SECOND EDITION

AMERICAN CHEMICAL SOCIETY

GRADUATE SCHOOL Reality Check

- ✔ *Prepare Yourself for the Challenges You Will Likely Face*
- ✔ *Receive Tips and Strategies from Faculty and Graduate Students*
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ACS Chemistry for Life®

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THE MAGAZINE FOR ACS STUDENT MEMBERS

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EDITORIAL: **Preparation for Graduate School Starts *Now***

BY CYNTHIA LARIVE

If you're considering graduate school, there is a lot you can do to ensure your success… and it's never too early to start.

Most important is completing a rigorous undergraduate curriculum, such as one that meets the requirements of an ACS-certified degree. Since chemistry research is becoming increasingly interdisciplinary, taking electives in other scientific areas of interest can be good preparation for interdisciplinary graduate work.

While your B.S. curriculum is likely to be course-intensive, graduate programs, especially those leading to the Ph.D., place less emphasis on courses and more on research. Therefore, completing an undergraduate research experience is excellent preparation. As a researcher, you will learn how chemistry is practiced, experience the challenges of asking scientific questions and designing experiments, and gain important skills and experience working in the lab as part of a research team.

Consider applying to an NSF Research Experience for Undergraduates (REU) program, which offers summer research experiences and provides a stipend that will allow you to live and work at another university in the U.S. or abroad. Alternatively, you could take advantage of summer internship opportunities at a corporate or government lab.

In graduate school you will be expected to give seminar presentations, write papers, and prepare a thesis or dissertation describing your research. Therefore, it's helpful to look for opportunities to hone your communication skills by presenting your undergraduate research results on campus and at regional or national ACS meetings.

Some students have trouble choosing one particular area to focus on in graduate school. To learn more about the different areas of chemistry, attend (or start) a seminar program in which students give presentations on their research or recent literature developments. Reading the scientific literature will also give you a better grasp of modern chemistry and the leading researchers in your field of interest. The ACS Directory of Graduate Research (acs.org/dgrweb) is a great (and free) online tool that can help you find professors working in different areas of chemistry and related fields.

A great opportunity to build leadership and teamwork skills is to become involved in your student chapter and in the ACS. Volunteer or work as a chemistry tutor, or organize a group of students to do chemistry demonstrations at a nearby school.

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All of these activities will help you develop the skills you need to be successful in graduate school and beyond. The sooner you take charge of your own professional development, the better you will ensure your success as a future M.S. or Ph.D. student. iC

Cynthia Larive *is chair of the ACS Committee on Professional Training and professor of chemistry at the University of California Riverside.*

Is Graduate School Right for Me?

BY MATTHEW J. MIO

There are many questions that students considering graduate school in the chemical sciences must ask themselves, but two of the most fundamental are, "Should I go to graduate school?" and, if the answer to that question is yes, "Do I have good reasons for doing so?"

In my experience as an undergraduate academic advisor, it is the first of these questions that stymies students the most, but the second is also critical. This article aims to help students answer both.

Professional vs. graduate degrees

Many undergraduate students who cross paths with the subject of chemistry are interested in earning a professional degree in the health professions. Professional degrees of any sort — including law, business, and architecture — are academic degrees that purposefully prepare the holder to work in a certain profession and stress skills and practical analysis.

Graduate degrees, in contrast, embrace a different educational outlook, and emphasize theory and research – the systematic search for information. Those who wish to earn such degrees are expected to make original contributions to knowledge during their graduate career. This is the core difference between a professional and a graduate degree: one accentuates skill competency, whereas the other stresses research.

Understanding this subtle difference can be difficult in light of modern society's pop culture fascination with the health and legal professions. Although *Grey's Anatomy* and *Damages*-type dramas abound, there have been very few TV shows about chemists (one telling exception is *Breaking Bad*!). Yet, this differentiation is at the very heart of answering the first question posed above: "Should I go to graduate school?"

I believe performing research at the undergraduate level is the single greatest factor in a student's educational maturation. Why? Those who engage in undergraduate research find out very quickly if they enjoy the discovery aspect of chemistry; in addition, the presentation aspect of research can develop writing, speaking, and critical thinking abilities. Having research experience is one way undergraduates can distinguish themselves from the pool of applicants with similar GPAs when it comes to applying for graduate school and professional employment positions. Remember that "systematic search for information" mentioned above? Certainly you've heard this definition before — it's science!

The engine of graduate study is research, and that engine is put together with the gears of science. Experimenting with undergraduate research can help you assess your interests and commitment to science. Of course, it's also OK to find out that you do not have a strong interest in laboratory work.

Undergraduate research experiences, even if negative, are significant factors to consider when making decisions about your future. Research is a major component of graduate school and in entry-level research and development (R&D) positions in industry. In industry, after you have a few years of experience, if you wish to branch out to new areas, there are many other paths that you can take that do not involve laboratory work. You can also choose a nontraditional career in chemistry that does not involve R&D, including forensics, public policy and advocacy, law, sales and marketing, public health, and regulatory affairs.

As a budding chemist seeking to determine your pathway, you can also personally investigate the question at hand. Ask members of ACS what got them interested in chemistry, and you are bound to get a variety of responses: a caring educator in their past, an inquisitiveness about materials, a love for "stinks and bangs," a desire to know more about the nanoscopic world. But ask the same individuals why they went to graduate school, and they'll very likely tell you that they love to do science. If *you* love doing science, then you owe it to yourself to consider graduate school.

Evaluating your motivations

If your devotion to science has you thinking about graduate school, the next stage of your decision is to evaluate your reasons for attending. In short, why go? Some people's faces light up when the subject of tuition-free higher education is discussed, but they may not be fully aware of the time and effort needed to persevere through a graduate education (five or more years, on average).

I am an undergraduate academic advisor, but I also served

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my own graduate department as a recruiter. In both capacities, I have had unique opportunities to work with and observe students who are motivated to attend graduate school for a variety of reasons. Some of these reasons, however, tend to ultimately result in student unhappiness, research advisor discontent, and premature cessation of study.

Seriously — think twice about attending graduate school if your sole motivation is pressure from family, friends, or your professor. As always, attempting to please others as a first priority inevitably leads to not pleasing yourself; however, when your heart is in your work, it never seems like work.

Some people who earn a Ph.D. do so because they are extremely motivated to be among the 2% of the population who have Ph.D.s, or to be considered "the best of the best." For many others, however, getting a Ph.D. credential and the title 'doctor' are small recompense for a five-year or longer investment of time and effort; the ends will not justify the means. I've also seen many students who choose to go to graduate school for no particular reason at all. People in this category tend to be more apathetic about their studies and research and more likely to drop out of graduate school. They seem to lack the commitment to education needed to succeed.

I've also observed some patterns among students who had successful graduate school careers characterized by positive research experiences, gainful employment, and personal growth and satisfaction.

Successful Ph.D. students are often motivated by a passion to deepen their knowledge of chemistry. Graduate school demands a paradoxical combination of qualities from the student. For example, you must be willing to become an expert at the same time that you are augmenting your overall knowledge base. In fact, when you complete your thesis, you will be the only person on the planet with expertise in that specific area! If you go on to work in industry, you will be considered an expert in your field and will be treated with much respect by your co-workers.

Others are highly 'career-motivated.' They view their careers as lifelong vocations that are professionally rewarding and financially viable, and tend to aspire toward ever-higher levels of responsibility. In many ways, these are some of the ultimate goals of every professional.

By rising to the challenges of graduate school and graduate-level research projects, you will also gain leadership, collaboration, and communication skills, as well as learn valuable lessons about teamwork. B.S. and M.S. level chemists typically work under the direction of a Ph.D. (or equivalent experience) level chemist. Chemists at all degree levels make valuable contributions to their companies' success, which makes your decision very important to your personal fulfillment on your career path.

Some students apply to graduate school because they seek intellectual challenge or maturity. They find that testing one's limits is an excellent way to delineate strengths and weaknesses; knowing weaknesses can lead to self-improvement. They may also be fascinated by the thought of finding what they don't know — this is a scary prospect that even many veteran professionals are not willing to face. Again, knowing your limitations helps promote your intellectual maturity.

Get your thinking in order

Be honest about your true reasons for attending graduate school. Proper alignment of priorities before enrolling in graduate school can yield fantastic, long-term career opportunities and personal fulfillment.

A very wise chemistry professor once told me: "Always get your thinking in order first." Why is it so important to consider the question, "Should I go to graduate school?" The path to even getting into graduate school is long, often lasting 8–10 months, and is fraught with the highs and lows of any major life decision. However, that process pales in comparison with the commitment needed to survive and succeed in earning one's degree!

Graduate school involves year-round coursework, reading, writing, presenting, and of course, research lab work that leads to a dissertation. Earning a terminal degree is not meant to be easy, and definitely is not for everyone. If you get your thinking in order ahead of time, the probability of success rises exponentially. Put simply, if you have dedication for science, you should consider attending graduate school. And if your motivation is strong, it will be one of the most gratifying experiences of your life. Good luck... and never stop asking questions! iC

Matthew J. Mio *is an associate professor at the University of Detroit Mercy in the Department of Chemistry and Biochemistry. In his more than eight years as a faculty member, the most enjoyable part of his career has been academic advising and helping students with their pre-professional training.*

Undergrad vs. Graduate School: How Do They Compare?

BY AMY M. HAMLIN

Now that you have mastered the art of balancing a full course load, a decent study schedule, some undergraduate research, and a social life, graduation is upon you... and it is time to move on to the next chapter of your life, graduate school. Graduate school may seem like a continuation of your undergraduate studies, but there are several differences one should be aware of before embarking on a journey toward a master's or Ph.D.

First, the way in which you are expected to learn new information will change. As an undergrad, there is a huge focus on grades and GPAs. You are expected to learn from lectures, textbooks, and hands-on laboratory experiments — and then be able to display your understanding of the concepts through exams, projects, or papers.

In graduate school there is less of a focus on classwork and GPAs. You will still take classes, but they will be fewer in number and usually only during your first year or two. These classes typically move at a faster pace and require more time outside of lecture. While it is still important to do the best you can in these courses, it may be difficult to completely grasp all the concepts presented. Your focus in graduate classes should not be on the grade, but instead on setting the foundation necessary for further independent study in your field.

Neither the number of credit hours you have taken nor the grades you receive measures your progress or success in a graduate program. Instead, progress is measured by your completion of specific program requirements, work in the research lab, and ability to communicate results to other scientists. Requirements differ by school but may include research reports, a qualifying exam, teaching requirements, a research proposal, a written thesis, and a thesis defense. Your research advisor will also have a big influence on your progression through graduate school and when you will graduate.

Chart your own path

The journey through grad school is unique for each student and is often influenced by your specific research project, as well as your advisor's opinion of your progress as a researcher and teacher. Everyone will take a different amount of time to complete his or her requirements, and the deadlines to complete specific milestones are not set in stone. Another student, even one who began at the same time as you, may not necessarily graduate at the same time. Time to complete a graduate degree depends on the group you join, the research project you undertake, and the pace at which you work. One's journey through graduate school is also influenced by future career and personal goals. For example, someone who wants an academic career may focus more on teaching and mentoring compared with someone focused on a career in industry.

As an undergraduate, you have the ability to tailor your degree toward your interests and future career goals by choosing your major, your elective classes, or a minor in another field. There are also opportunities to participate in extracurricular activities, internships, or study abroad programs. In many ways, this is similar to graduate school. There are many academic clubs for graduate students and student leadership positions available. You can also take classes outside of your field if you choose to. Some graduate students will also participate in summer internships or visiting student positions. It is also not uncommon for graduate students to continue taking or sitting in on classes even after the required classwork is completed.

As you progress through your graduate career, you will be expected to learn independently through reading the literature and attending seminars instead of textbooks and formal lectures. After classes are completed, there are no formal lectures or exams encouraging you to learn; instead, you must motivate yourself to continue learning. Reading and searching through the literature will become part of your daily routine. You will learn from both your colleagues and visiting professors, and through group meetings and informal discussions with lab mates. Many undergrads take advantage of opportunities to attend local or national scientific meetings to present their work, and these opportunities will continue into graduate school.

The focus on research

Probably the biggest difference between undergraduate and graduate school is that as a grad student, research becomes your main priority. Most undergrads thinking about going to grad school do participate in some type of undergraduate research, but not with the same intensity as a graduate student. As an undergrad, research is fitted into your schedule around classes, studying, and other extracurricular activities — but as a grad student, everything else is scheduled around your time in the lab. Early in your graduate career, you will begin working on your thesis project, and work-

PHOTO: SEAN PARSONS/ACS

ing on this project will be your primary focus for the next few years of your academic life. Research will often require late nights, early mornings, and weekends in the lab. Extracurricular activities and time with family and friends are often scheduled around experiments. For some graduate students, this rigorous lab schedule does not allow for as much flexibility or free time. In fact, sometimes it will be necessary to give up time with family and friends in order to focus on your work. Although it may seem attractive as an undergrad to be able to only fcus all your time on science instead of having to worry about other required classes outside of your major, it is possible to become burned out if you do not take a break to do something else every once in a while.

In college, there are times when school requires your complete attention, such as when studying for finals, finishing a final project, and so on. This is also true for graduate school. The few weeks before a department presentation or a qualifying exam can be very stressful, but these are the times when the studying and planning skills you learned in college will come in handy. There may also be occasions when more time is required in the lab, right when you're also trying to finish a paper or thesis, for example. Your organizational skills learned in college will be very useful during semesters in grad school when you have to juggle classes, teaching, and research. So don't throw out that college planner just yet! There are also some other obvious differences between undergrad and grad school. First, as a graduate student in the sciences, your tuition and fees will be covered and you will receive a modest teaching or research stipend to cover living expenses. So instead of relying on family, scholarships, part-time jobs, or student loans to finance your education, your educational expenses will now be covered — and you may even have a little extra money.

Another difference is that instead of getting breaks from school, such as spring break or summer break, you will have vacation time. Some schools or groups may even have a set number of vacation days you may take per year. University breaks mean a break from teaching, but that doesn't mean that you get a break from the lab. Lab work may even require working through long weekends and holidays when your friends are off having fun.

It is important to know what is the most pressing priority during each stage of your graduate career. Study and organizational skills learned in college will be very helpful as you further your education, but don't expect graduate school to just be a continuation of your undergrad experience. Graduate school is a huge commitment, but it also provides many new and exciting opportunities to learn and make a contribution to the scientific community. iC

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The Graduate School Process

For many students, the prospect of going to graduate school can be daunting. Here I discuss some simple guidelines to help you through the process of making decisions about graduate school.

BY JAMES BATTEAS

Deciding to go or not to go?

The first step, of course, is deciding if graduate school will further your career goals. This will depend on what you see as your long-term career plans. If you think that academia is in your future, then a Ph.D. is a must. If your career plans are focused on entering the chemical industry, you might take a job right after completing your B.A. or B.S., but an advanced degree may become important for potential advancement. In many industrial settings, only those with advanced degrees will be considered for management tracks and other leadership roles.

Let's assume that, whatever your reasons may be, you do want to go to graduate school. Now what? You probably have many questions, and a limited amount of time to plan your way forward. If so, here are a few answers and pointers to help you through the process.

JUPITER IMAGES

How to choose which schools to apply to

Once you have decided that graduate school is part of the career path for you, the next step is to pick the schools to which you want to apply. But how should you choose? At present there are approximately 170 schools that offer advanced degrees in chemistry. Depending on your situation, many factors may influence where you consider attending school, including family obligations or work constraints that place geographical restrictions on you (e.g., your company is paying for you to attend a graduate program, etc.).

However, the single most important factor in deciding those schools to which you should apply is the research focus (or foci) of the faculty. For each school you consider, you need to ask: "Are the faculty engaged in the type of research that I am interested in doing?" If you are not sure what area of research you want to pursue, then probably a bigger school is better for you, since it will tend to offer a broader range of opportunities.

How do you find out what faculty at the schools are investigating? Go to graduate school fairs, carefully look through departmental websites, and call or e-mail the department to request information on their graduate programs and faculty. It is good to do your homework at this stage, because once you decide to go to graduate school, you (and the school) are making an approximately five-year commitment. You want to make sure you are going to the place that is best for you. By the way, it also wouldn't hurt to e-mail the specific faculty members with whom you are interested in working. Most faculty love to talk about their work with prospective students, so drop them a note! Sending form e-mails to faculty, however, should be avoided.

What should go into your applications?

Luckily, most applications for graduate schools are about the same, so you will be able to recycle some of what you prepare for every school. Pay attention to the deadlines… and APPLY EARLY! Why? Many programs have additional fellowship funds to award, depending on the program, and when you apply early you have a better chance of being considered for these fellowships. At the very least, apply on time. Graduate recruiters and admissions committees may regard late applications as a lack of commitment or organization on your part, and these intangibles may make your application less competitive.

FEES

Be prepared to pay, as you will encounter fees along the way. Each time you take the Graduate Record Examination (GRE) costs around $140, for example. On top of these costs, there may also be application fees for the graduate programs you are considering, meaning that applying to six or seven schools could cost you as much as $600! If you can't pay the fee, ask the program if the fee can be waived or reduced. It never hurts to ask.

GRADES

Almost all graduate school applications will require transcripts from ALL schools you have attended. That includes that the local community college where you may have taken classes while home for the summer. Make sure that you request all of the transcripts in time to arrive by the application deadline (or earlier), as applications may be considered incomplete without them, and thus not get reviewed. In terms of grades, most graduate programs require a B average or better (3.0/4.0) to gain admission. Your application will be especially strengthened by good grades in your upper division courses. In fact, many places consider these grades more heavily than those in your first two years.

ENTRY EXAMS

You will also need to submit scores from the GRE. Check to see which exams are required by the schools to which you are applying, and learn their typical score requirements for admission. Not all schools require the subject test, but some do. Plan accordingly to have these exams completed in enough time for the scores to be reported before the application deadline.

If you are applying for admission in the fall, you should really target taking these exams by September of your senior year. If you are applying for spring admission (i.e. January or February), then you will need to have your GREs done by May of the year you graduate to receive your scores in time. Check with the schools to which you are applying to see whether they will consider applications for spring admission (some may not). If you are an international student, you may also be required to submit scores for the Test of English as a Foreign Language (TOEFL). Again, you want to make sure that these scores are reported in time for the application deadline.

PERSONAL STATEMENT

Every school will require you to submit a personal statement, in which you should succinctly describe what you have done to prepare for graduate school. You should take this part of the application very seriously. Here are a few tips for success:

Articulate your personal goals. Explain to the admissions committee why they should make you an offer to come to their school. Describe your career goals and what area(s) of research you wish to pursue. Take the time to outline the relevant coursework you have taken to prepare for advanced studies.

Describe your undergraduate research. Many places will not strongly consider applications from students with no research experience, so if you have not been involved in research yet, *do so*. This research can come in many forms, ranging from participating in research at your home institution, to going away for the summer to participate in a Research Experiences for Undergraduate (REU) program. The National Science Foundation maintains a list of schools with active REU programs on its website. Also, many schools, companies, and national labs offer summer programs that are internally supported, so check with them. No matter how you get it, *research experience is a must* for getting into a good graduate school. In your personal statement, you should relate your overall experience to the committee.

Explain your extracurricular activities. In addition to research, if you have been involved in clubs or other activities that have allowed you to develop leadership skills (e.g., serving as secretary of your local ACS Student Affiliates chapter, etc.), this is also useful to describe to the committee.

Research the faculty. Take the time to tell the admissions committee under which faculty members you are most interested in studying. This shows the committee that you have done your homework and that you have thought about what you want to do. As a rule of thumb, you should be sure there are at least three faculty members whose research interests you, since admission to a doctoral program does not guarantee you admission into a particular faculty member's group.

LETTERS OF RECOMMENDATION

Most programs will request at least three letters of recommendation in support of your application. These letters should come from faculty or employers who can speak to your experience in chemistry. You should include letters from faculty who have taught you in class or with whom you have done research. Make sure that you ask for these letters at least a month in advance.

Take the time to sit down with any letter writers who don't know you well to discuss your career aspirations. Prior to your meeting, give them a copy of your current résumé. If you don't have a résumé, learn how to create one now. As you begin to enter the professional workforce, an up-to-date résumé is a must, and many schools have services to help you prepare one (see the sidebar about resources, below). This will help your letter writers provide a more meaningful assessment of your background and goals to the admissions committee. Also, don't hesitate to bug your letter writers and remind them of upcoming deadlines.

WHICH SCHOOL IS RIGHT FOR YOU?

If you are lucky enough to be admitted to more than one program, then you face the tough task of narrowing down your options to one program. How do you decide?

VISIT THE SCHOOL

Many programs will offer you the opportunity to visit their school (and will pay for it) either during a visitation weekend or set of weekends. If you can't make one of the scheduled dates, ask about individual visits. You should take advantage of this, as it gives you the chance to see the school and meet with faculty and students to determine if you can see yourself in that program for the next five years.

This is not the time to geographically restrict yourself. Graduate school can be an opportunity to live somewhere different for a few years; and even if you don't like a particular area that much, you will only need to be there for a finite time. Ultimately, of course, just as with your decision about where to apply, you need to ensure that there are faculty members at the school with whom you would like to work. By visiting, you will have the chance to meet with these faculty and their students to get the 'real scoop' on what it is like to go to graduate school there.

EVALUATE YOUR CAREER SUPPORT

When you visit, take a close look at the facilities that the program offers. You want to make sure that you will have access to the equipment you need to conduct your research in a timely fashion. For example, if you are going to be doing a fair amount of synthesis, find out whether you will need to send your samples out for NMR or X-ray diffraction or mass spectrometry analysis, or will be able to have such procedures done on site.

In terms of your long-term career goals, try to evaluate how the program assists students in obtaining jobs once they graduate. See if they offer career assistance such as helping students prepare résumés, and whether companies actively seek students from the program for employment. Does the school have on-site interviews? Find out where the graduates from the school have gone after graduation, especially the students of the faculty with whom you are interested in working.

UNDERSTAND THE PROGRAM REQUIREMENTS

How many and what types of courses will you need to take? Since doctoral programs are research-intensive, it is unlikely that you will take many classes, but requirements vary from school to school. Are there cumulative exams or oral exams that you will need to pass? Many programs require students to teach a minimum number of courses. What is that requirement for the programs in which you are interested? While requirements vary, you will find that much of the overall workload is generally comparable, with probably the largest variations coming in coursework. Talk with several students at the school when you visit, and see how they feel about their course/workload. Individual impressions of the school can vary, so get a balanced opinion. If you hear the same things from several people, then the information is probably more reliable.

CAREFULLY EVALUATE YOUR OFFER

Most places will make you an offer that includes a teaching and/or a research assistantship. To fairly compare offers between schools, you must determine what your take-home pay will be, as well as what tuition and fees you will need to pay. At many places these costs may be waived; at others, tuition and fees are paid by the students, while the schools pay the students a higher salary. Don't be fooled by hidden costs! What types of health benefits are available to you as a student? What is the local cost of housing?

All this being said, don't let the stipend be your sole guide in choosing between schools. You are not going to graduate school to make money immediately; rather, you are going there to enhance your future career and overall earning potential. Everyone in graduate school 'lives on peanuts'—so ultimately, you need to be working with faculty whose research interests match your own.

Once you have decided, sign your offer on the dotted line and prepare to work hard. The next step is choosing a research advisor, a process that is addressed in this issue's editorial by Marjorie Caserio. Earning an M.S. or Ph.D. is not easy, but it will be one of the most rewarding experiences of your early career. Revel in the challenge! iC

Check out these resources from ACS

Graduate Education in Chemistry— Information about resources, planning for graduate work in chemistry, and more! **www.acs.org/education** and click on Graduate Education.

DGRweb— The ACS Directory of Graduate Research, an online resource on faculty and their research programs in institutions throughout the U.S. and Canada. **www.acs.org/DGRweb**

Experiential Programs in Chemistry— A one-stop source for information on summer research, internship, and co-op opportunities. **www.acs.org/epic**

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ACS **Member Insurance Program**

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Personal Statement Pointers

BY HOLLY C. GAEDE

Writing a personal statement can be the most daunting part of preparing a graduate school application. Your grades and GRE scores are just numbers, but the personal statement is, well, personal. The whole purpose of this statement is to reveal something about you.

Your aim should be to reveal not only that you are well-prepared for graduate school in general but also that you are particularly suited to the program for which you are applying. So, while you can have a common essay framework that you use for all your applications, you must tailor your applications for each school. Because of the customization that's required, preparing a good statement takes some research, which in turn takes time. Begin working on your essays early in the fall semester of your senior year so you can meet the graduate school application deadlines without pulling all-nighters that interfere with your grades.

Most graduate school programs ask for a statement that describes your research experience and career goals in one to two pages. In your essay, then, you need to talk a little bit about your past and a little bit about your future. However, don't make the mistake of beginning your essay with a statement along the lines of "I have been interested in chemistry ever since I was a little kid" or "Being a chemist has always been a dream of mine." Such trite approaches don't provide any useful information to the reviewing committee, and believe me, they have read it before. Include only extraordinary pre-college science experiences. For instance, you should definitely write about participation in the U.S. National Chemistry Olympiad or the Intel Science Talent Search. However, having a great high school AP chemistry teacher isn't all that unusual (thank goodness!) and says more about the teacher than it does about you.

Describe your research experience

Discuss your research experience. Most admissions committees want to see that you understand the nature of research. While coursework can provide you with basic laboratory skills, it rarely gives you a good idea about the (sometimes frustrating) pace of research. No program wants to admit a student who is going to quit the first time an experiment doesn't work. For this reason, undergraduate research is practically a prerequisite for graduate school. Fortunately, undergraduate research can take place in several different settings, including at your home institution, at a summer Research Experience for Undergraduates (REU), or through an industrial internship. Some students are even lucky enough to have experienced more than one of these options. In any case, talk about the overarching goals of the project(s) and what you specifically contributed. Point out uncommon skills that you acquired through your research (e.g., software, methods, instruments, or reactions that most undergraduates wouldn't have practiced).

Address how this experience influenced your desire to attend graduate school. If appropriate, comment on any obstacles or difficulties you surmounted to show that you have the perseverance necessary to succeed in graduate school. If you have presented your research in a formal setting or expect to have it published, provide the appropriate references. Publications and presentations show the committee that you can communicate

Once you have explained what you want to study, you need to explain why you want to study it there.

your science and that you can bring projects to completion.

If for some reason you haven't had an undergraduate research experience, you will have to convince the committee that your other experiences have sufficiently prepared you for graduate school. Possible approaches include writing about any projects you may have completed within the context of an instructional laboratory. Alternatively, you may be able to discuss what you learned from attending research seminars or conferences. There really is no substitute for research experience, so try your best to get some before you begin your application.

Discuss your career goals

Talk about your career goals. You may not have firm career plans yet, but if you are already set on an academic or industrial career, explain how you came to that decision. More importantly, you need to explain why you think this program will prepare you best for that career path. Make sure your goals align with the education the institution provides. For example, if you are convinced that you want to become a professor at a research-intensive university, it doesn't make much sense to apply to a school that sends all of their graduates to industrial careers, or vice versa. Doing so will show the admissions committee that you haven't done your homework — not a great argument for admission to a research program! If you are uncertain about your career goals and would like to keep your options open, say so. Explain why you think this institution and their curriculum will enable you to do so.

Tell the admissions committee what type of chemistry you'd like to study. If you want to study, say, bioinorganic chemistry, explain how that interest developed. Is it because you really loved both inorganic and biochemistry courses, and see this field as the perfect marriage of your interests? Is it because you've done research or an internship in the area? Have you taken a special course in the area? Show the committee that you have given some serious thought to this question. However, don't be worried that you are painting yourself into a corner. Admissions committees understand that your interests are evolving and that, even as you apply for graduate school, you still have a semester of your undergraduate curriculum left to explore. Many students indicate one interest area (or more) in an application but ultimately decide to pursue another specialty when they begin graduate school the following fall.

Explain program fit

Once you have explained what you want to study, you need to explain why you want to study it there. Obviously, this section of your essay also requires customization. You are wasting the admissions committee's time (and your own) if your interest lies in bioinorganic chemistry but you apply to an institution that doesn't have a single bioinorganic chemist on the faculty. Aim to list two or three faculty members whom you'd like to work for, and highlight the aspects of their research that appeal to you. Don't go overboard, though; you don't need to rewrite their research brochure. (The admissions committee should be quite familiar with their own faculty members' research interests!) Of course, your research interests should support your career goals. When your stated goal is to work in a pharmaceutical company, the admissions committee will be puzzled if you express interest in working for a gas-phase physical chemist.

Relevant extracurricular activities can be briefly mentioned, especially if used to illustrate a specific point. For example, if you completed an honors thesis as a varsity athlete, you know something about time management! Teaching or tutoring experience may show the committee that you'll be able to handle the first-year teaching assignment. Leadership in the ACS student chapter will show that you have an interest in chemistry that extends outside the classroom or laboratory. Involvement in other activities may show the committee that you are a well-rounded person with interests outside of science.

Proofread, proofread, proofread

Once you have written your statement, you should proofread it carefully. Essays with grammatical, spelling, or typographical errors will reflect poorly on you. Statements that mistakenly refer to schools other than the one to which you are applying are especially embarrassing and may convince the committee that you lack attention to detail. Particularly if you are not a native English speaker, ask someone else to read your statement. While confusing or muddled statements may not sink your chances for admission, they certainly won't improve them! Your college or university writing center may be able to help you improve your application essay.

Preparing a thoughtful personal statement can be a useful exercise that helps you clarify your goals and narrow your graduate school choices. Remember, the personal statement is just one piece of the application puzzle. Once you are admitted, you'll have the chance to visit the campus so the faculty can meet you in person. At that point, the admissions committee has already decided that you are a good fit for their program, and you will have the chance to decide whether you agree! iC

Holly C. Gaede *is the undergraduate advisor and a senior lecturer in the Department of Chemistry at Texas A&M University in College Station, TX.*

Getting that GREAT Letter of Recommendation

BY MICHELLE BOUCHER

There is more to getting a great letter of recommendation than simply having good grades. If it were just about grades, you wouldn't need letters; your GPA would speak for itself! Schools and programs use letters of recommendation as a way to go beyond your grades and learn about you as a student and a person. They want to hear about your strengths and weaknesses to help them decide if you would be a good fit for their program.

When I write a letter of recommendation, I try to include as much information about a student as I can. Since letters of recommendation are meant to provide evidence that you will succeed in your desired program or job, the more examples about you that I can provide, the better your letter will be. It is not how much a professor likes you, but rather how well he or she knows you that makes the difference between an okay and a great letter.

A great letter of recommendation will highlight all the ways a student is a perfect fit for a program. It can also put into context any weaknesses that might appear in a transcript; if you struggled in a particular class or semester, a recommender can use this place to explain (with your permission) what happened or how that experience helped you grow into a better student. A letter of recommendation should leave the reader feeling as if he or she really knows the student. It can often be the deciding factor in determining acceptance to a program. So how can you get one of those great letters of recommendation?

Ask someone who knows you well

I cannot say it often enough: letters of recommendation are about more than how you scored on exams. Don't just ask faculty from your highest-scoring classes to write your letter. Ask someone who knows you and can really speak to your strengths and potential.

Be prepared and organized

When you ask for a letter of recommendation, make an appointment with your professor, and expect to spend a little time talking with him or her. Bring with you a list of your potential schools or programs. Good letters of recommendation include discussions as to why the student is applying for the specific job or program, so expect that your recommender will want to know why you have chosen the places you have. Be sure to prepare a list of important information, including deadlines and how the letter needs to be delivered. For example, is it a system that requires your recommender to send in the letter by e-mail, or do you need a paper copy to include in your materials? Does the recommender need to send the letter directly to the school or program? Some recommenders like reading admission essays before writing their letters, since it is another way to get to know you better. It would be a great idea to have your essay at least started before your meeting.

Start early

Hopefully you are starting to see that there is more to getting a good letter of recommendation than simply picking a person and sending them an e-mail. Start early — in fact, as early as you can! Approaching your professor a month or two (or more!) ahead of the deadline may seem too early to you, but it really isn't. If I have decided to write a letter for you, it means I believe in you and your potential to succeed in your desired program. I want to take the time needed to write the best letter I can, full of examples of your strengths and how well you would succeed. I might even want to have a follow-up meeting with you to ask for the details that I need to make a strong case for your acceptance to the program. Most professors can, if pressed, produce a letter in a much shorter time frame... but why rush them for something so important to you?

Be a good student

Don't skim past this paragraph! I know that this seems, well, obvious... but hear me out! When I say that you should be a good student, I mean more than simply aiming to earn good grades (which are, of course, very helpful). A good student is also interested in learning material that is above and beyond what is needed for the exam, and is also an active learner who demonstrates his or her interest in learning. Do you volunteer to answer questions? Do you ask questions beyond the "will this be

on the test" variety? Do you ever visit during your professor's office hours? Are you interested in how the classroom material could be applied to real-life examples, and do you sometimes discuss these points with your professor? These interactions provide fantastic evidence, beyond just your GPA, that your recommender can use to prove that you are a good student.

Be involved

The more experience you have in your chosen field, the better the argument I can make that you'll be successful in that field. It's just common sense! Tutoring, being part of your ACS student chapter, doing research, attending talks on campus... there are lots of ways to be part of your departmental community. If you are involved with professional activities outside of campus (such as shadowing chemistry professionals, doctors, or pharmacists), be ready to talk about these experiences with your letter writer. The more evidence about your suitability for the program or position, the better!

You might notice that many of the things that will help get you a good letter of recommendation are activities that will also tend to make you a better student and future chemist (or doctor or pharmacist). Absolutely correct! If you start early thinking about how to get that great letter of recommendation, chances are very good that you'll become the type of student who gets those great letters. iC

Michelle Boucher *is an associate professor of chemistry at Utica College. Between her roles as organic chemistry instructor and co-advisor of the Utica College ACS student chapter, she writes a great number of letters of recommendation each year.*

From So-So to Great: Letters in Action

THE SO-SO RECOMMENDATION LETTER

A so-so letter of recommendation will try to be helpful but have very few examples or details, and usually will be very short. There are some standard phrases that show that the recommender is trying to be positive but has to stretch a few facts or impressions into a full letter. For this first letter, Millie Mole is a student who came to class and did reasonably well on her exams, but never asked or answered questions in lecture or lab, and had no other interactions with the professor or the department.

- "She seemed to be prepared for class and appeared to enjoy the subject matter."
- "Millie works well with her partner in the laboratory section of the class, and I believe that she would function well in a team setting."
- "From everything I know about your program, it seems likely that it would be a good fit for Millie."
- "I have no reservations in recommending Millie Mole to your school."

THE GREAT RECOMMENDATION LETTER

A great recommendation letter offers a number of specific examples to support the points the recommender is trying to make. When backed with details, the recommender can be a real advocate for the student and make a strong argument about why the student deserves to be considered for the program. For this second letter, Millie Mole is a student who was active in class, spent some time talking with her professor about her future plans, and was also involved in the department.

- "Millie Mole did very well in my class and was always completely prepared to engage the day's material; she came ready to ask questions amd reference the readings, and was quick to respond when I asked a question of the class. Millie worked hard outside of class and often attended my office hours to ask for clarification of a lecture point or get help on a particularly tough homework problem."
- "Millie is a cheerful and helpful presence in the department, as well as being a natural leader. For example, Millie took the lead and organized an outreach event for the ACS student chapter. She dealt with the challenges of organizing a trip to a local second-grade class, including..."
- "Millie is also an effective tutor for the department, and twice a week she helps the general chemistry lecture students work through homework problems and teaches them with cheerful patience. Her experience with these students will transfer well into a graduate teaching assistantship position, and I know she will do well as a graduate student instructor."
- "After performing research in our department for the past year, she understands the joys and challenges of laboratory work. Millie has been very successful in the laboratory and has learned a number of skills working on her project, including..."
- "Millie has spent a great deal of time considering her post-graduate plans, and is certain that she wants to attend your graduate school. From all our conversations about your program, I know that it would be a great fit for Millie since..."
- "I am delighted to recommend Millie Mole to your school, and I am certain that she will be a credit to your program." iC

Making the Most of Graduate School Visit Weekends

BY AMY M. HAMLIN

When you receive graduate school acceptance letters, you'll likely feel relieved that your future as a graduate student is secure. But now comes the big decision: Which graduate school will be the best fit for you?

Many factors go into deciding which school to attend, including specific research interests, location, and the size of the department. While at first glance it may seem overwhelming to gather this information about each school that has accepted you, all of this information is readily available online through ACS's DGRweb 2009 at www.acs/dgrweb This searchable database provides comprehensive information on chemical research and researchers at universities in North America. Take the time to check this resource. Being well prepared for a visit weekend can help make the visit much more productive.

Many Ph.D. programs will pay for part or all of your travel expenses and hotel for the weekend — but remember, these road trips are *not* a vacation. Rather, the purpose of visit weekends is for a student already accepted into a program to gather information about the institution and the department before deciding whether or not to accept the offer. It is a unique opportunity for you to interview the professors and current graduate students.

The right frame of mind

On a weekend visit, you don't need to worry about getting rejected. You're no longer the one being judged; rather, it is the chemistry department's turn to impress *you*. Remember too, you are not competing with the other visiting students.

Instead, you are now the interviewer, and taking on this role requires doing the proper research. Before you leave for the visit weekend, you should be prepared with the questions you want to ask and the information you want to gather about the department. Most departments post information online, such as the requirements for the different degrees and statistics about the program. Do your best to learn about the specific program before the visit weekend; this will better prepare you to ask questions. Be sure to do some research into the groups that interest you, read a few of the

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Keep Your Eyes And Ears Open: ***Be Observant and Ask the Right Questions***

Your interests may match those of a graduate program group on paper... but you will not know if the group will be a good fit for you until you actually meet the professors and some of the current graduate students. Make sure you feel comfortable and that you get a positive "vibe" from the experience. Be observant of your surroundings and the interactions among professors, staff, and students.

Look around the laboratory and take note of the range of experiences and backgrounds among the students and professors. Look in the professors' offices and note if there are personal items or family photos. While you are visiting, do people stop into the offices? Are the offices close to the labs? Go into the labs with the professors and observe the interactions between the professors and the graduate students.

When you meet with professors or graduate students, be sure to ask questions.

QUESTIONS TO ASK INCLUDE:

- Do graduate students work together on projects or does each person have his or her own project? Describe the culture of the chemistry department.
- What are the typical hours and days that the members of the groups work?
- What is the average time it takes for graduate students to complete their degrees?
- How much time per week do professors spend in the lab with graduate students?
- How often do graduate advisors have meetings with graduate students?
- What are the funding sources for the laboratory? Are graduate students responsible for seeking funding?
- What are the laboratory protocols?
- How many graduate students and postdocs are typically in each research group?
- What equipment is available to graduate students?
- If I have an issue on a research project, what steps would I take to resolve it?
- How are conflicts resolved?
- What is the publication process for the lab? Who are the authors, co-authors, etc.?
- What types of professional development opportunities are provided to graduate students, including conference and meeting attendance, career training, and job placement assistance?
- How is personal leave or emergency leave handled? Are there flexible work arrangements?
- Would you please describe your current research projects?
- How do you maintain diversity in the laboratory? Describe the work environment of your laboratory.

This list is not exhaustive; don't be afraid to ask any question that may come to mind. Listen to the questions others ask; they may come up with great questions you may not have thought of and make observations of things you have not noticed. iC

recent publications, and explore the various groups' websites to get a feel for the different research opportunities available. This is also a good time to decide which factors — such as prestige, location, research interest, and facilities,— are the most important to you when choosing which school you want to attend.

What to expect

Every graduate school's visit weekend is a little different, but in general the events are pretty casual. I would not recommend wearing your lab T-shirt full of holes, but you do not need to break out your fancy suit either; a nice pair of pants and shirt will be fine. Most visit weekends will include a presentation about the department, which will include information such as the requirements for the program and other general information about the department. You will also have time to meet with the professors and current graduate students to hear about their research and ask questions about their group. Some programs may also include facility tours, a social event, or a city tour as part of the visit weekend schedule.

Getting to know the professors

One of the most important aspects of the visit weekend is meeting with the professors. It is very important that you choose a graduate school and a research group that will allow you to pursue your research interests.

During the weekend you will have the opportunity to meet with several of the professors either individually or in a small group. The professors will probably ask about your research interests and past research experiences, and will possibly ask what you are looking for in a research group. Based on this information,

they will discuss with you the projects in the group that may be of the most interest to you, and why you should consider attending that school.

From the mouths of graduate students

Even though the meetings with the professors are very important, the current graduate students will probably provide you with the most valuable information. While professors are only going to share with you positive aspects of the department and their group, the graduate students will not hide anything. If there are weaknesses in the program, graduate students will not hesitate to share these with you if you ask. Graduate students will be honest about the things they like about the program and their group, and the things they are unhappy with. Talk to as many graduate students as you can. They are filled with information about what it is really like to work in a specific group and how well-equipped the facilities actually are.

Location, location, location

Another very important aspect to look into during the visit weekend is the community in which the school is located. Some schools will offer tours of the local area or of typical graduate student housing. The location of the school is more important for some prospective students than for others. Remember: you will be living here for the next several years and will become part of the community; it is important that you can feel at home.

Look at the cost of living in the area and ask current graduate students what they can reasonably afford with the stipend to determine if you can afford the lifestyle you desire during graduate school. Maybe being close to family is important to you, or maybe you want to be close to a skiing area, or in a big city; these are all things you should consider when looking at the location of the school. I recommend spending some time during the weekend to explore the area around the school on your own.

Digesting the experience

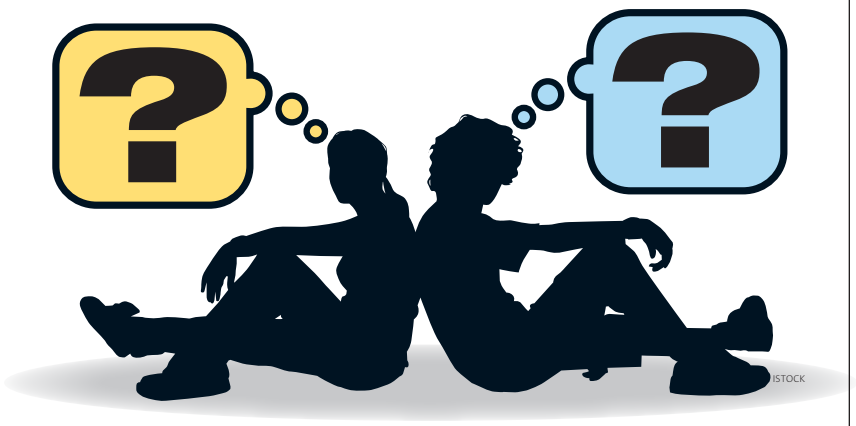
Visit weekends may feel overwhelming, but it is important that you gather as much information as you can about each school you visit. Even visit weekends that go poorly can teach you a lot about what you want in a graduate school. After the visit weekend is over, keep in touch with professors and graduate students you met at the schools that still interest you. They will be happy to answer any further questions you may have in making your decision.

Try to enjoy the visit weekend and relax a little bit — but do your best to make a good first impression; one conversation during the weekend may greatly influence your decision. During the visit weekend process, keep an open mind about each school you visit. If you make up your mind about a school before you visit, you may miss out on a great opportunity. iC

Amy M. Hamlin *is a graduate student at the University of California Berkeley studying synthetic organic chemistry. She graduated from the University of Detroit Mercy in 2009 with a B.S. in chemistry.*

ASK THE GRADUATE SCHOOL RECRUITER...

...about Applying to Graduate School



Featuring questions and answers with guest columnist Melissa Bowman, Coordinator of Academic Programs for Polymer Science at the University of Akron (UA), OH. One of her main responsibilities is recruitment and admissions for the M.S. and Ph.D. programs. If you have a question to ask a graduate school recruiter, please e-mail it to inChemistry@acs.org.

iC: How important is the GPA to the graduate school process?

Bowman: Admissions committees typically place a lot of weight on the GPA, especially in math and science courses. The average GPA of students admitted into UA M.S. and Ph.D. programs in polymer science is 3.50. Every part of each student's application is examined closely by the admissions committee, so there is no single element that would make or break a student's admission. Even though they are ranked by GPA, all applicants in the 3.0 or higher GPA range are evaluated on an individual basis.

iC: Do any other factors compensate for low GRE scores, or will high GRE scores compensate for low grades?

Bowman: Many admissions committees view GRE scores as good indicators of success. Successful research experience can sometimes compensate for lower GRE scores. UA's average GRE scores range from 1000 to 1200, verbal plus quantitative. With international applications, we find that each country typically has trends of certain scores, and the admissions committee keeps this in mind when evaluating these applications.

iC: If an applicant has had academic obstacles as an undergraduate, are admissions officers understanding of this, or do they focus on the GPA trend?

Bowman: Ph.D. programs typically have a very tough first-year interdisciplinary curriculum, and the rest of the program is research-intensive. Admissions committees often feel the best predictors of students' success are grades and test scores in science and math. Both help predict whether students are able to take on difficult subject matter and succeed. The admissions committee may be willing to take into consideration one or two subpar semesters, but not a pattern of such performance.

iC: How important is being published? Do you expect undergraduates to have first authorship on research papers when they apply to graduate school?

Bowman: Publications certainly catch the eye of our admissions committee members, but first authorship is not a necessity. Some prior research experience, however, is usually a must.

iC: Do undergraduates need to include recommendation letters from their research advisors?

Bowman: If a student has had a research experience, admissions committees typically expect to see a letter speaking about what they did, how they did it, and their outcomes. Letters of recommendation should come from professors who have first-hand knowledge about how the student handles a scientific question and answer. Our admissions committee members look closely at the wording in recommendation letters and often will contact a recommender if they have questions.

iC: What do admissions committees look for in a recommendation letter?

Bowman: Graduate school admissions committees look for students who are hardworking, innovative, and creative problem solvers who also have a passion for research. They want to see how students attacked problems, what avenues they used to solve problems, and the outcomes. They look for students who can work independently, yet contribute to a group as well. Recommendation letters should be based mostly on students' performance in the classroom and laboratory, so students should work hard in both. If students have the passion for scientific research it will show, and their professors can write about it.

iC: Should applicants e-mail faculty at the institution to which they're applying during the application process?

Bowman: We encourage prospective students to initiate conversation with graduate faculty about research topics and ask questions about their research. The best way to initiate contact is by e-mail.

iC: What is the expected 'netiquette' when contacting graduate professors?

Bowman: Send an e-mail introducing yourself and explain why you are contacting them. Let them know what kinds of projects you are working on and if there is any connection to something they are doing. Any questions about the application process, on the other hand, should be directed to the admissions office. iC

Navigating the Ups and Downs of Graduate School

Eight Common Pitfalls... and How to Avoid Them

BY BURT HOLLANDSWORTH

There it is. it's sitting in your mailbox. You glance and see that it's a thick envelope from the well-respected, top-notch chemistry graduate school that just happens to be your first choice. Your friends make you open it, and after a suspenseful moment you exclaim, "I'm in!"

You've just experienced your first graduate school high. Of course, there could just as easily be a letter that politely thanks you for your application, mentions that it was an especially talented class of undergraduates that applied this year, and wishes you the best with your other applications. Unfortunately, this is the start of the "ups and downs" of graduate school.

Even the best students will experience high and low points in their graduate careers. Here are some of the major pitfalls that you might encounter, and how to avoid them in most cases.

Choosing the wrong advisor

Four or five years of working for the wrong person will wreak havoc on your mental condition. Advisors come with all sorts of managerial styles, most of them learned from their own Ph.D. and postdoctoral advisors. Try not to pick a Ph.D. advisor solely on reputation, number of publications, group size, or by the advisor's research description in a catalog. Soon after arriving on campus, interview the advisors and get a feel for their personalities. Narrow your focus to two or three potential candidates, and then spend a considerable amount of time talking to their graduate students and postdocs.

Get a feel for their managerial style by asking questions like, "How often is this person in the lab?," "How often are group meetings?," and "How much of the day-to-day tasks and training are handled by the postdocs and senior members of the group?" If you are the type of person who needs creative space, don't join the group of a micromanager or an advisor who sets strict work hours. Conversely, if you feel like you need guidance and direction and will need an advisor who is continually challenging you with new ideas and checking up on you throughout the week, then go with someone who will keep you focused. Picking a not-yet-tenured faculty member is one way to ensure that you will get plenty of personal attention and will be challenged to produce results quickly and often. A personality mismatch with your advisor is a pitfall to avoid from the start.

Having too many advisors

Another situation to avoid is having too many advisors. It's not uncommon to work for two research groups at the same time on a collaborative project. These collaborations expose students to different types of experiments, give increased access to instrumentation and other equipment and personnel, and also give students two potentially strong recommendation letters instead of one. However, in some cases, neither advisor keeps track of "shared" students, and over time the students might fall off the map. If you choose to work with two Ph.D. advisors, be intentional about maintaining a strong relationship with both of them.

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Spending too much time in the lab

Graduate school will be the best time of your life to focus solely on chemical research. Take advantage of the time that you have to learn new lab skills and enjoy the thrills of frontline research. However, even though you may be tempted, don't spend every waking hour in the lab, especially if you are in a more competitive research group. Working too hard will cause a quick burnout, especially if your research is not producing results commensurate with your effort. It is not a pretty sight when graduate students burn out. They become irritable when small things go wrong or when they perceive that other group members are not working as hard. They sometimes become discouraged and start to work strange hours to avoid other people. Schedule some leisure time in your day that will get your mind off of chemistry. Join some friends for a regular walk or workout and encourage each other. It's a great idea to take at least one of the days of the weekend off to recharge your energy level.

ISTOCK

Spending too little time in the lab

Avoid being the group workaholic, but also avoid being the slacker who spends the least amount of time in the lab. Put yourself on a schedule, even if you are producing steady results. One unfortunate aspect of working for busy advisors is that they don't spend much time in the lab. If you are never there when they happen to be walking through the lab, then it is easy to fall through the cracks and out of favor with your advisor.

Letting results dictate your outlook

Every graduate student goes through both productive and slow times in the lab. The nature of chemical research dictates that there will be reactions that do not work, computations that need to be redone, and instruments that need to be fixed. Most graduate students will tell you that interesting results typically come in small bursts when several components of the research come together all at once. It's important to maintain some emotional distance from the process. Celebrate when things go well, but don't let your research success be the only source of joy in your life. When the results are lagging, keep in mind that a temporary stall in one area of research might yield unexpected results in the future. Think of every unexpected side product or instrumental glitch as another paragraph in your thesis.

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Painting yourself into a corner

Consider adopting the strategy of working on two separate lines of research at the same time. For instance, if your main research problem is the synthesis of a protein inhibitor, do some computational work on the side modeling the active site-inhibitor complex. If your synthetic work hits a snag, at least you will have some computational results to fall back on. If your computations become frustrating, then maybe you can make a breakthrough with an interesting synthetic intermediate. In this way, you can avoid putting all of your research "eggs in one basket."

Living an unhealthy lifestyle

Hopefully, you will look back on graduate school as the most productive time of your life. For some chemists, graduate school was also the time when they picked up some of their worst habits. Binge drinking or drug use is not a good response to failed research efforts. Drinking may help you forget your research troubles for a night, but they will still be there the next day. Stimulants may help you work all day and night on Monday but will cause you to crash on Tuesday. Keep a healthy and responsible attitude toward stress relief, and surround yourself with friends who do the same. Take time to exercise and to otherwise take care of yourself.

PHOTOS.COM

Most graduate students will tell you that interesting results typically come in small bursts when several components of the research come together all at once.

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Being afraid to say "no"

One of the hardest lessons to be learned is how to say, "No." There is nothing wrong with politely declining to be a graduate student council representative, teaching a course as an adjunct, reorganizing your group's chemical inventory, redesigning the group webpage, or running the summer softball league if you need to focus on your lab work. None of these activities is inherently bad, but they will all detract from your primary mission in graduate school, which is to contribute a body of original scientific work to the field of chemistry. You may be tempted to pad your résumé with all sorts of extracurricular activities, but remember that no item will carry more weight than a strong recommendation from your Ph.D. advisor.

Remember, too, that you are not alone — so do not isolate yourself. Build a network. Great places to start are joining the ACS Graduate Students Facebook group or a LinkedIn group.

As you progress through graduate school, keep an open mind. Don't become too discouraged when the going gets tough, and keep yourself open to suggestions on better ways to carry out your research. Try not to get too high or too low when the results roll in or dry up. Avoid the common pitfalls... and your graduate school experience will be as enjoyable as it is productive. iC

Burt Hollandsworth *graduated from The Ohio State University in 2004 with a Ph.D. in inorganic chemistry. He is on the faculty of Harding University in Searcy, AR, and is a member of the ACS Younger Chemists Committee.*

Mastering Graduate School Acrobatics

Balancing Research and Coursework with Relationships, Hobbies, and other Interests

BY ALLISON PROFFITT

While in China recently, I saw the Shanghai Acrobatics Troupe perform. One of the acts was a group of women spinning plates. It was surprisingly beautiful. They held up to eight long, thin poles— four in each hand— each topped with a whirling plate. With the tiniest flicks of the wrist, they kept all eight discs spinning, all eight poles gracefully splayed, dancing all the while. At the end, lest you thought it was all a trick, they dropped the plates, then the poles, and everything came crashing to the ground.

Graduate school can be like that. Keeping even two plates aloft and spinning (your coursework and research) is hard enough! Anything else — including relationships, hobbies, and other interests — seems like an impossibility. If you catch a glimpse of someone doing it well, you can't help but wonder if their plates are somehow attached to the poles. It may be tempting to dig in and focus solely on coursework and research; after all, that's what you're there for. But most successful graduate students recommend striving for a little more variety than that.

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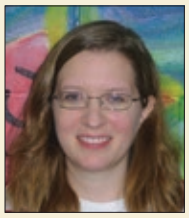
Chemists with whom I spoke encourage students to spend time building relationships, both inside and outside of the university, to prioritize healthy activities such as exercise or sports when possible, and to remain flexible and open with advisors for when (not if!) surprises pop up.

"One regret I have heard from others and that I also feel is that many people put their life on hold while in graduate school. In my own case, I purposely waited until I had an exit date before I even considered marriage and the possibility of a family. Now I wish I'd started sooner, or at least while in graduate school," says one chemist.

Of course, relationships can be tricky. While another chemist notes that many married graduate students seemed more stable and secure than their single colleagues, the stresses of graduate school can undoubtedly strain relationships. Not every nonstudent partner will understand the demands of graduate school, but many will. "I really need to give credit to my husband," says Meghan Knapp, who had been married for two years when she started graduate school. "I really made sure he was on board with my returning to school, so it was a family decision... He really helped me to stay sane!"

PROFILES

inChemistry spoke with three chemists about some of their challenges balancing life and graduate school, and solicited their advice.



MEGHAN KNAPP, who earned her Ph.D. in chemistry in 2006, started graduate school after teaching high school for three years. By the time she started graduate school, she'd been married for two years and owned a home. She had her first daughter the summer between her second and third year, and her mother was diagnosed with breast cancer several months earlier. Two and a half years later, her second daughter was born— right before her dissertation defense.

iC: ***What were some things you did well in balancing graduate school with the rest of your life? Any recommendations?***
MK: I wanted to stay plugged in with the other grad students, especially since I wasn't going to be on campus as much. We invited them over to our house a few times, and I made sure to stay involved socially with the other grad students as well. This really helped to create a support network on campus. I found other "nontraditional" grad students, as well as others who were considering getting married.

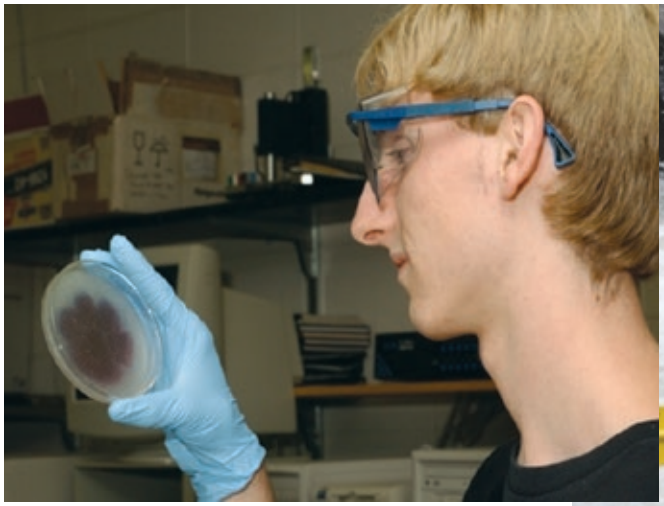
One of the key things is to select an advisor willing to work with you. I interviewed several advisors and mostly discussed their research, but I also tried to get a sense of the expectations of hours spent on campus and flexibility. Some types of research are going to demand that you be on campus at odd hours. Fortunately, I was able to find research I loved that I could do mostly during the day. Of course, that meant I couldn't wait until 10 to come in; I had to be there early if I wanted to go home early.

I tried to keep realistic expectations about what I could do and to be very upfront with my advisor. Communication is really key. When we had to change daycare centers on short notice, I knew that would affect my work schedule. Even though my advisor wasn't over my shoulder every moment of the day, I didn't want to miss work without letting him know why. I also let my advisor know right away about my mother's condition. That way, when I needed to go out of town for her surgery, I was able to take care of things smoothly rather than dumping it all on him at once.

In response to requests from several graduate students, the department worked on a policy to handle pregnancy and maternity leave. I tried to arrange things on my own for my first pregnancy, but it would have been much better if the policy were already in place. Finding an ally with some authority can really help make changes. While some may be more sensitive to your needs, professors who haven't gained tenure may be reluctant to make waves.

Several chemists urge students to carefully interview advisors and labs before making decisions. "Interview potential advisors over and over again, and talk to people in the group," advises Daniel Lutterman. "There are lots of good projects, but you want to be sure that you are a good fit for the lab environment." Christopher Pollock, a second-year graduate student at **Cornell University**, agrees. "From my experience, your choice in advisors is critical to how flexible you can be in grad school." Deciding early on that you are committed to a balanced life while in graduate school means that you will be more likely to choose an advisor and a lab environment that will be supportive of that.

Another chemist suggests that students make time to build relationships with more than one professor in the department. "Get to know at least two other professors in the department really well. You always need three letters of reference later on anyway," he says.



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SOUTHEASTERN EXPEDITIONS, INC

Christopher Pollock in the lab and taking some time out to enjoy a whitewater rafting adventure with friends.

Before **ANDY KIDWELL** graduated with an M.S. degree in chemistry in 2002, he had decided early on that completely immersing himself in graduate school wasn't going to work. He also made sports a priority, playing on recreational and intramural basketball, softball, and football teams. When his advisor accepted a position at another university, he chose to move with him and, in the process, gained some valuable insider experience in moving and setting up a lab.

iC: ***How did you balance graduate school with your other interests? Can you share any lessons you learned?***

AK: To me, it was very important to have friends to socialize with from inside my department and school. It was equally important to nurture friendships outside of school, for many reasons; I spent a lot of time building those relationships, many of which are still active today.

iC: ***Looking back, what do you wish you'd done differently? What advice would you offer?***

AK: Moving during your graduate studies is an extra burden. If, during your career, you need to set up a lab, having such an experience can help you know what really needs to be done when so you can maximize your time. However, moving will cost you valuable research time. At some point, you have to just pack as well as possible and let the movers do their job. On the arrival end, the goal should always be to unpack and get back up as fast as possible. Don't let it cost you too much time.

DANIEL LUTTERMAN received his Ph.D. in chemistry in 2007. He got married the summer before graduate school, and his children were born while he was in school. Having played baseball in college, sports were a priority outlet for him as well.

iC: ***How did you succeed at balancing graduate school with the rest of your life?***

DL: Put some time into trying to relax. I see a lot of graduate students who work from dusk 'til dawn. The results come a lot easier when you learn not to stress so much!

iC: ***Looking back, what do you wish you'd done differently?***

DL: I wish our families had been closer to Ohio State. We were both separated from our families and, since we had our children in graduate school, it would have been a lot easier if we had not been living so far apart. iC

Several chemists mention intramural sports and exercise as key parts of their life in graduate school. For other students, maintaining a favorite hobby — photography or music, for example — was a priority. Students who are involved in regular exercise, sports, or other activities have a natural release valve for stress and build a supportive network of friendships outside of the lab. "It is important to take care of yourself," says Knapp. "That means getting exercise or doing something relaxing to help relieve the stress."

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Of course, there is a limit to the number of plates even the most accomplished acrobat can spin. Some semesters, two plates will be plenty, and you'll pat yourself on the back for keeping just those two aloft. Other semesters, you'll be willing to pick up two or three more. The key is knowing when two is enough and, when you have space for more, always being as graceful as possible in the transition.

For the acrobats, the applause doesn't come until the end of the performance, when the dancers drop their plates and poles and the audience lets out its collective breath and cheers. In grad school, don't forget that there *is* an end. You *will* drop those plates with a soul-satisfying crash... and then walk off the stage, hopefully to thunderous applause.

As you consider what is worth your time and energy, remember that graduate school is only temporary. Don't neglect lifelong pursuits — be they relationships or hobbies — because of this fleeting performance. While spinning extra plates may take a bit more concentration, you will be glad at the end that you put forth the effort to do so. iC

Allison Proffitt *is a writer and editor based in Singapore and covers science all over the world. When she's not writing, she's traveling as much as she can.*

Research Projects: *A Matter of the Right Chemistry*

BY KELLY BOATRIGHT SEXTON

Not so long ago, I was a graduate student slogging away in the laboratory, with no light at the end of the tunnel. The project that I had been working on for the past two years was a high-profile project that aimed to open up a whole new field for my laboratory. It was the type of project that seems to draw young idealistic graduate students in droves: exciting, risky... and going nowhere.

A big problem was that my project was outside of the core expertise and focus of my lab, with the end result being that I wasn't able to benefit from the guidance of the more senior graduate students and postdocs.

Fortunately, midway through my third year in graduate school, a postdoc in my lab proposed that I work on a small side project that would answer some questions that had resulted from his work. At first glance, my new project did not seem to be terribly exciting, but by this point I just wanted to get my hands on publishable data. The thought of standing in front of an almost completely data-free poster at yet another conference, talking about experiments that I planned to do (once I got the project working) was more than I could bear. Since I had little to lose except my time, I decided to give it a try.

With my new side project, I was working in an area that fell within the core competencies of my lab for the first time in my graduate career. Additionally, the postdoc who had proposed my side project was an advocate with a vested interest in my success. I received excellent technical advice from those around me and began churning out data in no time. As it turned out, the results that I generated were exactly the opposite of what we had anticipated, and my side project quickly became my main project. My research led to a controversial hypothesis that eventually became the cornerstone of my thesis and the springboard to several first-author papers in respected journals.

Fortunately, my story had a happy ending, and I was able to graduate in just under five years, despite the fact that not one single experiment from my first two-and-a-half years of research ended up in my thesis. But we have all heard horror stories of the seven- or eight-year dissertation and, while you can never completely control for this scenario, you can take precautions to avoid having it happen to you.

Take care in selecting a lab

For starters, it is crucial that upon entering graduate school you select the right lab. Do your research! Find out how many graduate students your potential advisor has trained. Where are they now? How long did it take them to get their Ph.D.s? Give them a call and find out first-hand what they thought of the lab. Of course, if you are considering training with a new professor, you can't rely on their past record, but you can inquire about their expectations of a graduate student working in their lab. If a potential advisor expects a minimum commitment of six years in order to complete your graduate studies, you should at least know that up front.

Evaluate potential projects

Once you are in the lab, you should choose your main project carefully. Ideally, this would involve hours of discussion with your

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advisor and other members of your lab, during which your technical skills and scientific aspirations are considered and carefully matched with potential projects.

In reality, the scenario may fall somewhere between your advisor telling you exactly what project to work on, or your advisor taking off for a few weeks to go on the conference circuit while you figure it out yourself.

Either way, if you have any choice in the matter, I would advise against selecting a risky project, particularly one that is of interest to no one in your lab except you and your advisor. It is great to be independent as a postdoc, but your job in grad school is to graduate!

The most efficient way to gain new technical skills and develop into an independent researcher is to learn from the more experienced members of your lab. By having a project that is synergistic with the overall research focus of the lab, you are setting yourself up for success.

Take on side projects

A wise researcher once told me, "You should always be doing 10 things at once — one of them will work!" While I don't advise overextending yourself, I do think it is a good idea for most graduate students to have a side project or two. In fact, if you have decided not to heed my warning regarding risky main projects, having a safe side project is even more crucial. In addition to providing a backup plan should your main project fizzle, a side project can allow you to pick up additional skills and techniques that you might not have encountered otherwise.

I would recommend that your side project be one that is almost guaranteed to produce publishable results; try to pick the "low hanging fruit" of your lab. Often, a great opportunity for a side project is created by an exiting graduate student or postdoc. If possible, spend a few days chatting with them before they leave. Buy them coffee, take them out to lunch. You might be amazed at the new directions that they had in mind for their project that they will not be able to follow up on. An alternative source for side project leads is to read the dissertations of some of the recently minted Ph.D.s from your lab.

An additional benefit of a side project is that it will also allow you to retreat from your main project during periods of frustration. When you feel like setting your lab notebooks on fire, you can take a break and work on your side project for a few days (or weeks). Sometimes this can allow you the distance to frame the problem in a new way, resulting in a better approach when you return to it.

Make lemonade out of lemons

Finally, what should you do if you find yourself stuck with a project that is turning out to be a lemon? I would advise sitting down with an experienced and objective researcher and going over your progress to date. If they can't advise you on a new approach, perhaps they can help you to identify portions of your data that could be turned into a small publication. It may not be the splashy paper that you had envisioned, but even a modest publication can help you to gain the closure you need in order to move on.

Sometimes you just need to cut your losses. After a point, you do not learn anything more from beating your head against the wall over and over again with a failing project. Time spent on a project that is later abandoned is not wasted. Those years spent laboring at the bench while nothing worked? You were learning how to do research and gaining the skills that would allow you to take advantage of the opportunity when you finally had a project worthy of your devotion. iC

Kelly Boatright Sexton *obtained her Ph.D. from the University of California, San Diego. She completed postdoctoral training at Stanford University in 2005 and is currently a Senior Licensing Associate in the Office of Technology Transfer at North Carolina State University.*

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The Teaching Assistant's Guide to Success

BY AMY M. HAMLIN

The first few weeks of graduate school can often be over-whelming; between adjusting to living in a new area, taking several graduate courses, and researching possible Ph.D. advisors, you will probably feel like you are being pulled in too many directions at once. Along with these responsibilities, many first-year graduate students are expected to serve as teaching assistants (TAs) for a laboratory course or discussion section. This responsibility is often one of the top worries for an incoming graduate student. But even though teaching can be stressful, it can also be one of the most rewarding experiences of your first year.

Surviving the first day

You may feel nervous about your first day of teaching. With intimidating eyes staring back at you and students expecting you to share your knowledge with them, you may be asking yourself such questions as, "Am I qualified to teach other students?," "Will the students take me seriously and listen to what I say?," "Will I be able to answer the students' questions sufficiently?," or "Can I take command of a classroom or laboratory when needed?"

Yes, it may feel strange to be the one standing in front of the room teaching a course that you took only a year or two ago. But remember, you are teaching a subject that you love and excelled at as an undergraduate. Share some of that enthusiasm with your students! If you take your teaching responsibility seriously, your students will take you seriously. Having a sense of responsibility and being prepared for each class will help you to gain your students' trust and respect and will give you authority in the classroom.

The students have confidence that you know what you are teaching, so have confidence in yourself. You do not have to know everything. If you do not know the answer to a question, be honest with the students and admit that you do not know. Have the students help you as you work through the problem, or look up the answer after class and return to the question at the beginning of the next class. The students will probably learn more this way than if you just immediately spit out the answer to them.

Learn your students' names; it will help you to gain their respect and also help you feel more comfortable in front of them. Be sure to prepare the material for each class beforehand; the more prepared you are, the more comfortable you will feel in the classroom. Brainstorm possible sticking points in your presentation or techniques that students might find difficult during experiments, and be prepared to respond to these situations.

Seek help

Remember that you are not alone as you embark on your first semester of teaching as a graduate student. There are many resources available to you as a new TA, including on-campus teaching resource centers and professors or instructors in the department — but one of your greatest resources will be your peers.

Older graduate students were once in your shoes, teaching the same course as you. They can be full of useful advice about how to handle situations you may encounter, such as a rowdy classroom or a cheating student. They can also



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Your first-year classmates can also be a great resource to turn to as you develop your teaching skills.

help you figure out how to balance your time among your many responsibilities. You might even be able to get an embarrassing teaching story or two out of them.

Your first-year classmates can also be a great resource to turn to as you develop your teaching skills. Just as you studied in groups to understand the material you learned in undergraduate courses, you can team up with your graduate school classmates as you learn how to teach. Find the other graduate students teaching the same course as you. Discuss with them that week's material and how best to present it to the students. After each week, sit down together and discuss what went well and what you could do to improve. If your section meets later in the day or week, it is also very helpful to ask someone who has just taught the class about what problems (if any) they encountered.

Solicit feedback

Consider sitting in on other TAs' sections to observe their teaching styles. Everyone explains concepts in a slightly different way, and by observing different ways of presenting the same material you will be able to improve your own skills. They might even have a trick or two that you can use to help your class run more smoothly. It may also prove helpful to ask one or two of your fellow TAs to sit in on your class while you are teaching and have them suggest improvements that you could make.

Your students can also be a great resource. After a few classes, survey your students to ask them what they like and what topics they are still confused about. The students are there to learn, so they will be honest with you about what worked for them and what did not. Each group of students is unique, so it is important to adapt your teaching style to what best fits your students. Be sure to use a variety of teaching styles so as not to favor one type of student.

Begin preparing now

There are also several things you can do as an undergraduate to prepare to teach. The first is to pay attention to the teaching style of your professors during your courses. Notice how they keep the students' attention and how they respond to questions. You can also gain some teaching experience by working as a tutor for other undergraduates. Some colleges will even let undergraduates be TAs alongside a graduate student or professor.

Strive to be your best

No one is a perfect teacher the first time they step up to the board. It is a skill that is continuously developed over years and years of practice. To be a great teacher, you must be able to evaluate yourself and adapt to what works for your group of students.

One technique that really helped me was to keep a teaching journal. At the end of every class, I wrote down what went well and what I could improve upon. This helped me to evaluate what techniques worked for me and what areas of teaching I needed to work on. I would use my notes as I prepared for the next class to improve upon the weaker points. Throughout the semester, I was writing down more and more things that went well and less about what I needed to fix for my next class. Using this technique, I saw a great improvement in my confidence as the semester progressed.

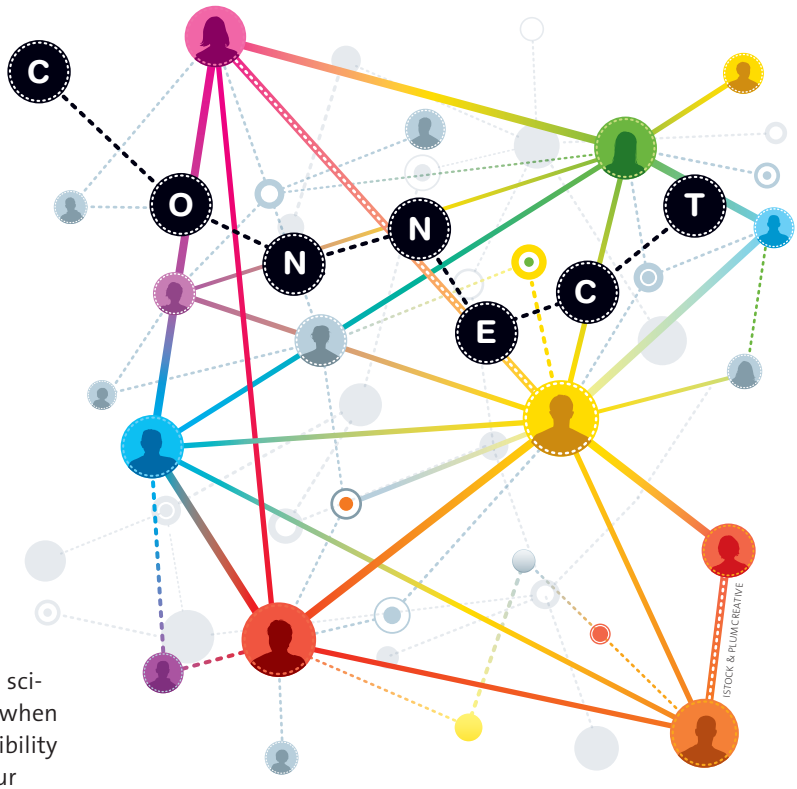
After the first few classes, you will feel more comfortable in front of your students and you will start to realize how rewarding teaching can be. It is very encouraging to help students understand concepts they previously struggled with and to watch students gain an interest and appreciation for the subject that you love. You will also gain confidence in your ability to share your knowledge with others — a quality that will help you greatly throughout your graduate school career. Remember to enjoy teaching: it is a great learning experience, and it can also be a lot of fun. iC

Amy M. Hamlin *is a first-year graduate student at the University of California, Berkeley, studying synthetic organic chemistry. She received her B.S. from the University of Detroit Mercy, where she was involved with the ACS student chapter.*

ACS RESOURCES: Easing the Transition to Graduate School

How the ACS Graduate and Postdoctoral Scholars Office Can Help You

BY JOE Z. SOSTARIC AND CORRIE Y. KUNIYOSHI



ISTOCK & PLUM CREATIVE

If you decide to pursue graduate studies in the chemical sciences, you will find that more is expected of you than when you were an undergraduate. Greater personal responsibility is just one example — first, relating to your studies and your research work, and later, with regard to your status as a freshly minted master's or Ph.D. chemist.

You'll also find differences between the types of ACS offerings and programs available to you as a graduate student compared with those programs offered by the ACS Undergraduate Programs Office. To help you successfully adjust to this transition, this article will introduce you to the offerings of the ACS Graduate and Postdoctoral Scholars Office (GPSO) and give you a few tips on how best to access and make use of the many programs and resources ACS offers to the graduate and postdoctoral scholars (GPS) community.

Access online resources now

The GPS community webpage, www.acs.org/grad, should be the first place you go as an aspiring graduate student. You'll find relevant and useful information on how to plan for and find the right graduate school, links to grants and fellowships, information for international students coming to the United States from abroad to study, and access to the many programs and resources ACS offers to the GPS community.

The *ACS Graduate & Postdoctoral Chemist* is e-mailed monthly to ACS graduate student members and subscribers. Subscribe to this free publication and take the time to read the *Bulletin* articles on careers and various opportunities and resources targeted to graduate students and postdocs. The information will help you gain a broader perspective on the chemical world around you. The magazine also lists funding and volunteer opportunities, science news, and meeting announcements. (See current and past issues, and subscribe to receive the magazine at www.acs.org/gradchemist).

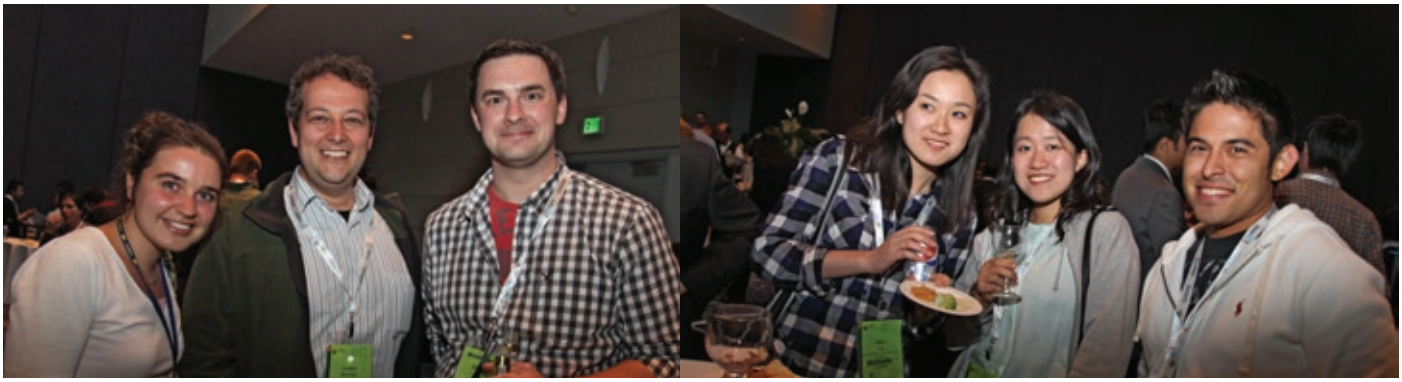
Connect with ACS, and students like you, for excellent networking opportunities

Connect with other graduate students

The ACS Graduate Students page on Facebook will help you connect with other chemistry graduate students. This page provides an excellent forum for networking with other chemists at similar points in their careers, and also for keeping in touch with GPSO staff. You'll get regular updates on topics and programs that are timely and relevant, receive invitations to special events at ACS national meetings, and become eligible for thank-you gifts by participating in our surveys. To access the ACS Graduate Students page, go to www.facebook.com and search for "ACS Graduate Students."

Ask Your Graduate Chemistry Department to Host a Workshop!

Help spread the word! The Preparing for Life after Graduate School workshop provides invaluable information on the job search and recruitment process, and GPSO wants to partner with your graduate chemistry department and/or graduate school to bring this resource to graduate students and postdocs. For more information, contact Corrie Kuniyoshi at graded@acs.org or at (800) 227-5558, ext. 6864. iC



PHOTOS: ACS

The ACS GPSO provides opportunities for graduate students to connect with one another. One of the most popular events is the Graduate and Postdoctoral Scholars Reception, which is held at every ACS national meeting.

A Graduate and Postdoctoral Scholars Reception is held at every ACS national meeting, usually from 7:00 to 8:30 p.m. on Monday, just before the popular poster session Sci-Mix. This reception generally attracts more than 700 graduate students and postdocs, who enjoy and evening of complimentary refreshments, opportunities to network with ACS technical division representatives, and a chance to win an iPad.

Get Involved!

ACS is committed to building a strong chemistry graduate student community through GPSO and other programs and activities. However, because the decisions you make as a graduate student may have long-ranging implications later in your career, the responsibility falls mostly on you.

Given this fact, you cannot afford to wait for opportunities to come knocking on your door. Start planning for your success early! Become involved with groups within ACS, such as the Younger Chemists Committee, your local section, and technical divisions. Seek out mentors, network with your fellow students and other chemists at ACS national meetings and, most of all, make sure you know how to go about starting a successful career.

STAY INVOLVED

The period in your life where you must take a proactive role to be successful begins now. ACS has the programs and resources you'll need as a graduate student — but we will need to hear from you and your fellow students and postdoctoral colleagues in order to deliver many of these services to you.

Be sure to stay in touch with us and the GPS community so that your needs can be met. Indeed, whether you're an undergraduate student considering graduate school, or you've already taken that step, join the ACS Graduate Students page on Facebook today and leave a post on the wall to let us know that you've arrived! We'll be glad to welcome you!

If you have any questions about the programs and resources available through the ACS GPSO, or would like to share any comments or concerns, do not hesitate to connect with us at GradEd@acs.org. We look forward to serving you!

Plan your career

Depending on your particular situation as a graduate student, the responsibility for career preparation may fall largely or entirely on your shoulders. The two-day Preparing for Life after Graduate School workshop (www.acs.org/gradworkshop) is organized by ACS GPSO with the support of a host chemistry department, and provides senior graduate students and postdoctoral scholars with information, tools, and strategies on making career choices, obtaining positions, and other challenging tasks. This unique workshop will enable you to:

- **Examine careers suitable for Ph.D. chemists**
- **Get to know the critical non-technical skills that employers look for in candidates**
- **Find employment opportunities**
- **Prepare for academic positions**
- **Learn to put this knowledge into practice.**

Joe Z. Sostaric *is manager of the GPSO at ACS. He obtained his Ph.D. in chemistry in 1999 at the University of Melbourne, Australia, and has worked in scientific research, consulting, and graduate education.* **Corrie Y. Kuniyoshi** *is a senior education associate in the GPSO at ACS and editor of* ACS Graduate & Postdoctoral Chemistry. *She obtained her Ph.D. in chemistry from the University of California, Los Angeles in 2005.*

Graduate Students and Recent B.S. Recipients Receive Discounts on ACS Dues!

A person who is a full-time graduate student, majoring in a chemical science or related academic discipline, is entitled to a discount of one-half of the membership dues. Special student subscription prices for most journals are available.

In addition, if you are graduating with a bachelor's degree in a chemical science, you may apply for membership within one year from the date of graduation to receive an extra discount of one-half of the membership dues.

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