, let's start at the beginning, or nearly the beginning, of my experiences. When I was a premedical and chemistry major at Southern University and A&M College—an HBCU (Historically Black College or University)—in Baton Rouge, LA, my goal was to become an emergency room physician. The television show ER *had just debuted, and I had done paramedic ride-alongs as an Explorer through the Boy Scouts. (Yes, the Boy Scouts!) I was convinced that the adrenaline rush of emergency medicine was for me. However, by senior year I had come to the realization that I wasn't very passionate about medical school. I thought I could be relatively successful, but I just wasn't as thrilled about the prospect as some of my colleagues. After commencement, I had a degree but neither a job nor any immediate plans. I had done several internships in industry and enjoyed them, so I called one of these companies and went to work as a contract chemist. Fortunately for me, many of the scientists there knew me well from my internship, and they also knew that I was considering going to graduate school. As a result, I was treated a bit differently from the other B.S.-level chemists. My supervisor provided an opportunity to work fairly independently in a research lab, revising a biocide synthesis for scale-up for the pilot plant. Because I had plenty of friends who were B.S.-level chemists and worked as technicians in industry, I knew my independence wouldn't last for long unless I got a graduate degree.*

After weighing all the options, I soon enrolled in Louisiana State University's doctoral program in chemistry. I was a "B" student as an undergrad but had always scored well on standardized tests (including the GRE), and I received a prestigious Board of Regents graduate fellowship. Even so, I was intimidated. Having graduated from a small school, I had the perception that my peers were both smarter and better trained. Exceptional mentoring by my adviser got me past a rough start, and I soon remembered the thrill of science and the profession of chemistry. I also fell in love with the challenges of research in microfluidics, an emerging technology.

Soon, commencement was drawing near. Again, I had to contemplate my future. I had doubts about industry after experiencing it firsthand and talked with my adviser about my budding aspirations for the professoriate. In return, he gave me leadership roles within our large research group, responsibility for directing an undergraduate student's research during the academic year, and mentoring opportunities with summer students. My adviser also began sharing tips and insights about writing grant proposals. Around this time, I was selected to serve on the search committee for a vice chancellor. That eye-opening experience really helped solidify my plans. Even so, I kept an open mind,

and at graduation I received an offer in industry as well as others for postdocs in academe and government.

I decided to accept a National Research Council (NRC) Postdoctoral Fellowship at the National Institute of Standards and Technology (NIST). A good friend who had also been an NRC fellow at NIST recommended it as a good experience. While there, I wanted to remain flexible and explore all the possibilities. A once-in-a-lifetime opportunity emerged during my tenure at NIST that allowed me to serve for a week as a U.S. delegate to the meeting of Nobel laureates in Lindau, Germany. Interacting with the laureates was wonderful, as was the opportunity to form a network with other young scientists, many of whom were considering academe. I also made connections around the DC area and gained wonderful friends at NIST. As we postdocs individually sought jobs in academe, I became more and more settled upon the professoriate as a career choice. However, many of my experiences during interviews differed a bit from those of my colleagues.

Fast forward a bit and I've completed one year as an assistant professor. Wow! Everything "they" tell you at the workshops is true, and yes, it does apply to you: You learn to go without sleep, you are married to the job, and surprisingly, you come to love it. (Remember my adrenaline addiction?) But, there are also other things they should tell you as widely and as loudly, especially if you are a woman, a minority, or both!

During the job search, pay particular attention to minority hiring initiatives on the campus, diversity programs in the department, tangible commitments to diversity, policies on establishing or maintaining a culturally competent workplace, and support groups for minority faculty, among other considerations. In most cases, particularly at majority institutions (and paradoxically even at others), you will be the only minority or woman in your department, and maybe one of only a handful on the campus. Ask the difficult questions. The institution may not have had any reason to consider these things in the past.

After landing the position, develop effective time-management skills. Really. Although your department will attempt to shield you from overcommitment to service assignments, if you are part of a minority group, it is likely that every diversity program on campus will want and need your contributions. Also, I often receive requests for help from minority students all over campus. These are real people with real problems, and it is nearly impossible to turn them away and sleep well at night. (You're going without sleep anyway, right?) Here are some tips that have helped me manage.

- *Develop a thick skin. My mentor, Dr. Saundra McGuire, advises choosing a gracious perspective. It may not be correct, but it is the healthiest approach.*
- *Attend workshops for minority faculty (GEM, The National Consortium for Graduate Degrees for Minorities in Engineering and Science; QEM, Quality Education for Minorities; SREB's State Doctoral Scholars Program Compact for Faculty Diversity; COACh, Committee on the Advancement of Women Chemists; ACS programs; etc.).*
- *Subscribe to* The Journal of Blacks in Higher Education *or another publication relevant to your minority status.*
- *Learn as much as you can about diversity issues such as institutional invisibility versus hypervisibility, psychological tokenism, and stereotype threats. You may have these experiences, and there is validation in the diagnosis. (Knowing is half the battle.)*
- *Look for allies in unexpected places, and take advantage of all the opportunities you can without stretching yourself too thin. These opportunities allow you to grow and will also be experiences you'll share with your students.*

- *Pace yourself. Have the patience to effect change over time.*

I could continue with specific tips, but each may not be appropriate for your individual case (learn to be situational). The general advice I offer is this. Maintain relationships with others—this includes both mentors and peers (it will definitely help during periods of institutional invisibility). Much of the saving grace for me has been talking to friends who are having the same experiences. You will not be the first to have these experiences, and unfortunately, you are not likely to be the last (possible but not probable).

Finally, serve as a mentor. While you're scheduling your nervous breakdown in Outlook, you'll remember why you're doing what you're doing in the first place. One of the greatest rewards I've experienced this past year was sending one of my undergraduates to NIST for a summer program. Another came from listening to the technical presentations my doctoral students made at the national meeting of an organization that had recognized me during high school for potential in science. In the end, effecting change and making a difference in the lives and careers of future minority scientists will be one of the greatest returns on your investment in academe.

solicit letters of evaluation from colleagues and former students. View the process as practice and preparation for the real thing. But it is also a time for you to ask whether or not the academic life is meeting your expectations. Do you feel that you are performing well in an important undertaking? If not, you should probably look elsewhere. If you survive the third-year review, and chances are that you will, you may be rewarded with a junior sabbatical that gives you a semester's leave to concentrate on your scholarship.

In most institutions, tenure decisions are made during the sixth year of appointment. This is a major step, because in granting tenure, the institution is making a lifelong promise of employment. The ill-defined "they" want to know as much about you as they possibly can before making such a commitment. Your past achievements will be viewed as predictors of your future productivity. But to attain tenure in a research-intensive institution, you will be expected to go well beyond your doctoral and postdoctoral work. You will need to assemble all the materials identified in the previous paragraph, and probably a good deal more. The time to begin building your tenure file is right after your third-year review. You no doubt will receive an evaluation as part of that review process. Study this with your mentor, and review your strengths and weaknesses. Determine any areas that require reinforcement or improvement, and develop a plan to achieve those ends. Set up a series of specific benchmarks against which you can measure your progress. For example, you might set goals such as revising an existing course or devising a new one, finishing two research papers, making a presentation at the next national ACS meeting, or submitting a new research proposal to a funding agency.

Maintain an updated list of your various accomplishments in scholarship, teaching, and service, and keep your student evaluations. Your department or institution may require an annual addendum to your personnel record, but if not, prepare one anyway. Present yourself in the best possible light, but be scrupulously honest and avoid padding. Your mentor can be of particular assistance here. Another useful document, also required by some colleges and universities, is the personal development plan, in which you describe your goals for the next year (or two or three). You update this periodically as you meet your goals and develop new ones. Teaching portfolios also provide documentation of your accomplishments. Annual addenda, personal development plans, or teaching portfolios—whatever is prevalent at your institution—should be part of your tenure file. For tenure decisions, external evaluations are almost always solicited, and the extent to which the candidate has access to these letters varies.

The details of the tenure process also vary widely, but in most colleges and universities, decisions are made at both the departmental and institutional levels. Committees and administrators are involved, and positive departmental recommendations can be overturned at a subsequent level. Even negative departmental recommendations are sometimes reversed, although this is unusual. Typically, positive tenure recommendations by the final campus authority are formally endorsed by the board of trustees or another governing body. Appeal of a negative decision is possible but commonly only on procedural grounds. Such action is almost always messy and divisive.

If the system works as it should, no special effort should be required for tenure. It should be a reward for doing what is expected. A source of anxiety for many young faculty is uncertainty over what those expectations are. Find out as much as you can, but it is unlikely that you will be able to find a tenure formula that applies at your college or university. That's probably fortunate. Imagine what the formula would look like: a string of variables such as number of courses taught, books published, papers published, and conference presentations; dollar value of research grants; average student evaluation score; hours of committee service per week; etc.—each variable multiplied by a coefficient

appropriate to the institution. And that's assuming a linear function; maybe Veritas College uses a power series. It's enough to make a P-chemist quake! The point is that a fair evaluation of a faculty member's achievements and potential must consider quality as well as quantity, and every case must be judged on its own merits.

You should recognize that circumstances may support a request to adjust the normal six-year tenure clock. If you come in with previous faculty experience, you may be able to negotiate an early tenure decision. This could put you at a disadvantage, because you will have less time to amass a research and teaching record at the institution. However, if your past accomplishments are sufficiently strong, this should present no serious handicap. At the other extreme, the probationary period may be extended if events have slowed your normal rate of professional progress. This could happen if you arrived without a completed dissertation, took a leave of absence for health reasons, or took parenting leave. Some women have complained that even requesting maternity leave, let alone a delay of the tenure decision, can be taken as evidence of a lack of academic dedication. If the provision is available, taking advantage of it should not disadvantage the candidate.

Finally, this is probably the place to disclose the existence of a hidden variable, a fourth criterion that extends the teaching–research–service phase diagram in another dimension: collegiality. Few colleges or universities admit that it is a consideration, yet the ability to get along well with colleagues is a significant predictor of future contributions. Selfish individuals, unwilling to cooperate and compromise, can poison a department. Your "fit" will be considered—consciously or unconsciously. But fit cannot and must not mean homogeneity with respect to race, ethnicity, gender, sexual orientation, religion, politics, or philosophy. If you think that you have been subjected to such discrimination, you owe it to yourself and to others to take legal action or bail out. Similarly, harassment of any sort should not be tolerated.

In summary, the best preparation for gaining tenure is simply doing the best job you can as a teacher, researcher, and contributing member of the academic community. If you are aware of your strengths and weaknesses relative to the values of the institution, the decision, favorable or not, should not come as a surprise. Let us assume that it is favorable, as it was in the case of Jason Cody, who provides our last statement from the field (see p 72). Welcome! You are a tenured associate professor, a permanent member of this immortal profession. And now your work *really* begins—but that's the subject for another book.

Continuing the Tradition: A PFF Success Story

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When I graduated from a small, liberal arts college and headed off to graduate school, my hope was to get a Ph.D. and return to a small campus to pass on my enthusiasm for chemistry. My relationships with professors drew me to chemistry; I wanted to inspire others in the same way. To my delight, I now teach at a small college, engage undergraduates in my funded and published research program, and have acquired laboratory instrumentation that astounds some of my colleagues at larger schools. I helped direct my path by making several crucial decisions along the way.

The first major step I made toward the professoriate was to tell my adviser that my goal was to teach and do research at a small college. This simple admission was terrifying. Looking back, I think I was able to do this because the situation was relaxed (we were riding on a commuter train with our spouses) and because my wife was there, to affirm my enthusiasm. Because I took the plunge early and confessed my aspirations, my adviser was willing to support, under time constraints, my involvement in the Preparing Future Faculty program later. If I hadn't been so forthright early on, I might have been denied the chance to explore the academy as a career. Although he still thinks I sold myself short by not choosing a larger research university as an employer, he honors my successes and always asks me about my career and research.

I first learned about the triune expectations of the academy—teaching, scholarship, and service as a PFF fellow in my third year of graduate school. Naming and discussing these career components with effective, mature practitioners helped me dive into my first job with my eyes wide open. My PFF mentor and I spoke frankly about textbooks, departmental and institutional dynamics, and new pedagogical approaches. More importantly, I was able to get direct criticism about my teaching. Usually classroom observation is evaluative; with my mentor, it was purely constructive. During my one week in charge of his classroom, I took two major detours from my carefully written lecture notes. I was scared yet invigorated in front of the class. I knew that as I relaxed into teaching, I would have to address my tendency to stray from my notes.

Also in my third year of graduate school, I turned a degree requirement into an exercise in preparation for work at a small college. My task was to prepare and defend an original research proposal. I intentionally chose a project that would use the instrumentation that would be available at most four-year colleges. I specifically avoided the highly competitive areas of research that would require large research budgets and many workers. As a result, I was able to articulate during my interviews my desire to be at a small school and my understanding of some of the limits on the types of research that can be explored in that setting.

Immediately after completion of my dissertation, I found a one-year sabbatical replacement position at a nearby small college. As soon as I was hired, I asked my dean to appoint me to a faculty committee. Although many faculty members shun committee work, I wanted to experience the service part of the job firsthand. I also knew that during future interviews for tenure-track positions I would be able to demonstrate how I fully understood the requirements of the job.

My first year of teaching was both exhausting and invigorating. Because of the temporary nature of my appointment, I sought to fit into the department. I especially tried to match the academic expectations of the other professors; I did this through several short meetings with the chair of the department each week. I asked for input on quiz averages, amount of homework, etc. In short, I tried to learn as much as I could during that first year. After about two months of classroom teaching, I was the professor, not just playing the role of the professor.

Next came my research postdoctoral year. True to my liberal arts background, I wanted this opportunity to be mind-broadening. I spent one year working in a laboratory in Nantes, France. During my undergraduate years, I had passed up the opportunity to study abroad because of the course (laboratory) demands of my chemistry major. I made the opportunity for myself after graduate school. My fellowship included travel money for a return interview trip. Three weeks and seven interviews later, I had several job offers to choose from. During one interview lecture, I once again detoured from my notes (I didn't get that job offer). I realized from my campus visits that the opportunities for research at seemingly comparable schools could differ greatly. I weighed my job offers on what was actually available, not what was promised by administrators to be in place before I would arrive. Then, I used some time during the remainder of my postdoctoral year to polish my research proposal for submission to several funding agencies.

I was able to start my tenure-track position with a pedagogical experiment: My introductory chemistry course was largely problem-based, with only a few minutes of lecture each day. The chair of the department suggested I try this approach since I already had some experience in front of the classroom and would be paired up with another young professor who was teaching the other section of the course and was also willing to try the experiment. My colleague and I checked each other; we caught wrong assumptions and quiz problems that were too challenging. Together we made far fewer mistakes than either of us would have made alone. This problem-based approach gave me a way to teach that didn't require me to carefully stick to my notes!

My research got off to a slow start. By nature, I am a frugal person. In my laboratory, I spent a great deal of time trying to make do with equipment that wasn't quite right but was already available rather than purchasing new things. Ironically, although my start-up package was very modest, I had more money than time. By the third summer of research, I was much more willing to spend money. This was helped by the ultimate successes of my resubmitted proposals and by the realization that time was my limiting quantity.

During my first few years of research, I had no results to present at scientific meetings. I went to them anyhow. I used my college travel allowance to go listen to current research, meet people from other small schools who were succeeding, and recharge my enthusiasm for chemistry. Although I was tempted to rationalize that I would be better off by spending the time in my laboratory, I knew that I needed to stay connected to friends from graduate school and my community of researchers. As the only inorganic chemist at my college, I might have felt isolated. Ultimately, my friends and professional contacts fostered at meetings enabled me to acquire the used instrumentation that I need for my research.

Now that my research is more productive, I take my students with me to meetings so that they can see the larger community of chemistry. The relationships that form the fabric of a small college are what drew me to this career, and it is an honor for me to continue the tradition.

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Colleges and Universities in the United States

The Carnegie Classification of Institutions of Higher Education (2000 Edition). Menlo Park, CA: The Carnegie Foundation for the Advancement of Teaching (2000). This material explains the 2000 Carnegie Foundation classification system of higher education institutions. Available as a PDF file at http://www.carnegiefoundation.org/Classification/index.htm

Mike Conlon maintains a site that provides links to the home pages of colleges and universities in the United States. The list is comprehensive and lists schools alphabetically: http://www.clas.ufl.edu/CLAS/american-universities.html

Maricopa Community College District maintains a site that provides links to the home pages of community colleges in the United States. Schools can be found using a search engine: http://www.mcli.dist.maricopa.edu/cc/

The University of Texas at Austin website contains lists of colleges, community colleges, and universities in the United States. The lists can be accessed by state or alphabetically: http://www.utexas.edu/world/univ/

Demographic and Salary Information

The Chronicle of Higher Education's Almanac. Provides statistical information on institutions, faculty, staff, administration, and students: http://chronicle.com/stats/archive/almanac.htm (a subscription may be needed to view some of the information).

The Chronicle of Higher Education provides statistical information on academic institutions: http://chronicle.com/stats/institutions.htm (a subscription may be needed to view some of the information).

The Chronicle of Higher Education provides statistical information about faculty and staff: http://chronicle.com/stats/faculty.htm (a subscription may be needed to view some of the information).

The Chronicle of Higher Education provides statistical information about students: http://chronicle.com/stats/students.htm (a subscription may be needed to view some of the information).

The Chronicle of Higher Education provides statistical information about scholarly research: http://chronicle.com/stats/scholarly.htm (a subscription may be needed to view some of the information).

The Chronicle of Higher Education provides a searchable database of faculty salaries for the 2000–2001 school year: http://chronicle.com/stats/aaup/2002/

What Professors Earn. By *The Chronicle of Higher Education* (2002) An article that uses tables and graphs to summarize the findings by the American Association of University Professors on the salaries of professors: http://chronicle.com/free/v48/i32/4832aaup.htm

Professional Organizations for Colleges and Universities

The Association of American Universities (AAU) is a professional organization that deals with the issues and concerns of "research-intensive" universities: http://www.aau.edu/

The Association of American Colleges and Universities (AAC&U) is a professional organization dedicated to the issues and concerns of liberal education. Includes both public and private schools (both 2-year and 4-year institutions): http://www.aacu-edu.org/

The American Council on Education (ACE) is a professional organization that includes all types of colleges and universities: http://www.acenet.edu/

The American Association of State Colleges and Universities (AASCU) is a professional organization devoted to the issues concerning all types of 4-year public institutions: http://www.aascu.org/

The National Association of Independent Colleges and Universities (NAICU) is a professional organization dedicated to the issues concerning all types of private institutions (ranging from research universities to women's colleges): http://www.naicu.edu/

The American Association of Community Colleges (AACC) is a professional organization dedicated to the needs and issues of 2-year institutions: http://www.aacc.nche.edu/

The Council of Graduate Schools (CGS) is a professional organization "dedicated to the improvement and advancement of graduate education": http://www.cgsnet.org/

Preparing for an Academic Career

General

Tomorrow's Professor: Preparing for Academic Careers in Science and Engineering. By Richard M. Reis. New York: Wiley-IEEE Press (1997).*

Tomorrow's Professor Listserv provides postings on higher education: http://sll.stanford.edu/projects/tomprof/newtomprof/

To sign up for the Listserv of Tomorrow's Professor: http://sll.stanford.edu/projects/tomprof/newtomprof/#Anchor-HOW-46919

How to Get All-Important Teaching Experience. By Richard M. Reis. July 21, 2000, in *The Chronicle of Higher Education Career Network Catalyst:* http://chronicle.com/jobs/2000/07/2000072102c.htm

A Ph.D. Is Not Enough: A Guide to Survival in Science. By Peter J. Feibelman. Reading, MA: Addison-Wesley (1993).

Cracking the Academia Nut: A Guide to Preparing for Your Academic Career. By Margaret Newhouse. Cambridge, MA: Harvard University Press (1997).

The New Professor's Handbook: A Guide to Teaching and Research in Engineering and Science. By Cliff I. Davidson, Susan A. Ambrose. Bolton, MA: Anker Pub. Co. (1994).

Scholarly Pursuits: A Practical Guide to the Academe (4th Edition). By C. Verba. Cambridge, MA: Harvard Graduate School of Arts and Sciences (1997).

Successful College Teaching: Problem-Solving Strategies of Distinguished Professors. By Sharon A. Baiocco, Jamie N. De Waters. Boston, MA: Allyn and Bacon (1998). Chapter 10 has practical advice for the common problems teaching assistants are faced with.

The Chicago Guide to Your Academic Career: A Portable Mentor for Scholars from Graduate School Through Tenure. By John A. Goldsmith, John Komlos, Penny Schine Gold. Chicago, IL: University of Chicago Press (2001).

The Preparing Future Faculty Program

Home page of the Preparing Future Faculty (PFF) Program: http://www.preparing-faculty.org/PFFWeb.Contents.htm

List of online resources compiled by the PFF Program: http://www.preparing-faculty.org/PFFWeb.Resources.htm

The American Chemical Society's website on preparing future chemistry faculty: http://www.acs.org/portal/Chemistry?PID=acsdisplay.html&DOC=education%5Cstudent%5Cpffweb.html

Building the Faculty We Need: Colleges and Universities Working Together. By Jerry Gaff, Anne S. Pruitt-Logan, Richard A. Weibl, and participants in the Preparing Future Faculty Program. AAC&U Publishers (2000). To order, visit http://www.aacu-edu.org/publications/index.cfm

The Association of American Colleges and Universities (AAC&U) publication *Liberal Education*, Vol. 88, No. 3, Summer 2002, is a special issue dedicated to the Preparing Future Faculty program. Available at http://www.aacu-edu.org/liberaleducation/index.cfm

Other

Science maintains dedicated to the issues and career needs specific to postdocs http://nextwave.sciencemag.org/pdn/

Minorty Scientist Network is concerned with the needs of minority students, specifically "the education of underrepresented minority students at the undergraduate level and encouraging those students to make the transition into graduate education": http://nextwave.sciencemag.org/miscinet/

Black Issues in Higher Education is a bimonthly newsmagazine dedicated to minority issues: http://www.blackissues.com

The Younger Chemists Committee of the American Chemical Society provides virtual mentoring: http://membership.acs.org/scripts/Y/YCC/oneonone/oneonone-mentors.asp

Ph.D. Resources is maintained by the Re-envisioning the Ph.D. Project of the University of Washington, Seattle, WA. This site includes links for many resources that will help Ph.D. students during their graduate experience (from qualifying exams to teaching) and during their job searching (from writing CVs to job postings): http://www.grad.washington.edu/envision/phd/index.html*

Seeking an Academic Position

General

So You Want to Be a Professor? A Handbook for Graduate Students. By P. Aarne Vesilind. Thousand Oaks, CA: Sage Publications (2000).*

University Teaching: A Guide for Graduate Students. By Leo Lambert, Stacey Tice, Patricia Featherston. Syracuse, NY: Syracuse University Press (1995).

The Academic Job Search Handbook (3rd Edition). By Mary Morris Heiberger, Julia Miller Vick. PA: University of Pennsylvania Press (2001).*

On the Market: Surviving the Academic Job Search. Edited by Christina Boufis, Victoria A. Olsen. New York: Riverhead Books (1997).

Put Your Science to Work: The Take-Charge Career Guide for Scientists. By Peter S. Fiske. Washington, DC: American Geological Union (2001).

Getting an Academic Job. By Jennie Jacobs Kronenfeld, Marcia Lynn Whicker. Thousand Oaks, CA: Sage Publications (1997).

How to Succeed in Academics (Successful Career Management). By Linda L. McCabe, Edward R. B. McCabe. San Diego, CA: Academic (2000).

What a Ph.D. Chemist Should Consider Before Accepting an Academic Position. PDF file is available from the American Chemical Society's Career Services: http://www.chemistry.org/portal/resources?id=c60bb4ba95a111d6fed44fd8fe800100

How To Get a Tenure-Track Position at a Predominantly Undergraduate Institution. Provided by the Council on Undergraduate Research. Available at http://www.cur.org/publications.html

Landing an Academic Job: The Process and the Pitfalls. By Jonathan A. Dantzig of the Department of Mechanical and Industrial Engineering at the University of Illinois at Urbana–Champaign: http://quattro.me.uiuc.edu/~jon/ACAJOB/Latex2e/academic_job/academic_job.html

Job Postings

Academic360.com is a meta-collection of Internet resources that have been gathered for the academic job hunter. It includes links to faculty, staff, and administrative announcements: http://www.academic360.com/

Academic360.com also provides convenient links to all of the U.S. national laboratories' job postings sites. The U.S. national laboratories often have quite a number of postdoctoral positions available: http://www.academic360.com/faculty/science.html

The Academic Employment Network is a website that lists available positions: http://www.academploy.com/

The Academic Position Network also provides job listings: http://www.apnjobs.com/

For a comprehensive list of job postings provided by *The Chronicle of Higher Education Career Network:* http://chronicle.com/jobs/

For a comprehensive list of job postings provided by Black Issues in Higher Education: (a subscription is required) http://www.blackissues.com

Chemical & Engineering News Classifieds contains job postings: http://pubs.acs.org/cen/cenwelcomepage.html

The American Chemical Society's online career source includes job postings and resources: http://pubs.acs.org/chemjobs

The American Chemical Society's Career Services provides additional resources and career information: http://www.chemistry.org/portal/Chemistry?PID=career.html&DOC=careers\index.html

The Next Wave site, maintained by *Science,* has information on career development, job postings, grants, and more (a subscription to *Science* is necessary for access): http://nextwave.sciencemag.org/index.dtl

The Preparing Future Faculty website has links helpful to job seekers: http://www.preparing-faculty.org/PFFWeb.Resources.htm#career

The Camille and Henry Dreyfus Foundation, Inc., has postdoctoral programs: http://www.dreyfus.org/

CVs, Portfolios, Teaching Philosophy, Research Proposals, and Interviewing

CVs

The Curriculum Vitae Handbook: Using Your CV to Present and Promote Your Academic Career. By Rebecca Anthony, Gerald Roe. Iowa City, IA: Rudi Pub. (1994).

The CV Doctor. By Mary Heiberger, Julia Miller Vick. Sept 17, 1999, in *The Chronicle of Higher Education.* It provides good advice for preparing a CV and analyzes some samples: http://chronicle.com/jobs/99/09/99091701c.htm

Jobstar.org contains general information on CVs as well as links to samples and other sites on how to write a CV: http://jobstar.org/tools/resume/res-cv.cfm

Tips on Writing a Curriculum Vitae. By the Department of Career Services of the American Chemical Society: http://chemistry.org/portal/servlet/resources/org/chemistry/avercom/display/ContentRetrievalServlet/ACS/ACSContent/careers/ACS_Vitae.pdf

The Basics of Science C.V.'s. By Richard M. Reis. March 31, 2000, in *The Chronicle of Higher Education Career Network Catalyst:* http://chronicle.com/jobs/2000/03/2000033102c.htm

Cover Letters

201 Dynamite Job Search Letters (3rd Edition). By Ronald L. Krannich, Caryl Rae Krannich. Manassas Park, VA: Impact Publications (1997).

The Basics of Cover Letter Writing. By Richard M. Reis. March 3, 2000, in *The Chronicle of Higher Education Career Network Catalyst:* http://chronicle.com/jobs/2000/03/2000030302c.htm

How to Write Appealing Cover Letters. By Mary Morris Heiberger, Julia Miller Vick. April 21, 2000, in *The Chronicle of Higher Education Career Network* Career Talk Column: http://chronicle.com/jobs/2000/04/2000042101c.htm

Portfolios

Successful Use of Teaching Portfolios. By Peter Seldin & Associates. Bolton, MA: Anker Publishing (1993).

The Teaching Portfolio: Capturing the Scholarship of Teaching. Russell Edgerton, Patricia Hutchings, Kathleen Quinlan. Washington, DC: American Association for Higher Education (1991).

Preparing a Teaching Portfolio. By Fran Mues and Mary Dean Sorcinelli at the Center for Teaching at the University of Massachusetts, Amherst (2000): http://www.umass.edu/cft/publications/teaching%20portfolio.pdf

The Center for Teaching Excellence at Iowa State University, maintains a site of that outlines what material should be included in a teaching portfolio: http://www.cte.iastate.edu/portfolio/contents.html

The Center for Effective Teaching and Learning at the University of Texas at El Paso website contains tools on how to develop and assess a teaching portfolio and includes samples of portfolios (with teaching philosophies!): http://www.utep.edu/cetal/portfoli/

By the Center for Instructional Development and Research at the University of Washington website includes guidelines, links to other sites, and a list of books about teaching portfolios: http://depts.washington.edu/cidrweb/PortfolioTools.htm

The Center for Instructional Development and Research at the University of Washington website includes details of what you might put in your teaching portfolio: http://depts.washington.edu/cidrweb/TeachingPortfolioPage5.html

Teaching Philosophy

Writing a Teaching Philosophy. By Lee Haugen at the Center for Teaching Excellence, Iowa State University (1998): http://www.cte.iastate.edu/tips/philosophy.html

Tips on how to write a teaching philosophy by the Center for Effective Teaching and Learning are posted on the University of Texas at El Paso website http://www.utep.edu/~cetal/portfoli/writetps.htm

More tips on how to write a teaching philosophy as well as items to include in a teaching portfolio are posted onthe site of the Center for Instructional Development and Research at the University of Washington: http://depts.washington.edu/cidrweb/PortfolioTips.htm

Answers to commonly asked questions about a teaching philosophy are posted on a site run by the Office of Instructional Consultation—TA Development Program at the University of California at Santa Barbara: http://www.id.ucsb.edu/IC/TA/port-FAQ.html

How to Write a Teaching Philosophy for Academic Employment. Provided by the American Chemical Society's Career Services: http://www.chemistry.org/portal/servlet/resources/org/chemistry/avercom/display/ContentRetrievalServlet/ACS/ACSContent/careers/empres/careers_academicnews.pdf*

Research Proposals

General information about what to include in a research proposal is posted on non-discipline-specific site created by C. Sandra Jamieson, Drew University: http://users.drew.edu/~sjamieso/research_proposal.html

Interviewing

101 Great Answers to the Toughest Interview Questions (3rd Edition). By Ronald W. Fry. Franklin Lakes, NJ: Career Press (1996).*

Ph.D. Interview Preparation Guide for Positions in Academia. By Trina Sego and Jef I. Richards of the University of Texas at Austin. This site tells you what the faculty is generally looking for in a candidate, what to expect in the interview process, and how to prepare and gives sample questions that you should be prepared to answer as well as ask:
http://advertising.utexas.edu/JR/InterviewPrep.html

The American Chemical Society's Interview Handbook:
http://www.chemistry.org/portal/servlet/resources/org/chemistry/avercom/display/ContentRetrievalServlet/ACS/ACSContent/careers/empres/interview99.pdf

Giving a Job Talk in the Sciences. By Richard M. Reis. March 30, 2001, in *The Chronicle of Higher Education Career Network Catalyst:* http://chronicle.com/jobs/2001/03/2001033002c.htm

The Job Offer

The Right Start-Up Package for Beginning Science Professors. By Richard M. Reis. Aug. 27, 1999, in *The Chronicle of Higher Education Career Network Catalyst:*
http://chronicle.com/jobs/99/08/99082702c.htm

Keeping an Academic Position

General

Methods of Effective Teaching and Course Management for University and College Science Teachers. By Eleanor D. Siebert, Mario W. Caprio, Carri M. Lyda. Dubuque, IA: Kendall/Hunt Publishing Company (1997).

McKeachie's Teaching Tips: Strategies, Research, and Theory for College and University Teachers (10th Edition). By Wilbert J. McKeachie. Boston, MA: Houghton Mifflin Co. (1999).*

Teaching Tips for College and University Instructors: A Practical Guide. By David Royse. Boston, MA: Allyn and Bacon (2001).*

Tools for Teaching. By Barbara Gross Davis. San Francisco, CA: Jossey-Bass Publishers (1993).

The Courage to Teach: Exploring the Inner Landscape of a Teacher's Life. By Parker J. Palmer. San Francisco, CA: Jossey-Bass Publishers (1998).

The Courage to Teach: A Guide for Reflection and Renewal. By Rachel C. Livsey. San Francisco, CA: Jossey-Bass Publishers (1999).

Mentor in a Manual: Climbing the Academic Ladder to Tenure (2nd Edition). By A. Clay Schoenfeld, Robert Magnan. Madison, WI: Atwood Publications (1994).

Getting Tenure. By Marcia Lynn Whicker, Jennie Jacobs Kronenfeld, Ruth Ann Strickland. Newbury Park, CA: Sage Publications (1993).

Teaching within the Rhythms of the Semester. By Donna Killian Duffy, Janet Wright Jones. San Francisco, CA: Jossey-Bass Publishers (1995).

Making the Most of College: Students Speak Their Minds. By Richard J. Light. Cambridge, MA.: Harvard University Press (2001).*

The Chicago Handbook for Teachers: A Practical Guide to the College Classroom. By Alan Brinkley. Chicago, IL: University of Chicago Press (1999).

Teaching and Learning in College: A Resource for Educators (4th Edition). Edited by Gary S. Wheeler. Elyria, OH: Info-Tec (2002).

A Handbook for Adjunct/Part-Time Faculty and Teachers of Adults (4th Edition). By Donald Greive. Elyria, OH: Info-Tec (2002).

Teaching Strategies and Techniques for Adjunct Faculty (4th Edition). By Donald Greive. Elyria, OH: Info-Tec (2002).

Handbook II: Advanced Teaching Strategies for Adjunct and Part-Time Faculty. By Donald Greive. Elyria, OH: Info-Tec (2002).

A Guide to Classroom Instruction for Adjunct Faculty. By John H. Reed. Washington, DC: American Chemical Society (2002).

Science Teaching Reconsidered: A Handbook. Prepared by the Committee on Undergraduate Science Education. Washington, DC: National Academy Press (1997). Can be previewed at http://books.nap.edu/books/0309054982/html/9.html#pagetop

The National Teaching and Learning Forum. By James Rhem. Oryx Press: http://www.ntlf.com

Teaching from the Heart: Seasons of Renewal in a Teacher's Life. By Parker J. Palmer. Written and produced by Patrick O'Donnell and Joey Easton O'Donnell; produced by Global Village Communications. San Francisco, CA: Jossey-Bass Publishers (1999). 1 videocassette (33 min): sd., col.; 1/2 in. VHS.

Grant Writing/Guidelines/Sources

I'll Grant You That: A Step-By-Step Guide to Finding Funds, Designing Winning Projects, and Writing Powerful Proposals. By Jim Burke, Carol Ann Prater. Portsmouth, NH: Heinemann (2000).

Winning Grants Step by Step. By Mim Carlson. San Francisco, CA: Jossey-Bass Publishers (1995).

At the Helm: A Laboratory Navigator. By Kathy Barker. Plainview, NY: Cold Spring Harbor Laboratory Press (2002).

The National Science Foundation's overview of funding opportunities is posted online: http://www.nsf.gov/home/grants.htm

The Camille and Henry Dreyfus Foundation, Inc., has funding opportunities for new faculty members: http://www.dreyfus.org/

The National Institutes of Health (NIH) has funding opportunities: http://grants.nih.gov/grants/index.cfm

The Research Corporation: http://www.rescorp.org/

The Petroleum Research Fund (PRF): http://chemistry.org/portal/Chemistry?PID=acsdisplay.html&DOC=prf\index.html

The Council on Undergraduate Research (CUR) provides grant information as well as general information useful for people at or planning to teach at undergraduate institutions: http://www.cur.org/

Community on Science is a great place to search for funding opportunities: http://www.cos.com/

A database of grants and funding opportunities: http://www.grantsnet.com/search/srch_menu.cfm

Proposal Writer's Guide. By Don Thackrey of the University of Michigan. "This Guide is intended for faculty and staff members with little or no experience in writing proposals for sponsored activities": http://www.research.umich.edu/proposals/PWG/pwgcomplete.html or http://www.research.umich.edu/proposals/PWG/pwgcontents.html

Writing Research Proposals to the National Science Foundation. By Susan Finger at Carnegie Mellon University. Includes writing tips and guidelines: http://www-2.cs.cmu.edu/~sfinger/advice/proposal.advice.pdf

How To Develop and Administer Institutional Undergraduate Research Programs. Provided by the Council on Undergraduate Research. Available at http://www.cur.org/publications.html

How To Get Started in Research. Provided by the Council on Undergraduate Research. Available at http://www.cur.org/publications.html

How To Mentor Undergraduate Researchers. Provided by the Council on Undergraduate Research. Available at http://www.cur.org/publications.html

Online Teaching

Building Learning Communities in Cyberspace: Effective Strategies for the Online Classroom. By Rena M. Palloff, Keith Pratt. San Francisco, CA: Jossey-Bass Publishers (1999).

Lessons from the Cyberspace Classroom: The Realities of Online Teaching. By Rena M. Palloff, Keith Pratt. San Francisco, CA: Jossey-Bass Publishers (2001).

Assessment Resources

Effective Grading: A Tool for Learning and Assessment. By Barbara E. Fassler Walvoord, Virginia Johnson Anderson. San Francisco, CA: Jossey-Bass Publishers (1998).

Learner-Centered Teaching: Five Key Changes to Practice. By Maryellen G. Weimer. San Francisco, CA: Jossey-Bass Publishers (2002).

Designing and Assessing Courses and Curricula: A Practical Guide. By Robert M. Diamond. San Francisco, CA: Jossey-Bass Publishers (1997).

Building a Scholarship of Assessment. By Trudy W. Banta and Associates. San Francisco, CA: Jossey-Bass Publishers (2002).

They're Not Dumb, They're Different: Stalking the Second Tier. By Sheila Tobias. Tucson, AZ: Research Corporation (1990).

Revitalizing Undergraduate Science: Why Some Things Work and Most Don't. By Sheila Tobias. Tucson, AZ: Research Corporation (1992).

Issues Specific to Large Classes

Teaching Large Classes: Tools and Strategies. By Elisa Carbone. Thousand Oaks, CA: Sage Publications (1998).

Making Large Classes Interactive. By Barbara Walvoord. A production of the Instructional Television Workshop, University of Cincinnati Raymond Walters College Media Services Center. Cincinnati, OH: University of Cincinnati (1995). 1 videocassette (ca. 30 min): sd., col.; in VHS format.

Journals Related to Chemistry/Science Teaching

The Journal of Chemical Education (published by the Division of Chemical Education of the American Chemical Society). The journal "offers articles of interest to teachers of chemistry at all levels, from high school through graduate courses. Articles include reviews of new areas of chemistry, methods for teaching difficult concepts, discussions of learning theory, lecture demonstrations, computer programs, course outlines, and new laboratory experiments": http://jchemed.chem.wisc.edu/

The Chemical Educator (published by Springer) serves as a "reference to current topics, experiments, and teaching methodology" at an "affordable cost": http://link.springer-ny.com/link/service/journals/00897/index.htm

The Chemical Heritage Foundation offers educational resources for teachers to incorporate "historical perspectives into the teaching of the chemical sciences": http://www.chemheritage.org/

The Journal of College Science Teaching (published by the National Science Teachers Association, or NSTA): http://www.nsta.org/journals

The Journal of Research in Science Teaching (published by the National Association for Research in Science Teaching and available through Wiley Interscience or Jossey-Bass) "publishes reports for science education researchers and practitioners on issues of science teaching and learning and science education policy." http://www.josseybass.com/cda/product/0,,TEA,00.html or http://interscience.wiley.com/

The Journal of Engineering Education (published by the American Society for Engineering Education, or ASEE): http://www.asee.org/jeeonline/default.cfm

Chemistry (or Science) Specific

The American Chemical Society: http://www.chemistry.org/portal/Chemistry

The Sheffield Chemdex, a "directory of chemistry on the web," provides links to chemistry departments, companies, compounds/molecules, and more: http://www.chemdex.org/

Science a Go Go promises to "get your brain into gear with the latest science news, offbeat technologies, scientific hot topics, bizarre scientific research, cryptic experimental results, and the liveliest science discussion board on the Internet." http://www.scienceagogo.com/

Other

The American Association of University Professors is an organization whose purpose is to "advance academic freedom and shared governance, to define fundamental professional values and standards for higher education, and to ensure higher education's contribution to the common good." http://www.aaup.org/

Project Kaleidoscope (PKAL) is an organization dedicated to sustaining strong undergraduate programs in the sciences. Some issues PKAL specifically addresses are "the quality of the faculty, the character of the facilities, the design of the curriculum, the shape of the institutional culture, and budgets." It also sponsors meetings and conferences: http://www.pkal.org/

*Particularly recommended