

The Magazine for ACS Student Members
April/May 2011

in Chemistry

Transitions



Planning Your Next Move



ACS
Chemistry for Life™

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Preparing for Your First Research Project, p. 13
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PEPPERDINE UNIVERSITY



COURTESY OF TIM TRUST



MIKE CIESIELSKI

Cover art: Dreamstime Stock Images. Fractal-generated lancet-shaped chains, connected into structures, look like bacteria or algae under a microscope. Inset photo: Students participating in undergraduate events at a recent ACS national meeting.

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On to the Next Thing

BY MALIKA JEFFRIES-EL



DAVID GIESKE

In the lyrics of his hit song, "On to the Next One," Jay-Z tells us that even though he is a successful rapper, designer, and business mogul, he's always planning a few steps ahead — a great strategy that has kept him ahead of most of his competition.

Normally, I don't recommend taking advice from rap songs, but Jay-Z is correct in that you should not rest on your laurels and celebrate your current success before you plan your next move. As many of you head toward the end of your undergraduate career, now is the time to plan your future.

Fortunately, a degree in chemistry opens the door to a variety of opportunities, including employment right after school, an internship, or a graduate program. However, all of these things take time to apply for — so plan accordingly.

Moving forward to the coming 2011–2012 academic year, if you decide to pursue a graduate degree in chemistry or some other discipline, you will need to send in your applications sometime between December and February. Since you will need transcripts and letters of recommendation, you should line those up at the start of your senior year. You should also plan on visiting the programs that you are accepted to, so try to consider that when planning your spring class schedule. If you decide to enter the workforce, consider that many companies have a hiring cycle that creates new positions at the beginning of their fiscal year, which is usually July. You will also need to prepare and send out résumés and cover letters.

Whichever pathway you decide to take, know that time and knowledge is power. An excellent approach is to take advantage of the various services available to you through the ACS. If you are looking for a job, consider attending an ACS national meeting and taking advantage of the numerous on-site interviews offered. Also, attend the workshops on interviewing and résumé preparation offered by ACS Career Services. If you are looking for a graduate program, attend a graduate school recruiting event and meet with representatives from dozens of programs in one day. If you can't make it to the meeting, the Society has lots of information available to you on its website, www.acs.org.

Looking back to when I was finishing college, I recall that it was one of the most exciting times of my life. As scary as it may seem, decisions that you make today will greatly impact your future. Think about what you want from life, and then research what it will take to achieve your goals. Remember, to quote writer Eudora Welty, "It doesn't matter if it takes a long time getting there; the point is to have a destination." **ic**

MALIKA JEFFRIES-EL is an assistant professor of chemistry at Iowa State University and an associate member of the ACS Society Committee on Education.

BY ROBIN LINDSEY

Do you have questions about ACS student chapters or other programs at ACS? If so, e-mail us at undergrad@acs.org and we'll find your answer.

Q What services does the ACS Undergraduate Programs Office offer to chapters?

A The Office supports student chapters in a variety of ways, by providing chapter awards and recognitions, programming at national meetings, ideas for chapter activities, grants to support chapter activities and travel to national meetings, and leadership training opportunities for chapter officers. In addition, individual student members also receive a host of benefits, including this magazine, career services, and much more. For more information, go to www.acs.org/undergrad.

Q How can I establish a checking account for our student chapter?

A Before opening a checking account for your chapter, you will need to obtain a federal Employer Identification Number (EIN) number. You can get the number instantly online at www.irs-ein-online.com or by completing the SS-4 Federal Tax ID form.

Q How do I order ACS bumper stickers?

A Bumper stickers are available from the Undergraduate Programs Office. To place an order, please call us at 1-800-227-5558, ext. 4480 or 6166, or e-mail us at undergrad@acs.org. We offer quantity discounts, and shipping and handling charges are extra.

Q What is the process for sending in our chapter report?

A You must submit your chapter report online through Manuscript Central at <http://mc.manuscriptcentral.com/saacs>, so make sure either your chapter president or faculty advisor has an online account with this Web-based resource and locate the chapter's OPEID code so you can upload your report to the system. The OPEID code is an eight-digit number that is included on the official list of student members you received from ACS last fall. Once you have successfully uploaded the report and your attachments and photos, our office receives an e-mail from Manuscript Central informing us that your chapter report has been received.

Q How do I order ACS Exams Study Guides?

A Before ordering the study guides, make sure that your chapter has active ACS status, which means that six or more members of the chapter are also ACS student members. All active student chapters may contact the ACS Exams Institute at Iowa State University to order ACS Exams Study Guides. The address is: ACS Exams Institute at Iowa State University, 0213 Gilman Hall, Ames, IA 50010; 1-800-854-1672 (phone), or 515-294-4492 (fax). **ic**



ROBIN LINDSEY is a program administrator in the ACS Undergraduate Programs Office.

Share what's going on in your chapter! If your chapter would like to be featured in the ACS Student Chapter Spotlight, please contact Audley Burke at 800-227-5558, ext. 4565, or a_burke@acs.org.

COMPILED BY AUDLEY S.V. BURKE

Winthrop University Rock Hill, SC

Chapter president: Ethan Nichols
Number of chapter members: 35
Number of ACS student members: 5
Institution environment/ composition: Small, public, suburban, 4-year institution

Q How do you ensure a smooth officer transition from year to year?

A We elect our officers each February, and they serve as "officers elect" until the current officers step down a few months later in May. By shadowing the outgoing officers before they take office, the new officers learn their responsibilities and how to be effective in their positions.

Q How have you "Put a Human Face on Chemistry"?

A Each year during National Chemistry Week (NCW) we perform simple and entertaining chemistry demonstrations for elementary school students at the local natural science museum, including some interactive hands-on activities. Our goal is to promote an interest in chemistry and science in our community, especially among young students.

Q What are some of the interesting ways your chapter recruits its members?

A We send e-mails to all chemistry majors inviting them to our first meeting each semester, where we usually serve pizza and soft drinks. In addition, we post flyers in the chemistry building to advertise the chapter and upcoming events and meetings. In recent years, we have also created chemistry-themed T-shirts that we sell as fund-raisers; as an added benefit, when students wear the T-shirts around

campus, it advertises the chapter and helps bring in new members.

Q How do you retain members from year to year?

A We try to engage the members of the chapter in regular and frequent activities, such as fund-raisers, demonstrations for NCW, and meetings with guest speakers.



WINTHROP
UNIVERSITY

Q What are your most popular or unique chapter activities?

A In the spring, we make and sell liquid nitrogen ice cream at a busy area of campus as a fund-raiser and to promote awareness of the organization. Students also really enjoy interacting with the elementary school students during our NCW demonstrations.

Q What professional development activities do you sponsor?

A At the beginning of each fall, we organize a poster session where students who have completed summer research can share their experiences and results, show off what they have learned, and help

get freshmen and sophomores interested in research.

Q What innovative methods of communication are used?

A We have recently started a Facebook page for the chapter and we are using it to keep members and other students informed about upcoming events and activities.

When the new officers aren't sure what to do, I try to remind them of what has worked in previous years.

Q What has been the most rewarding aspect of your service as a faculty advisor?

A I have enjoyed helping the students get interested in chemistry and science, and share their interest with the community.

Q What advice can you offer those new to the advisor position?

A I try to let the students run the show as much as possible. I only get involved with the business side of things if there is a problem, or they need a liaison with other parts of the university.

Faculty advisor

Aaron M. Hartel, 4 years

Q Why/how did you become a faculty advisor?

A When I first came to the university, I started attending the chapter meetings. My involvement at the meetings led to my volunteering to become the advisor.

Q What challenges have you faced in your position?

A The biggest challenges have probably been keeping the chapter active and organized from year to year. Each year brings new officers with different levels of interest, energy, and leadership ability.

The University of Texas at Dallas Richardson, TX

Chapter president: Martin K. Huynh

Number of chapter members: 52

Number of ACS student members: 11

Institution environment/composition: Large, public, suburban, 4-year institution

Q How do you ensure a smooth officer transition from year to year?

A We have our elections soon after the spring semester begins, usually around February. Outgoing seniors can focus on final projects and graduate school affairs while new officers can get accustomed to their positions with the guidance and support of the outgoing officers.

Q Do you have any unique or specialty positions?

A We have a social chair that is responsible for fall and spring barbecues, the homecoming competition, the spring banquet, and broomball games with faculty and graduate students. Our university also has a Student Organization Forum (SOF), and we have two representatives who attend SOF meetings, help register the organization each semester, and keep us updated on university rules regarding student organizations.

Q In what ways does your chapter give back to the community?

A We have a strong tradition of performing demos and teaching experiments (slime, paper chromatography, etc.) to elementary and middle school children, Boy Scouts, and other youth groups. We have created portable kits that contain all of the materials, equipment, and procedures for hands-on experiments that can be delivered to elementary schools. We have also been involved in off-campus science events at the Dallas Museum of Science and Nature, local libraries, and Texas Instruments. Last but not least, we judge local science fairs in conjunction with local politicians, engineers, and scientists.



COURTESY OF UNIVERSITY OF TEXAS AT DALLAS



Q How do you retain members from year to year?

A We have meetings that cater to the diverse career paths of our members: professors who talk about undergraduate research and graduate school, medical school officials who talk about admissions and research, and campus supplemental instruction officials who talk about peer-led tutoring or other on-campus teaching opportunities. We also involve the membership in planning and implementing a wide range of chapter activities.

Q What types of activities do you sponsor?

A Our signature service event is Kids in Chemistry Day, where we invite 100 local fifth graders to the UTD labs to do experiments, view demos, have lunch, and then dump slime all over our faculty advisor or an unlucky officer! Each semester we also play broomball games that pit undergraduate students against faculty and their lab teams.

Q Do you collaborate with other campus clubs on activities?

A We work with pre-health organizations by sharing speakers from medical schools who talk about research, the choice between M.D. and Ph.D. programs, admissions, etc. We also help the service fraternities with their annual math and science camps for elementary students by leading all of the chemistry activities.

Q What is your most successful fund-raiser to date?

A Our goggle sale happens at the beginning of each semester. We also sell shirts, pens, organic reaction tables, and other necessities for students at cheaper prices than the campus bookstores.

Faculty advisor

John W. Sibert, IV, 7 years

Q What challenges have you faced in your position?

A Involving the full membership in as many activities as possible and maintaining relevance/engagement by continuing to evolve activities and develop new ones (i.e., not resting on our laurels).

Q What has been the most rewarding aspect of your service as a faculty advisor?

A Watching the development of the members as people and students. In addition, I enjoy seeing the genuine happiness of the younger "scientists" that we engage in our community activities; we validate their natural curiosity in the world around them.

Q What advice can you offer those new to the advisor position?

A Create an environment of possibilities for the members such that creative proposals for a range of activities are supported. The next step is to ADVISE by helping make the proposed activities happen, but NOT directing the activities. Saying "Yes, you can" to the students instead of "No, you can't" means more work — but also more rewards! **IC**

GOT FACEBOOK?!

We have developed a Facebook page, complete with group and fan pages. Student members can access this page to learn about happenings at ACS, view pictures from meeting events, and network with other student members nationwide. Just look up Audley "UNDERGRADPROGRAMS" Burke in the search box and send us a friend request.

Why Wait? Join Now!



CSI: PEPPERDINE!

A Case of Collaboration between
an ACS Student Chapter and
Local High School Students

BY DAVID GREEN AND JOE FRITSCH

IT'S A CASE OF INDUSTRIAL espionage! GreinAnalytix, LLC has developed a powerful new performance-enhancing drink that consists of an iron supplement, sugars, an organic flavoring agent, and a secret ingredient: a cologne featuring α - and β -pinene and limonene. Made from common natural ingredients and undetectable by any common drug testing facility, it is so powerful that an athlete using it can run a 5K race at speeds only seen in the 100M dash! Unfortunately, others want the recipe ... and they'll pay or DO anything to get it.

Two senior chemists at GreinAnalytix, Doctors Tyrone Shoolaeces and Ivana Kikboodie, are leaving the lab one evening — and Shoolaeces is secretly carrying two complete sets of the separated ingredients to sell to a competing company for a huge profit. Tyrone stops to retie his shoes, and Kikboodie goes on ahead.

Later, Kikboodie finds that Dr. Shoolaeces has fallen — or <gasp!> been thrown — from the balcony (and also shot, for good measure). The question is, *Who done it?*

So begins *CSI: Pepperdine*, a chemistry outreach activity between the Chemistry Department of **Pepperdine University, Malibu, CA**, the local student chapter, and students from Hillcrest High School in nearby Granada Hills.

Originally under the sole direction of David Green (whose brother, James Green, was the high school chemistry teacher at Hillcrest HS), *CSI: Pepperdine* is a chemistry-based “whodunit” ... and



A Pepperdine University chapter member helping students analyze absorbance spectroscopic data.

one of the most interactive of a long line of Pepperdine outreach programs for the surrounding community. Over the past 10 years, hundreds of students have benefited from the collaboration of these chemistry instructors.

Until three years ago, high school students would come to Pepperdine for a "Chemistry Day" during which GC/MS, HPLC, IR, and absorbance analyses were completed. Starting in 2007, we have co-administered the program, along with student volunteers recruited from Pepperdine's ACS student chapter. We re-cast the standard on-campus visit as a "whodunit" and added new tests for the students to do.

Now the high school students are divided into five forensics teams that collect evidence from each of four separate suspects, and one team is given the "authentic" performance-enhancing elixir. Each team analyzes its evidence, and then the whole group reconvenes to identify the perpetrator by comparing individual team results to the authentic sample.

The high school students rotate through five analysis stations to analyze their evidence:

- Fingerprinting the composition of the cologne compounds with GC/MS sampled by solid-phase microextraction.
- Sugars analysis for sucrose, glucose, and fructose with HPLC.
- Iron analysis by quantitation with iron thiocyanate with a calibration curve derived by each team using absorbance spectroscopy.
- Gunshot residue analysis for Cu and Ba qualitative chemical tests.
- Identification of organic flavoring agents with infrared spectroscopy by comparison to a library of compounds.

At each station, the analytical tests are designed to be completed by the high school students themselves (or with minimal assistance from chapter members). After all of the data have been collected, the teams regroup to determine the perpetrator. Three of the four suspects have evidence that yields a combination of positive and negative results, while one has evidence identical to the "authentic" samples. Through data comparison between teams, suspects are ruled out for not having "the evidence" consistent with the authentic sample, and the guilty party is identified.



Top and bottom: Hillcrest High School students making a determination of iron using absorbance spectroscopy
Right: Pepperdine University chapter members posing at the crime scene



The Pepperdine University chapter members are integral in making each edition of *CSI: Pepperdine* a success. They participate in setup of the chemicals and instruments in advance of the big day. During the event, the members explain to the participants how each instrument or test works, and they train a member of the team to complete the test. The members guide the high school students through the data collection and analysis.

As a result, they interact very closely with the students, and often even pose as the suspects!


The high school group is

comprised mostly of under-represented minorities, and the students vary in their chemistry abilities. Our experience and the comments by the chemistry teacher indicate that the high school students love interacting with chapter members, whom they view as accomplished scientists. For some of these high school students, attending college is not necessarily one of their goals. This event brings them onto a campus and, by working with student scientists, opens their eyes



to the possibility that they could attend college one day, and perhaps they themselves could lead a similar event.

Also, being exposed to a college setting in laboratories, classrooms, the cafeteria, etc., expands their view that the college students aren't so different from themselves, and they could do it too.

Early in each spring semester, the faculty and student members begin thinking about the who, what, where, and when of *CSI: Pepperdine* in anticipation of the event. With each passing year, we have refined and modified the overall schedule of the day-long event and the chemical tests. We expect that the coming year will be a success with the continued support of the Pepperdine University ACS student chapter. 



JOE FRITSCH is an assistant professor of chemistry and an ACS student chapter advisor at Pepperdine University. **DAVID GREEN** is a professor of chemistry at Pepperdine University. He has been involved in science outreach programs since 1980. In 2007, the authors co-created *CSI:Pepperdine*.



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***Capturing the energy and enthusiasm
of ACS student members ...
showcasing the activities, events,
and accomplishments of
their chapters.***

COMPILED BY LORI BETSOCK



Florida International University (Miami) recruiting new members at a recent university club fair

COURTESY OF FLORIDA INTERNATIONAL UNIVERSITY



Chapter members from University of Tennessee at Martin celebrating a LuAu-themed homecoming

COURTESY OF UNIVERSITY OF TENNESSEE AT MARTIN



Union University (Jackson, TN) members celebrating National Chemistry Week with a semi-formal dinner and a keynote address by Dr. Michael Hayes

COURTESY OF UNION UNIVERSITY



Georgia College and State University (Milledgeville) members sharing chemistry at the Deep Roots cultural arts and music festival

COURTESY OF GEORGIA COLLEGE AND STATE UNIVERSITY



A Guilford College (Greensboro, NC) student helping the environment with the chapter's Adopt a Stream Program

COURTESY OF GUILFORD COLLEGE



The Waynesburg University (PA) chapter providing local high school students an opportunity to experience college-level science at its annual Science Day outreach event

COURTESY OF WAYNESSBURG UNIVERSITY



COURTESY OF WESTERN STATE COLLEGE

Western State College (Gunnison, CO) members posing and spelling out their passion for C-H-E-M-istry atop Mt. Princeton near Nathrop, CO



COURTESY OF XAVIER UNIVERSITY OF LOUISIANA

Members from the Xavier University of Louisiana (New Orleans) participating in community service at a local food bank



COURTESY OF MOREHEAD STATE UNIVERSITY

A student at Morehead State University (KY) enjoying the opportunity to pie a professor at a chapter fund-raiser



COURTESY OF NORTHERN ILLINOIS UNIVERSITY

The Northern Illinois University (DeKalb) chapter fund-raising through its annual glass-blowing demo and glassware sale



COURTESY OF NORTH DAKOTA STATE UNIVERSITY

North Dakota State University (Fargo) members presenting a favorite demo for area students

Be Candid! Get Your Chapter Photo in inChemistry Magazine!

To get your picture published in a future issue of *inChemistry* magazine, send your high-resolution photos of ACS student members engaged in chapter activities to Lori Betsock at L_betsock@acs.org.



Transfer Students: Moving Forward by Moving On

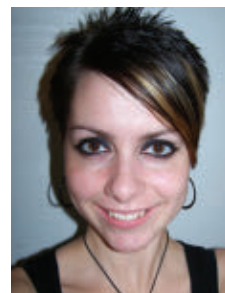
BY BLAKE J. ARONSON

IS THE COLLEGE YOU'RE NOW ATTENDING THE SAME COLLEGE WHERE you started at as a freshman? Or are you thinking about transferring to another college?

Even if you answered "no" to both questions, chances are good that you know someone who is a transfer student or who is considering becoming one. The National Center for Education Statistics estimates that almost 60 percent of all college seniors have attended more than one institution during their college careers. The National Science Foundation reports that around 40 percent of science and engineering bachelor's and master's degrees are awarded to students who previously attended a two-year college.

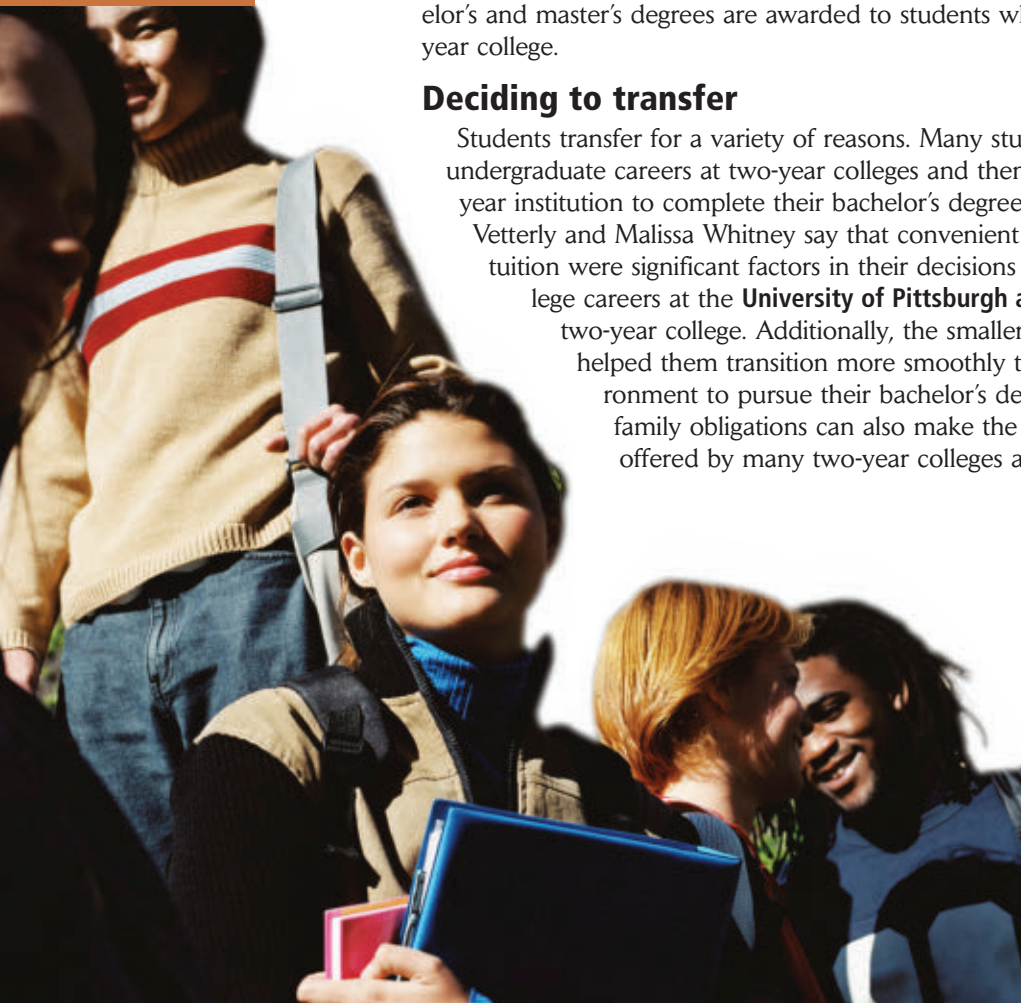
Deciding to transfer

Students transfer for a variety of reasons. Many students begin their undergraduate careers at two-year colleges and then transfer to a four-year institution to complete their bachelor's degrees. Both Stephanie Vetterly and Malissa Whitney say that convenient location and lower tuition were significant factors in their decisions to start their college careers at the **University of Pittsburgh at Titusville, PA**, a two-year college. Additionally, the smaller two-year program helped them transition more smoothly to the college environment to pursue their bachelor's degrees. Work or family obligations can also make the flexible schedules offered by many two-year colleges appealing.



Stephanie Vetterly

COURTESY OF STEPHANIE VETTERLY



Other students transfer from one four-year program to another. Often, students choose these types of transfers to pursue a particular course or major, to take advantage of an institution's location or reputation, or because their starting institution was not a good fit.

Overcoming the challenges

While transferring to a different institution may be a necessary or welcome change, it does not mean that either the process or the experience is easy. According to the 2009 National Survey of Student Engagement, transfer students are more likely to feel marginalized and isolated than non-transfer students. They are less likely to report strong relationships with their faculty and classmates, feel satisfied with their college, and participate in such high-impact experiences as internships, capstone projects, and research with faculty.

Be prepared to deal with feeling isolated as a transfer student. You will face the same challenges that all first-year students encounter — adjusting to a new campus, a new culture, and new financial aid. The courses will be more challenging and you'll be taking them alongside students who have known

Making Transfer Students Welcome

Increasingly, colleges are trying to address the challenges faced by transfer students. Some colleges offer academic advisors specifically to assist transfer students. Others, like **Miami University of Ohio**, **Minnesota State University at Mankato**, and the **University of California at Santa Barbara**, offer "transfer success" courses that provide continuous orientation to transfer students over the course of the term. Still other institutions, such as the **State University of New York College at Oswego** and **Texas Tech University in Lubbock**, offer peer-mentoring programs for new upperclassmen.

Students themselves can help their transferring classmates. If you see a new face in your chemistry class, be sure to introduce yourself. Offering to show transferring students around campus, inviting them to study groups and social events, and offering advice on courses are all ways to make transferring students feel welcome.

A welcoming atmosphere can make all the difference. For example, McBride has nothing but praise for how his institution supported him: "The **University of Arkansas** did everything they could," he says, "to make me feel welcome during the application process and after."

How ACS Student Chapters Can Help Transferring Students

ACS student chapters can play a key role in helping transfer students acclimate. ACS student chapters provide an instant network of people with at least one common interest (i.e., chemistry). Additionally, recruiting transfer students is a smart and mutually beneficial way to boost membership. Here are some things ACS student chapters can do:

- Host a "Welcome to Our College" event at the beginning of the year. Target upper-level classes, in addition to introductory courses.
- Have regular study sessions. Share notes, old exams, and insights about different professors.
- Visit local two-year colleges and other institutions that students might transfer from. Share information about your chemistry program and your chapter's activities.
- Partner with student chapters at two-year colleges and other transferring institutions. If they do not have an ACS student chapter, help them get one started.
- Make time to reach out to the new faces in your chemistry classes.

Transfer students are often trying to find a balance between academics and social activities. Chapter members are in a great position to help students find that balance.

each other for a while and have already made connections. Vetterly found living on campus helped with the adjustment. "I hate to use the phrase," she says, "but I feel like I'm getting more of the 'full college experience.'" Getting involved in study groups and campus organizations (like an ACS student chapter) can help transferring students make new friends and assimilate more easily.

Of course, living on campus can be an adjustment in itself. Ethan McBride, who recently transferred to the **University of Arkansas at Fayetteville**, had to get used to using public transportation, eating primarily on campus, and attending social events, none of which he had done as a commuter student prior to his transfer.



Ethan McBride

COURTESY OF ETHAN MCBRIDE

Choosing a Transfer Institution

Deciding which institution to transfer to can be every bit as challenging as finding the right college to start at. If you are considering or planning to transfer colleges, be sure to consider the following:

- Policies and standards: Will your courses transfer? Can you transfer mid-year? What deadlines are you facing?
- Housing: Can you live on-campus? If not, is there affordable housing near campus?
- Academic system and environment: Does the institution follow semesters or quarters? Do you like the level of competitiveness? Are there opportunities to work (and socialize) with your classmates?
- Support systems: How does the institution support transfer students? What type of access will you have to tutors, counselors, financial aid officers, etc.?
- Social activities: Is there an ACS student chapter? Are there other activities you would enjoy?

Meanwhile, although Erine O'Connor had no trouble adjusting to the social scene, the exams at **The College of New Jersey in Ewing** were a revelation for her. "The work load has not bothered me, because my professor for Organic Chemistry I and II at my community college really prepared me," she says. However, she adds, "The tests are very difficult."

While a new campus presents a wide variety of new opportunities, Vetterly cautions transferring students against trying to do everything at once. In particular, she says, "don't try to cram all your classes into one semester."

Preparing to transfer

Are you planning to transfer? If so, study hard. According to the National Association for College Admission Counseling, most colleges assign "considerable importance" to post-secondary grades when considering whether to accept



Erine O'Connor

COURTESY OF ERINE O'CONNOR

transfer students. McBride agrees, crediting his first institution, **Texarkana College**, with preparing him for the transition. He says that the high expectations of his professors, the academic rigor of the courses, and an emphasis on good study habits helped prepare him to succeed.

Do your research to determine whether your courses will transfer to your new institution. Not all institutions will give you credit for the college-level courses you have taken. Find out which courses will transfer, and also which required courses you will still need to fulfill at the new institution.

You will also want to visit the campus. Spend the night, if you can. Get a feel for the campus and make sure it is a good fit for you. Consider whether you like the other students and the neighborhood, and even the weather. Know the housing situation. How plentiful is on- and off-campus housing for incoming transfer students? Whitney discovered that visiting her new campus helped her become familiar with the layout before classes started.

Whitney and McBride found talking with professors to be invaluable in learning the in's and out's of the new administration, finding the courses they needed, and preparing for the new campus culture. Connecting with professors, McBride says, "not only opens your mind to new ideas, it opens up doors for your career down the road." In the short term, it can help you identify courses and undergraduate research opportunities you may want to pursue; in the long term, such connections can become the first step in a mentor relationship that can help shape your professional career.

McBride also highly recommends hanging on to the notes and materials that you accumulated at your first institution. "You never know when that old organic chemistry test on alcohols might come in

handy. It is sort of like having your own personal study group on campus, where you can reference anything you need from your previous courses."

Vetterly, McBride, Whitney, and O'Connor all agree that the benefits of college transfer have compensated for the challenges. All are excited by the opportunities at their new institutions and are considering post-graduate degrees. "The more you achieve," McBride says, "the less difficult it seems to get to the next level. Soon enough, you might find yourself a leader in a new and innovative field — all because you were excited about it." **ic**



BLAKE J. ARONSON is a senior education associate in the ACS Education Division's Office of Two-Year Colleges.





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Your First Undergraduate Research Project

BY BURT HOLLANDSWORTH



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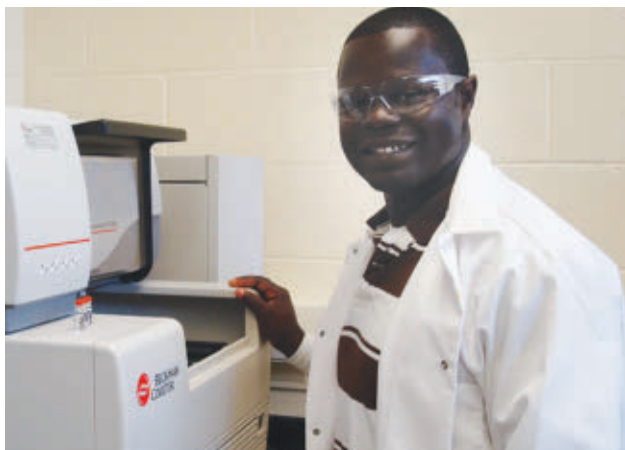
SO, YOU'VE BEEN THINKING ABOUT UNDERgraduate research in the chemical sciences. Maybe your favorite professor has been hounding you since freshman year to stay at school one summer and do some organic synthesis. Perhaps you're feeling anxious about the impending professional school application process, and feel weak in the "research experience" category.

Whatever the reason, considering an undergraduate research project is a good idea. Research can complete the learning process started in your chemistry courses. For many chemists, there is no more fulfilling experience than doing one's part to design and implement experiments that answer a scientific question. But before you begin the project, and before you start even looking for an advisor, there are some important questions you may want to ask yourself.

What kind of research is best for me?

Most research projects can be classified as either "basic" or "applied." Basic research is designed to answer an interesting question about nature — for instance, "Is it possible to make a 1,3-substituted pyrazole starting with hydrazine and a diketone?" The designer may not even have an end use for pyrazoles, but believes that finding a novel way to make them would be an interesting undertaking that requires extensive experimentation.

Applied research, on the other hand, could be described as seeking to develop a new technology or method to be used for a specific purpose. For example, in industry, applied research often centers on discovering new scientific knowledge regarding the commercial application of a product, process, or service. A good example would be, "Is it possible for us to



Emmanuel Quainoo, a graduate student in the Mwongela Research Group.

COURTESY OF KENT STATE UNIVERSITY

develop a method to find peroxide explosives on clothing at a ppb level using mass spectroscopy?" Applied research projects are less open-ended than those involving basic research and lead to more definite applications in the "real world."

If you want to be able to tell your friends and family about a tangible application of your research, you should probably pursue a more applied project. If you are more interested in learning something new and exciting for its own sake, either applied or basic research might work well. Often, professors will have ideas for projects that span the continuum between applied and basic research.

Which research area is best for me?

There is no chemistry research project that works equally well for all students. For example, if you hate column chromatography, then organic synthesis might not be a good choice. If you enjoy analyzing the same types of samples over and over and then finding meaningful patterns in the data, you might prefer research involving analytical chemistry.

Many professors are both teachers and researchers, and many are willing to design undergraduate projects related to chemical education for students who plan to teach. Do not be afraid to suggest a project topic to one or more faculty members at your institution. You might be surprised when they are able to find a connection between your interests and ideas of their own. They may even want to collaborate with another faculty member to advise you on a cross-disciplinary project.

Keep in mind that some advisors might require that you complete some prerequisite coursework before starting research. But this is not always the case; many projects can be easily adapted for students with nothing more than general chemistry experience.

Research during the semester will be a good test of your ability to juggle multiple responsibilities.

When should I do research?

The short answer to this question is, "summer." It is not wise to try to cram your first research project into a regular semester. Undergraduates are notoriously busy people, and you do not want to put yourself in the position of having to choose between doing research and completing your regular coursework. Summer will provide you with many continuous weeks devoted solely to your project, free of the distractions of the normal school year.

Another advantage of doing research during the summer is that professors tend to have smaller teaching loads, and therefore are less distracted and can devote more time to mentoring undergraduate research. Remember to devote the last couple of weeks of the summer to writing the results of the project in a concise document with the aim of aiding other students who might continue in the same line of research.

After you have completed one or two summers of research, you might consider taking a reduced course load one semester and signing up for some hours of independent research credit. Research during the semester will be a good test of your ability to juggle multiple responsibilities. This experience would be very similar to the first few years of chemistry graduate school, where students are required to start graduate research while teaching several lab or recitation courses, and it may help you to decide if you can handle the challenges of graduate school.



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How do I prepare for my project?

You should never begin a project without devoting several days to researching the chemical literature on your chosen topic. This ensures that you are not "reinventing the wheel" by

repeating experiments that have already been completed by others. Use a good literature search in a program like SciFinder Scholar®, and don't be afraid to search way back in time. Our forefathers (and foremothers) did some wonderful chemistry in the late 1800s and early 1900s that is often overlooked by anxious investigators. More than one chemist has been surprised to find their "novel" idea was published long ago. Buy a good notebook and practice keeping detailed notes on all of the methods and chemicals that you find in the literature.

Finally, complete some safety training before starting any undergraduate research project. Hopefully your institution has a standard safety course required for all research students. If not, ask your advisor to devote some time to providing on-site



Undergraduate research experiences provide you with some of the most memorable experiences of your undergraduate career.

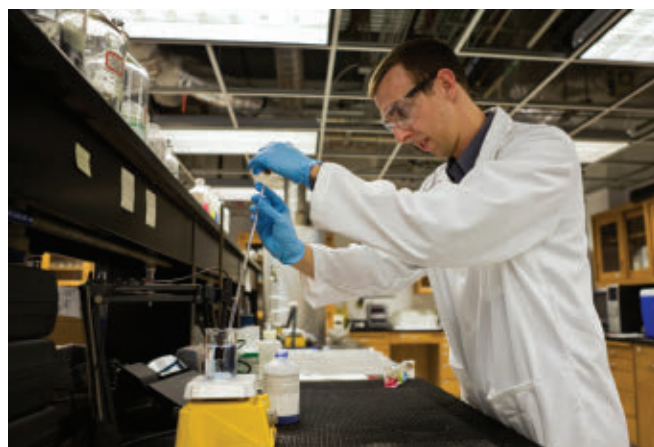
safety training in the chemicals and methods used in their projects. Keep a record of any safety training on file. Do not forget safety fundamentals (wear your goggles, lab jacket, and closed-toed shoes), do not try to mimic the experimental methods of older and more experienced students, and never do any experiment unless you are 100% sure that your methods are safe.

Who is going to pay me to do research?

This is one of the most important questions you might ask about undergraduate research. First, ask your department chair about grants from your institution. Some departments earmark funds from donors to pay for undergraduates to do research on campus. Your advisor or department chair may also be able to arrange for free housing for you if you stay over the summer to do research.

Keep an eye out for competitive, campus-wide, non-discipline-specific calls for research proposals. Your faculty advisor

Keep an eye out for competitive, campus-wide, non-discipline-specific calls for research proposals.



might be able to help you identify and write proposals for these types of programs. At larger schools, or at undergraduate intuitions with very active research programs, some faculty may have external research grants that they can use for undergraduate research stipends. Last but not least, check with your department chair for a list of faculty with external funding and/or submitted research proposals.

If you are willing to travel, there are many institutions that actively seek funding for undergraduate research. Go to www.GetExperience.dreamhosters.com for a listing of undergraduate research opportunities, International Research Experiences for Undergraduates (IREUs), and a guide to undergraduate research. You will find information on a variety of locations where undergraduate research funding is provided on a competitive basis.

Finally, do not be afraid to seek out and complete a good undergraduate research project. You will find that research provides a sense of accomplishment that is very different from even outstanding achievement in the classroom. You will develop the ability to plan experiments and apply your chemical knowledge to real scientific situations. Undergraduate research projects will do more than pad your resumé! They will provide you with

some of the most memorable and meaningful experiences of your undergraduate career. **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.



Transitions and Transformations in Study Abroad

**What Happens When You Venture
Outside Your Cultural Comfort Zone**

BY MEGAN BRENN-WHITE

NEARLY EVERYONE WOULD AGREE that study abroad is a life-changing experience. But how does it actually change your life ... and what kinds of changes can you expect before, during, and after any experience abroad?

This question is more complex than you might think. Studying or doing research abroad is a very personal experience, and your reaction to the experience may be colored by your own unique background, personality, curiosity, coping skills, powers of observation, and flexibility.

What's more, participating in a study abroad program in a country where you speak the language and are familiar with the culture will be a completely different experience than doing research in a country that you are just discovering. Even doing research for a couple of weeks in a country that is outside your "cultural comfort zone" can deliver experiences and lessons you might never get in a semester-long stay in a country that seems less "foreign" to you.

It can be challenging for chemistry students to fit in a study abroad experience during the academic year, so many opt for summer research programs abroad such as the National Science Foundation-sponsored International Research Experience for Undergraduates (IREUs) or the Research Internships in Science and Engineering (RISE) program sponsored by the German Academic Exchange Service.

These programs attract hundreds of applications because they provide valuable research experiences with full cultural immersion through working in a local lab. They also offer scholarships to cover living expenses and an infrastructure of support that may make living abroad seem less daunting.

Although these programs are generally shorter than a full semester, they offer one of the most immersive cultural experiences available to undergraduate students in any field. Being placed in a laboratory and jumping into serious chemistry research with international colleagues offers a number of unique opportunities to learn about both the culture of the host country as well as the international and collaborative nature of much research.

Culture shock

One of the most unusual challenges you'll encounter during study abroad is culture shock, or adjusting to a new way of life in a foreign country. By successfully learning to overcome these challenges you'll grow as a person.

Culture shock usually involves four or five phases. During the first phase, you'll feel excited to be in a new place. This feeling can fade quickly as inevitable challenges arise — and the second stage of being frustrated with life in the host country sets in. During this phase, you may withdraw from activities, feel depressed, or experience significant homesickness. You may find yourself making comparisons to your home country and may feel the host country is often lacking.

"I found having to communicate with everyone in broken English to be exhausting and I didn't know any German at the beginning," says Caroline Davis, a junior chemistry major at **San Diego State University** in CA, who did the RISE program at **RWTH Aachen University** in 2010. Her laptop broke in the first week, so she felt cut off from people at home; on top of that, she recalls, the fact that grocery shops weren't open on Sundays in Germany required "a lot of planning." Even so, this was Davis' first experience outside of North America, and by the end of her stay, she was in tears at having to leave her new home. The challenges were outweighed by her relationships with people

she met in Aachen and the enjoyment of spending a summer in Europe — and she is now planning to apply to master's programs in Germany next year.

Adjusting to the new culture

The third stage, which Davis had clearly entered by the end, is where you begin to gain a deeper understanding of the host country, and things you might once have seen as "wrong," you now view as simply being different. You'll probably notice these differences less and less as you move through your daily activities. The host country will start to feel like home in many ways.

Tim Trost, a junior at the **University of Chicago** in IL majoring in biochemistry and German, studied abroad in Switzerland as a high school student. During that year, he learned important lessons on how to ease the transition to a new country. Trost, who is currently spending his a junior year at the **University of Applied Sciences** in Hamburg, Germany, suggests, "Make friends and go out and join clubs because the only way to meet people is to go out and try to find people who share common interests with you."

Trost further explains, "Once you make friends, the transition is not even noticeable. Of course you'll be homesick sometimes, but if you meet people and have fun, you won't be as affected by your homesickness, and eventually it will go away all together."

The final stage of culture shock involves a true adaption to the new country. This stage is generally only experienced by people who have lived abroad for at least a year, are fluent in the local language, and have started to establish real roots in the new location.

As a chemistry student working abroad in a lab for a summer, you may dwell in the honeymoon phase for the entire time, or you may move straight to or through the frustration and homesickness phases. As a student of chemistry, your focus on the culture of the host country may not be as intense as could be the case for students in the humanities or social sciences. After all, whether or not you speak the language of



Tim Trost

COURTESY OF TIM TROST

Whether or not you speak the language of the host country, you and your colleagues all speak the language of chemistry.



COURTESY OF TIM TROST

the host country, you and your colleagues all speak the language of chemistry. The laboratory will provide a familiar surrounding where you can draw on your academic skills and, most likely, communicate with your colleagues in English.

Reentry process

Returning home can present its own challenges; transitioning to life in familiar surroundings can create “reverse culture shock” that is at least as strong as the adjustment to life in the host country. Bruce LaBrack, one of the foremost experts on culture and study abroad, talks about the “Top Ten Challenges for Returnees,” bringing up everything from a sense of boredom at home compared to the excitement of the study abroad experience to the fear that this special experience might somehow be lost.

According to LaBrack, “The more the science students are immersed in day-to-day contact (particularly involving applied research activities), the more likely they are to see the links between cultural values, attitudes, and behaviors. They also are likely to gain an understanding and, hopefully, an appreciation of, the fact that culture is an important variable even in the supposedly ‘value neutral’ area of conducting scientific research.” He thinks that science students may experience less difficulty upon reentry because they have experienced the impact of culture first-hand on their field of study and may identify their reentry issues as being “culturally based” and not related to them as individuals.

From student to chemist

Elise Ottenfeld, a senior chemistry student at the **University of Alabama–Birmingham**, spent the summer of 2009 at the **Justus Liebig University of Giessen in Germany** as part of the RISE program. She said that one of the major transitions for her was from being “just a chemistry major” to “understanding that I will be a researcher one day and my research in my own home country will be relevant to all of the other laboratories around the world that are working on the same problems.”



Elise Ottenfeld

COURTESY OF ELISE OTTENFELD



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Having the opportunity to conduct independent research as an undergraduate in an international environment will strengthen your graduate school or job application. It can also serve as your first real step into the global research community. Seeing how the problems are approached by colleagues in a different country, how an international research group works, and how the group collaborates with research groups in other countries, shifts one's perspective from getting a particular laboratory task completed to seeing how completing the task can advance the borders of knowledge.

Science students are increasingly looking for the kinds of immersive study abroad experiences that their counterparts in other fields have enjoyed for decades. Luckily, new opportunities to take courses taught in English while studying abroad, as well as the growth in research programs abroad, are opening doors for chemistry students.

The various transition processes that take place during a study abroad experience may occur simultaneously, and rarely happen in a linear fashion. But no one will come home the same as when he or she left. The more open students are to learning about the new country and to facing the various challenges head on, the more they will learn about themselves and the more self confidence they'll develop in their ability to manage complex situations. **IC**

Additional Resources

International Research Experiences for Undergraduates:
www.nsf.gov/crssprgm/reu/list_result.cfm?unitid=10003

Research Experience in Science and Engineering:
www.daad.org/page/rise

What's Up with Culture (website on culture and study abroad): www2.pacific.edu/sis/culture/

Study Abroad Database: www.iiepassport.org

Funding for Study Abroad: www.studyabroadfunding.org



STOCK



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IYC 2011
International Year of
CHEMISTRY

This special feature is presented in recognition of the International Year of Chemistry and efforts to bring a worldwide focus to issues concerning alternative energy sources.



PLANTS FUEL DRIVE TO GREENER DRIVING

BY CYNTHIA WASHAM

IN THE HIGH-STAKES RACE TO PRODUCE THE VEHICLE fuel of tomorrow, the bets are on ... pond scum. Believe it or not, ordinary, slimy, green aquatic algae may one day make ethanol look as environmentally friendly as a Humvee.

"These alternatives could replace our need for oil," explains Maureen McCann, referring to both algae and terrestrial plants that can be used to create biofuel. McCann is the director of **Purdue University's** Center for the Direct Catalytic Conversion of Biomass to Biofuels, better known as C3Bio, in West Lafayette, IN.

The switch to biofuels won't come for a few years, though. And not in algae's slimy green form. Scientists have a way to go before oil from algae approaches the cost and efficiency of petroleum. But McCann and her colleagues have little doubt that clean vehicle fuel will one day be produced from biomass.

About 10 percent of most gasoline already comes from biomass, in the form of ethanol, made by fermenting corn using yeast. Ethanol has its benefits, including emissions that are cleaner



Maureen McCann

than gasoline. But it's hardly a panacea. Major drawbacks include the energy needed to produce ethanol and the fact that it encourages deforestation. It also requires the use of land that could otherwise be used to cultivate food crops and drives up the price of corn used for food. Meanwhile, the chemicals needed for planting, fertilizing, and harvesting corn all take a toll on the environment as well.

And then there's the inefficient process of extraction: yeast is used to ferment corn or soybean starch to recover sugar; but the yeast also uses some of the

TO GET STARTED IN AN EMERGING FIELD, TRY SOME TIME-TESTED STRATEGIES

Peter Beadle is a Ph.D. chemist whose career in renewable energy has taken him from his native Scotland to California. Over the course of his career, he has progressed from work in R&D labs to management positions in the emerging solar power and fuel cell industries, eventually rising to the level of president of BP Solar's North American operations.

Today Beadle oversees **www.greenjobs.com**, a website listing job openings in green industries including biomass, solar, and other renewable energy industries. Beadle launched the site in 2004, in part because he believed in the promise of renewable energy. In addition, he explains, he recognized that as the industry rapidly expanded, companies would probably have a hard time supplying the required talent themselves from within their own organizations. "For the first few years," Beadle recalls, "our website didn't have much competition; but more recently, it seems like there's a new online green jobs site about every week."

According to Beadle, finding a job in the biomass field, like finding a job in any area of chemistry, requires a mix of knowledge, strategy, and networking. "It's much easier if you narrow your focus," he says. "Learn about the particular industry that interests you and its

key players, and network to meet people and make yourself known. The best way to do that is to get involved at the local level with an association or other professional group related to the field."

Volunteering in such a local association is especially helpful, says Beadle, because it can help to demonstrate that you're enthusiastic about the subject area, and that you can get things done. In addition, some local associations offer training to help their members acquire new skills and knowledge in their subject area. "One scenario is that you join



an industry group knowing little about the field, but after making some connections, you learn of an internship; this leads to successful relationship that in turn leads to a job offer. Internships are often a necessary prelude to getting an entry-level job."



Peter Beadle

If you have the right qualifications and you are a good fit with an employer, you can command a very good starting salary. "The more general your qualifications,

the more competition you'll face, and the lower the salary will tend to be," Beadle observes. "With a BS degree, you would probably be starting with an entry-level salary. If you demonstrate real knowledge that you can apply immediately and take on a role within the organization, you could be looking at a starting salary in the \$50,000–60,000 range. And if you have an appropriate graduate degree, it could be a lot more."

If you're interested in learning more about jobs in renewable energy industries like biomass, the Web has a variety of resources to offer. One such resource is "Getting into Greenjobs," a document available on the Jobseekers Resources section of **www.greenjobs.com**. The site also includes various other resources for people interested in jobs in renewable energy fields.

carbon from the corn — a portion of which is released as carbon dioxide. The bottom line is that only two-thirds of the plant can be fermented to produce ethanol.

To make matters worse, even if ethanol could be produced more efficiently, its low density makes it unsuitable as a gas substitute in most engines. That's why gas sold at gas stations has no more than 10 percent ethanol. "Car engines do not behave well with ethanol," McCann observes. "There are problems with corrosion."

What about flex vehicles, which are designed to use up to 85 percent ethanol (E85)? Unfortunately, at present only a few gas stations offer E85, so most owners are forced to use low-ethanol gasoline. And motorists aren't buying enough flex cars to prompt gas companies to add more E85 pumps.

Catalysts are key

Environmentalists realize the only way to produce truly green fuel is to go beyond the energy-intensive and wasteful fermentation process and use the entire plant. Unlike ethanol, cellulosic fuels need not be made from corn or soybeans. Rather, they can be made from non-food crops, including fast-growing grasses and trees. Even better, the variety of low-maintenance plants that can be used for cellulosic biofuels enables them to be grown nationwide, not just in the Corn Belt. This reduces the



Students from Texarkana College (TX) tour Red River Biodiesel, a developer of biofuel technology in New Boston, TX. The biodiesel is synthesized from any single seed oil, animal fat, or a combination of these ingredients.

COURTESY OF TEXARKANA COLLEGE

energy spent transporting fuel.

"Our take on biofuels is we really need cellulosic solutions to meet our nation's climate, energy, and security goals," explains Jeremy Martin, senior scientist for the Union of Concerned Scientists, a Washington, D.C.-based advocacy group. "Non-food biofuels are so important."

We'd all be driving with cellulosic biofuels today if it weren't for the stubborn polymer lignin. Lignin gives plants and trees their woody firmness, but it also makes it tough for enzymes to break plant cellulose into the glucose needed to synthesize fuel.

Researchers at Indiana's C3Bio are studying catalysts that break down cellulose more efficiently than yeast. "We're examining the application of chemical or thermal catalysts to transform biomass directly to biofuels without needing a living organism," McCann says. "We need catalysts that are cheap and also robust — so they can be used again and again. We're building a knowledge base of chemical catalysts, but we're at extremely early stages."

One of the most innovative approaches McCann and her colleagues are pursuing is genetically engineering a catalyst into the plant. The catalyst would grow with the plant and break down lignin to make the plant's sugars available.

Promise in a pond

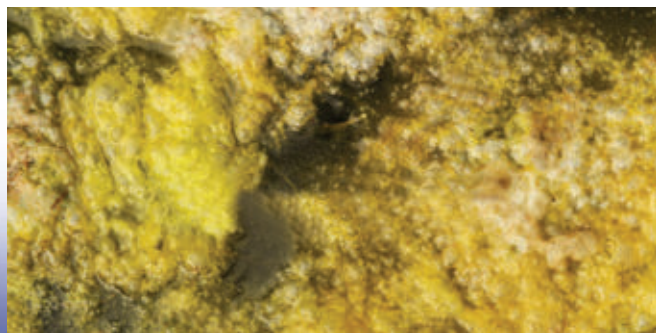
At the Enterprise Rent-A-Car Institute for Renewable Fuels in St. Louis, Richard Sayre is also working toward turning biomass into fuel. But he eschews terrestrial plants in favor of water-bound algae.

"Algae have the potential to produce 2 to 10 times more biomass per land than any terrestrial crop," he said. "Up to 65 percent of the mass is neutral lipids that can be converted to the full spectrum of fuels — gas, diesel, and



Richard Sayre

COURTESY OF RICHARD SAYRE



Cellulosic biofuels are made from the entire plant's biomass.



Algae have a high-energy density, the same as conventional diesel fuel. Algae-based fuel emits far fewer greenhouse gases than gasoline, and the production process removes CO₂ from the atmosphere.

aviation fuel.” Other benefits include algae’s fast growth rate and propensity to thrive anywhere there’s water. In addition, says Sayre, “another strong advantage is that it can capture carbon dioxide.”

Oil extracted from algae is similar to vegetable oil. In commercial production, this oil would be shipped to a refinery, where fatty acids would be converted to alkenes and volatile hydrocarbon fraction. Gas and jet fuel could use the volatile hydrocarbons, while diesel is made solely from alkenes. Ethanol, in contrast, can’t be used to create jet fuel. “The only fuel option for aviation is oil-based,” Sayre explains, “so the aviation industry is very interested in algae-based biofuel.”

Like other biofuels, algal varieties are not harmless, but they do greatly diminish toxic emissions. Sayre explains that they produce no sulfur emissions, and 40 to 60 percent less nitrogen and particulate emissions — which are toxic byproducts associated with lung irritation, cancer, and heart disease.

Although algae can grow just about anywhere, Sayre and his colleagues have found that temperature and humidity are optimal in Hawaii and the southeastern region of the United States. Areas that are warm, but dry, require far more water to keep up with evaporation. To minimize the carbon footprint, he suggests algae-growing pools be filled with wastewater from power plants.

Despite its promise, biofuel from algae is still too costly and inefficient to produce to compete with fossil fuel. But Sayre

believes that bioengineering offers the potential to create more productive species that will make it more competitive. “We’re trying to increase the efficiency of photosynthesis,” he notes. “Our objective is to identify the metabolic bottlenecks in converting sunlight into energy.”

False alarm?

Sayre acknowledges that some skeptics have raised concerns about bioengineered algae escaping and threatening natural algae. “The idea that a superorganism will take over,” he suggests, “is a lot of noise. We already have harmful algae blooms, and they’re not from invasive species. Instead, they’re from nutrient input or changes in temperature.”

Still, to be on the safe side, Sayre’s researchers are considering a terminator gene. This gene would be engineered to thrive in the presence of a chemical in the water. If the algae end up in water without the chemical, the terminator gene would kill the algae. “There’s a lot of precedent for doing this,” he said.

Another change the two anticipate is local production and distribution of biofuel, putting an end to long-distance transportation of fuels and the environmental harm that comes with it. Catalysts will reduce the need for the large refineries associated with corn fermentation. McCann suggests cellulosic biofuel might even be produced in mobile refineries brought out to the field.

Sayre also predicts algae used for fuel will be cultivated in various locales. “One of the great things about renewables is that their production will take place in locations closer to the end user, rather than centrally developed and shipped long distances,” he said. “The industry is moving in leaps and bounds almost every day.”



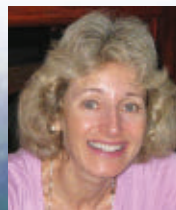
COURTESY OF COLORADO STATE UNIVERSITY ENGINES & ENERGY CONVERSION LABORATORY



Down the road

Sayre envisions biofuel from algae powering car engines in about five years. McCann also expects cellulosic biofuels from terrestrial plants to power cars. And for short, urban trips, they suggest electric cars might eliminate the need for any liquid fuel.

“We’ve seen the consequences of putting all our eggs in one basket and having all our dependence on one type of fuel,” McCann adds. “It’s important that all avenues of renewable energy be explored.” **ic**



CYNTHIA WASHAM is a freelance writer based in South Florida.



Permanent Temporary EMPLOYEES

**It may sound like an oxymoron ...
but it's actually a whole new way to work!**

BY LISA M. BALBES

FINDING YOUR FIRST JOB IN A CHEMISTRY-related field can be challenging, especially if you do not have previous research experience. You may find, as are a growing number of scientific professionals, the best solution is to accept a contract or temporary position.

Until recently, most businesses hired permanent employees during profitable times and kept them on — even during leaner times. In general, workers were more loyal to their employers and seldom switched jobs. Today, things are different. According to the Bureau of Labor Statistics, people employed as contractors or temporary workers account for at least one-quarter of the workforce, and this percentage is growing at two to three times the rate of the traditional work-

force. In addition, temporary workers and contractors are expected to comprise nearly 50% of the U.S. workforce, added in as the economy continues to recover.

The rapid rise in contract or temporary work is not only a result of recent economic changes; it's also a reflection of a new workforce of individuals who want flexibility to change employers as their personal situations change. Workers increasingly are taking charge of their own career direction. In this environ-



ment, staffing companies are on the rise, matching workers and jobs in all fields, including chemistry.

Candidates are placed in temporary positions — which can actually last anywhere from a few weeks to a couple years — sometimes with a “right to hire” option at the end of the contract. Some staffing companies also act as recruiting firms, finding candidates for permanent placement — also known as direct hires. In many cases, the staffing company also serves as career advisor, helping shape and develop the careers of the people they place.

Working with recruiters

There are many national and local firms that specialize in placing scientific professionals, and you can apply through their websites or they may find you through LinkedIn or other professional networking groups. The recruiters will initially screen your educational background, activities while in school (type of degree, internships, research, hands-on work, etc.), course work, résumé quality, experience with lab techniques and instrumentation, and so on.

If your background matches their client's needs, you will have a phone screening, then an in-person interview. They will look at not only your technical expertise and competence, but also non-technical attributes, especially your professionalism and long-term career goals. In doing so, the recruiter is trying to find out not only what you can do, but also what you want to do, so that he or she can find a position that will be a good fit for your skills and interests. The firm will also check your references, especially former technical supervisors.

Here are some additional tips about the interview process. As a candidate, you should NEVER pay a fee to staffing companies, and they should check

with you before submitting your résumé to any client organizations. You should try to find out if the staffing firms have access to scientific positions that are of interest to you, if they have exclusive agreements with any companies, and what their track record is for placing people with backgrounds similar to yours.

If you decide to work together, the recruiter will act as your agent, identifying suitable openings and submitting your information to the client companies. It is in a recruiter's interest to place you, since the recruiter's pay is often based on placements. However, remember that the recruiter's primary job is to find highly qualified individuals for his or her client companies — and not necessarily to find a job for each candidate — so you should continue to look for positions yourself as well.

Remember that the recruiter's primary job is to find highly qualified individuals for his or her client companies.

You can choose to work with multiple agencies simultaneously, but you should still check out each one, and make sure you are comfortable having it represent you. Each agency will have its own personality and processes. Some recruiters will accompany you to interviews and maintain contact throughout your placement, while others are more hands-off.



It is very important to keep track of who does what, and to make sure your name is not submitted multiple times to the same company — which can make you look desperate — so be honest with the recruiter about where you have already applied. Keep a written list of every company and job in which you are interested, along with the job code and date you applied, how you found the opening, who you talked to, etc. Job hunting can be a lengthy process, so you should keep all this information on file for 6–12 months.

You should maintain contact with the staffing company every three-to-four weeks and touch base and let them



know of any changes in your situation. The company's responsiveness can be an indication of how marketable your skill set is.

Once the recruiter identifies a suitable opening, he or she will make sure you are still available and interested, then present your credentials to the client company. The hiring company will select from among the candidates, and conduct in-person interviews. If the hiring company selects you, you may become a direct contractor for them, or work at the client company location as an employee of the staffing agency. If the latter, your hours worked may be reported to one or both companies, but your paychecks and benefits, if any, will come from the staffing company.

It is important to understand the details of the business arrangement between yourself, the staffing company, and the client/hiring company. As a temporary worker, you may or may not receive fringe benefits such as paid time off, health insurance, retirement contributions, and overtime pay — but if you do, they will come from the staffing company, and you may have to pay for them. Working overtime may or may not be allowed, and you may be treated differently from traditional employees. You may not, for example, be invited to company social events by the hiring company since you are an employee of the staffing company, who may hold their own events.

Your personal career agent

Many recruiters and candidates develop close working relationships over multiple placements. Since staffing com-



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Contracting can be a great, flexible way to try out different companies and types of jobs, to build your experience, and to find out what you really enjoy doing.

panies are in the employment business, they know the market, and are often the first to recognize new or emerging trends. Building a relationship with a good recruiter can give you access to sound career advice and information on marketplace trends, increase the number of positions to which you are exposed, and help you start out your new position on the right foot.

A good staffing company will “not only prepare you as a candidate, but also help you know the culture of the company very well, so you can be a good fit and be engaged from the start,” says Alan E. Edwards, senior director for Kelly Scientific Resources. Some staffing firms go even further, helping job-seeking candidates improve or enhance existing skills; Kelly Scientific, for example, offers its employees access to over 200 online professional and personal development courses.

It's helpful to be completely candid with a recruiter about exactly what you're looking for. In return, the recruiter can tell you if your goals are reasonable and may suggest additional skills that would make you more marketable or make you aware of new career options that you had not considered.



Alan E. Edwards

COURTESY OF ALAN E. EDWARDS

Contracting can be a great, flexible way to try out different companies and types of jobs, to build your experience, and to find out what you really enjoy doing. If you don't like an assignment, you can always ask the agency to find you a new one.

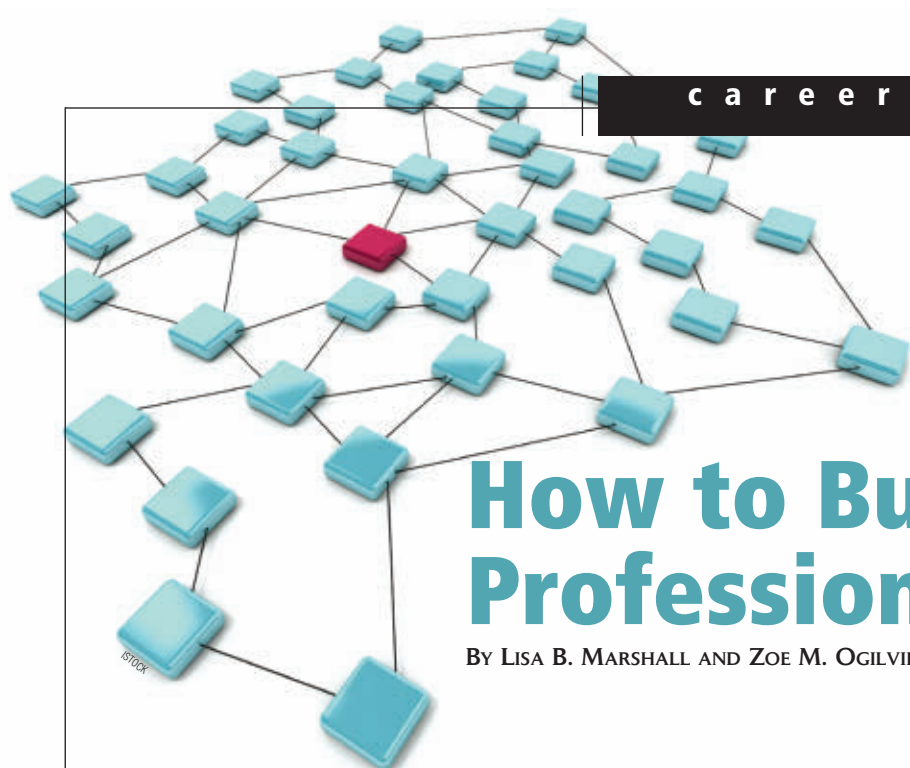
Many people discount contract employment because of its temporary nature, and as a result, may be constantly looking for another, permanent job. Some companies do set a limit as to how long you can work directly for them as a contractor, usually between 6 and 18 months. After this time period, you have to either leave or be hired permanently. This does not apply if you are an employee of the staffing agency. The advantage of working with a staffing company is that your recruiter will look out for new opportunities that might be a good fit for you, and you often get more warning than a traditional job as to when it will end.

Many hiring managers like working with contractors. This gives the managers a chance to observe potential employees in real positions and judge their skill levels and fit with the company over a long period of time. If there is a good fit, an offer of permanent employment may be made. In an increasing number of companies, this may be the best way to work your way into a permanent position.

To make the most of a contract position or even a contracting career, treat it as the real job that it is. Go the extra mile and then ask what more you can do. Learn as much as possible. Take advantage of the resources and expertise of the staffing agency and recruiter, and always be on the lookout for the next step in the evolution of your own career. After all, everyone can use a friend in the business. **IC**



LISA M. BALBES is founder of Balbes Consultants LLC, author of *Nontraditional Careers for Chemists*, published by Oxford University Press, and a freelance scientific communication consultant. She also blogs on career development for scientists.



How to Build Your Professional Network

BY LISA B. MARSHALL AND ZOE M. OGILVIE

YOU MAY THINK THAT YOU don't have a professional network ... but you actually do! It is all the professors, colleagues, students, mentors, relatives, friends and teachers who have helped or guided you — including your piano teacher, school principal, advisor, aunts and uncles, and even the hosts of your favorite podcasts or blogs! You create your professional network by maintaining consistent and persistent relationships with people you already know. By developing and maintaining these relationships, you build and expand your network.

Imagine the process of networking as a funnel with a very wide opening at the top, that gradually narrows down to a small opening at the bottom. Every day we have dozens of conversations, in many different media and forums, with many different people. Some of these conversations “spill out” of the top of the funnel, while others move down to its narrower neck, as we build stronger and closer relationships.

You've got connections

The more time you spend with someone, the more likely you'll discover and develop connections. If you're fortunate, you'll also develop strong, deep, trusting relationships with a select few. Picture these as the few drops that come out of the end of the funnel.

“Networking,” therefore, is just the process of communication with the goal of developing closer, solid, quality relationships with people who share similar backgrounds and interests.

The Power of Connections

After completing my undergraduate degree, I went online to search for an internship. Out of the more than 20 positions for which I applied, I received only two call-backs — but one of them landed me a great internship. I didn't realize it at the time, but my prospective new boss was an alum of my university, and we shared many similar interests and activities. In fact, because of these shared connections, I practically had the job before I even interviewed. Later, as a result of my work during the internship, I was able to leverage my new connections to obtain my current paid position.

— Zoe M. Ogilvie



COURTESY OF ZOE M. OGILVIE

Develop your relationships by checking in

The question that many students have after completing their degree is, “How exactly do I develop my professional network?”

You've just finished your university program and are moving into a new stage in your life — so let everyone know! Keep them updated on your activities, and also ask how they are doing. A very easy way to stay in contact is to celebrate achievements — both theirs and yours.

Occasionally, if something good happens, you might send an e-mail that says, “Just a quick update. I'm excited because I just got an interview with XYZ. Any good news on your end?” In a way, sending such a message gives your connections ‘permission’ to brag a bit. Their responses are also great to read, because they allow you to get to know what is important to each particular person. This same strategy could also work via Facebook “wall posts,” which are a little less formal than e-mails but serve the same purpose. Keep in mind, you don't need to have significant news to contact



all have talents, and a sincere offer of your assistance can go a long way toward building a relationship for the future.

One of the especially beneficial — and easy — aspects of maintaining your network is sharing interesting or useful information. Whenever you receive an e-mail with a link to something that you think might be interesting or useful, pass the link on to your contacts who share

your network; it's okay to simply check in with professors, fellow graduates, and mentors by asking how they are doing.

Really, it's that simple. We have written many e-mails that only say, "I was thinking about you today and wanted to check in. How are you doing?" We almost always get a reply, sometimes right away, and sometimes not for several weeks. Keep in mind that it's small interactions that build into relationships over time.

The challenge is to remember to do these networking maintenance tasks. You may get busy and, before you know it, several months will have slipped by. If you haven't contacted anyone, not even your closest of friends, try setting up a separate Google calendar that just keeps track of your networking activities. Set task reminders to check in either once a quarter, or once every six months, depending on the relationship. The idea is to ensure that you make contact on a regular schedule. Depending on the relationship, check in more frequently with those you are closer to.

Offer your help to promote your skills

Another great way to build your already established relationships is to offer your help. Networking, especially at the beginning, is about giving to others. Every person has professional "currency" to offer. For example, you might offer to help connect people within your network, review a book or blog, or offer encouragement. You might give some advice or a referral, or maybe even offer to speak at an event. The point is, we



Talking over the phone may seem like a lost art these days, but it is essential to networking.

similar interests. Doing so lets your contacts know you are thinking of them ... and this gets them thinking of you. You might want to very briefly explain why you find the link useful or why it is interesting, making it easier for your contacts and also adding a more personal touch.

Give 'em a ring (or a ping)!

Remember that one of the easiest ways to start networking is to pick up the

phone. Talking over the phone may seem like a lost art these days, but it is essential to networking. Here's why: when you're speaking with someone, you are able to hear the other person and have a more intimate connection than sending a quick e-mail or Facebook status update. So get over the fear of picking up the phone. This is not to say you should call every day; rather, be persistent and consistent with your communication and be sure to include phone calls as part of your strategy.

One of the fastest ways to advance an initial contact is through a conversation. How many times have you sent an e-mail and not heard anything back? Face-to-face contact is bound to get a reaction. Many times it is better to simply talk and joke with someone in person — this also allows you to get to know people more naturally.

If you have contacts who are not local, try doing a video chat. You could also do this with people who live nearby, but meeting face-to-face for meals or coffee or participating in activities you both enjoy is an even better way to build and extend such relationships.

Networking is all about consistent

and persistent communication, but also remember that it's never too late to connect. Most of us are so busy that when others reach out to us, we are happy for the contact — no matter how much time has passed. With these tips and a fresh outlook, you too can build on your relationships from your days at the university, previous work, or potential employers — and perhaps, find opportunities that you never knew existed. **ic**



LISA B. MARSHALL (www.lisabmarshall.com) is a communication expert, host of "The Public Speaker" podcast, and author of *The Public Speaker's Guide to Ace Your Interview: 6 Steps to Get the Job You Want* (Macmillan Audiobooks) and the ebook, *Ace Your Interview*.

ZOE M. OGILVIE works in the Office of Student Life at Fairleigh Dickinson University in Teaneck, NJ, where she is also earning a master's degree in professional communications and media.



ACS members at a reception during the Washington, DC, National Meeting and Exposition in 2009.



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ACS Membership: What's the Value after Graduation?

By JENNIFER TAYLOR HOWELL

YOUR UNDERGRADUATE years have exposed you to many things — among them the importance of community. As you prepare to leave the unique community you formed as a college student and member of your ACS student chapter, think about ways to stay connected. One way is to renew your ACS membership after you graduate. ACS offers students and chemical professionals opportunities to participate in a worldwide scientific community while advancing their careers.

Building a career is not only important for you personally, but also for society as a whole, because you represent the future of chemistry. The scientific community is relying on you to help find solutions for tomorrow's problems. ACS provides members with forums to help educate the general public — especially the youth — in communities nationwide and to advocate for causes that help the planet. With more than 163,000 members, ACS helps individual members connect with other chemistry professionals, enabling you to use your voice, skills, and abilities effectively to make a difference.

ACS offers its members many specific programs and resources. Learn more about them so you can get the most from your career in chemistry.

Meetings

Attending an ACS national or regional meeting provides you the opportunity to present your research findings to the broader chemistry community. You can also learn about the latest research by attending symposia, stay current on new technologies and products at the exposition, and expand your professional network with peers and other professionals in your field.



ACS Communities

By participating in ACS local sections, you can meet and network with ACS members who live and work near you. You can also join any of the 33 technical divisions to connect with others in your area (or areas) of interest. The Younger Chemists Committee is a great way to meet and network with other early-career chemists, professionals in the chemical sciences, and students. ACS also offers several online communities, including the ACS group on LinkedIn and the ACS Network.

Career Resources

ACS offers a wide range of programs and services to help members throughout every stage of their chemistry careers. By attending career workshops at ACS meetings, you can enhance your résumé and polish your interviewing skills. In addition, you'll have access to free, personalized career coaching through the ACS Career Consultant Program, as well as expert guidance on job search strategies, interviewing techniques, résumé writing, and salary negotiation techniques.

Resources for Finding Jobs

Only ACS members can participate in career fairs at national meetings and access the ACS Jobs Database and C&EN Classifieds (in print and online) two weeks before non-members. Likewise, the online Salary Comparator is an extremely valuable ACS member resource for calculating the market value of your professional skills before you head into an interview.

ACS Directory of Graduate Research

Throughout your chemistry career, when you need information about graduate schools or need to know who's doing research closely related to yours, you'll find the answer by searching the ACS Directory of Graduate Research (DGR) and the online DGRweb. Both resources provide statistics, faculty biographies, and other pertinent information about 675 chemistry-related graduate programs in the U.S., Canada, and Mexico.

ACS Publications

Your subscription to weekly online or print issues of *Chemical & Engineering News* will help you keep current on breaking news and the latest research from around the globe. Members can stay up-to-date on the latest findings by selecting up to five personal subscriptions to the more than 35 online high-quality, respected ACS journals. You can also sign up now to receive free issues of the *Graduate Student Bulletin* to get news and information about resources, opportunities, and events specifically geared toward graduate students and post-docs in the chemical sciences.

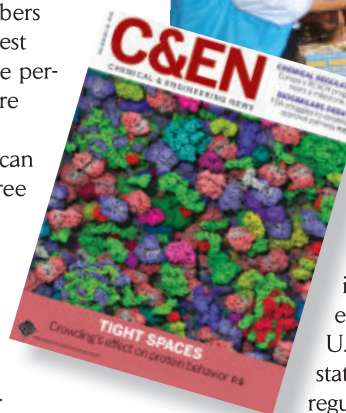
Community Outreach and Advocacy

If you've helped to present Kids & Chemistry, National Chemistry Week, or Chemists Celebrate Earth Day events with your student chapter, you're already familiar with some of the Society's com-

munity outreach and advocacy programs. What's more, you have experienced first-hand how these programs help to increase the public's awareness of the importance of chemistry in our everyday lives. What you may not realize is that you can continue to spread your passion for chemistry after you graduate from college and no longer belong to an ACS student chapter. Outreach and advocacy programs are available for individual participants, as well as activities in which you can take part through ACS local sections and divisions.



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Policy

Legislation that may impact the chemical enterprise comes before U.S. state and federal state governments on a regular basis, and ACS is committed to helping

members stay current and weigh in on high-priority issues. The Act4Chemistry program provides support to individual members, local sections, and other groups. Individual members can become involved at different levels and also join advocacy groups.

Sustainability

Are you concerned about the challenges of sustainability? ACS members can take advantage of resources from the American Chemical Society/Royal Society of Chemistry sustainability alliance, including the ACS podcast series "Global Challenges/Chemistry Solutions." As a member, you can also participate in one of the ACS Sustainability Engagement Event teams.


Green Chemistry

ACS members can attend special events such as the Green Chemistry

and Engineering Conference and the ACS Summer School on Green Chemistry and Sustainable Energy. As a member, you can also apply for special green chemistry awards and fellowships.

For these and all of the other reasons you joined ACS as an undergraduate, you should continue your ACS membership in the years to come. The American Chemical Society realizes that the transition from student to full-time professional can be challenging. That's why ACS offers student discounts on dues, including a 50% membership discount for all recent graduates within one year of

graduation, as well as for those enrolled full time in graduate school.

This is an exciting time in your career and ACS hopes to continue to be a part of your journey. For additional information about these resources, visit GradStudent.ACS.org. 



JENNIFER TAYLOR HOWELL is a senior marketing associate in the ACS Division of Membership and Scientific Advancement.

The Undergraduate

242nd ACS National Meeting

DENVER, CO • AUGUST 28–SEPTEMBER 1, 2011

Sunday, August 28

Hospitality Center

8:00 A.M. – 5:00 P.M.

Graduate School Reality Check

9:00 – 10:30 A.M.

Pharmaceutical Chemistry Symposium

10:45 A.M. – 12:00 NOON

Careers in Chemistry Workshop

1:00 – 3:00 P.M.

Leadership Training Workshop

3:00 – 5:00 P.M.

Networking Social with Graduate School Recruiters

5:00 – 6:30 P.M.

Monday, August 29

Hospitality Center

8:00 A.M. – 5:00 P.M.

Graduate School Recruiting Breakfast

8:00 – 9:30 A.M.

Outreach Workshop

9:30 – 11:30 A.M.

Eminent Scientist Lecture and Luncheon *Featuring Thomas R. Beattie*

11:45 A.M. – 1:15 P.M.

Undergraduate Poster Session

2:30 – 4:30 P.M.

Sci-Mix/Successful Student Chapters Poster Sessions

8:00 – 10:00 P.M.



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Program in Denver

Opportunities for Graduate School Recruiters

Showcase your graduate program at the "Networking Social with Graduate School Recruiters" on Sunday, August 28, and the "Graduate School Recruiting Breakfast" events on Monday, August 29. It's a great opportunity to meet and talk with hundreds of undergraduate students who will be attending the 242nd ACS National Meeting in Denver, CO. For more information on how to register for these events, please contact Lori Betsock at l_betsock@acs.org or at (800) 227-5558, ext. 6188.

For more information, contact the ACS Undergraduate Programs Office at 800-227-5558, ext 4480, or go to www.acs.org/undergrad.

*Program format and times are subject to change.
Please consult the final program.*

All events are sponsored or co-sponsored by the Society Committee on Education Task Force on Undergraduate Programming.

CHAIR: **Charles Baldwin**, Union University, Jackson, TN.

PROGRAM CHAIR: **Ludivina Avila**, South Texas College, McAllen, TX.

Travel Grants for Student Chapters

National Meeting Travel Grants are available to active ACS student chapters.

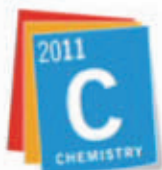
For more information, please contact Audley Burke at a_burke@acs.org or (800) 227-5558, ext. 4565.



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**If your school would like to include a notice in an upcoming
issue of *inChemistry*, contact Lori Betsock,
(800) 227-5558, ext. 6188 or e-mail l_betsock@acs.org**

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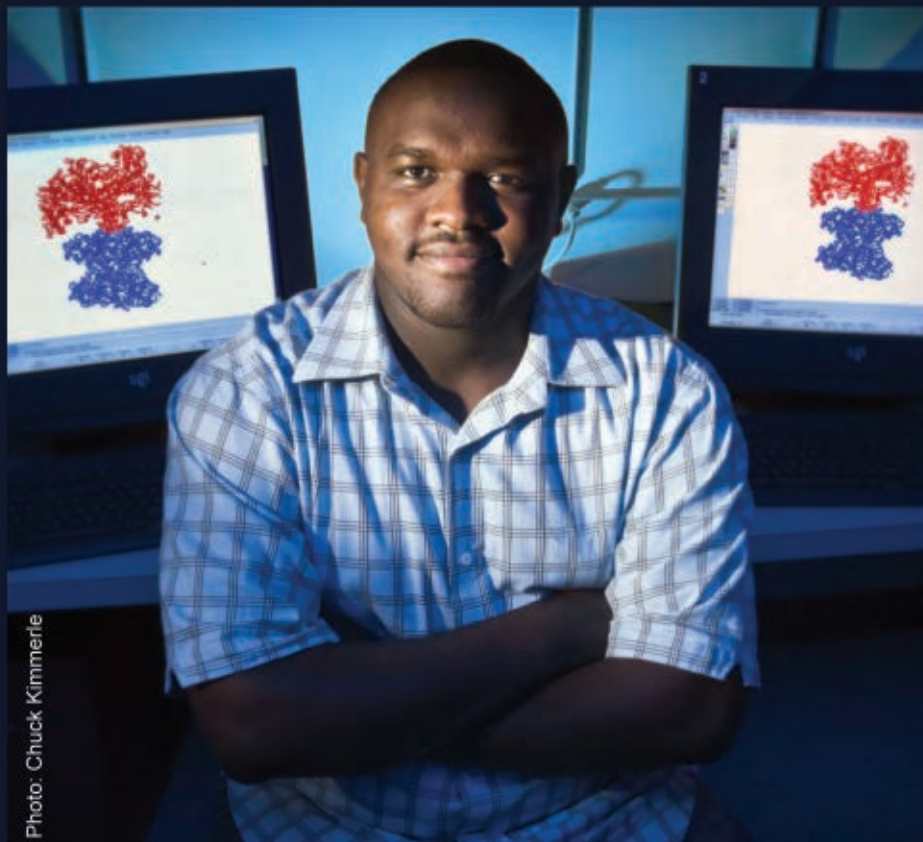


Photo: Chuck Kimberle

Neville Forlemu, Ph.D.

Researcher, Icahn Medical Institute, NY
UNCF/Merck Science Initiative Fellow '08
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