The Magazine for ACS Student Affiliates
Volume 15 ■ Number 4
April/May 2006

in Chemistry


COURTESY OF PEPPERDINE UNIVERSITY


GREEN CHEMISTRY INSTITUTE


PAMELA MARRONE, AGRAQUEST

Cover: Photodisc, Inset photo courtesy of Virginia Wesleyan College

in Chemistry is available free to Student Affiliates of the American Chemical Society and the faculty advisors to Student Affiliates chapters. Student Affiliates dues: $36; for an application, call the Undergraduate Programs Office at 800-227-5558, ext. 4480. The American Chemical Society assumes no responsibility for the statements and opinions advanced by contributors. Registered names and trademarks, etc., used in this publication, even without specific indication thereof, are not to be considered unprotected by law.

Being Green

By Mary M. Kirchhoff

In the immortal words of Kermit the Frog, "It's not easy being green." For you and other readers of *in Chemistry*, being green means constantly looking at the potential environmental and human health impacts of your work. Maintaining this focus can be challenging – because historically, chemists have not been trained to do so.

Each year for the past few years, an issue of *in Chemistry* has been dedicated to green chemistry — the design of chemical products and processes to prevent pollution. Chemists who apply green chemistry to their research try to minimize energy use, maximize atom economy, and avoid using hazardous substances. Green chemistry is not limited to a single area, but is an approach that is applicable to all branches of chemistry.

The real impact of green chemistry comes in its applications to global environmental problems, and Earth Day is a good time to reflect on these challenges. Our dependence on fossil fuels, for example, is linked to a number of environmental concerns, including climate change and air pollution. You know from your chemistry classes that when you burn a hydrocarbon, carbon dioxide is produced and, on a global scale, this process contributes significantly to climate change. Chemists and engineers are simultaneously developing alternative energy sources while searching for new technologies to capture the carbon dioxide currently produced by the combustion of fossil fuels. This is green chemistry in action!

Most countries enforce a wide range of environmental laws, which have been very effective in cleaning up the environment. Despite this progress, large quantities of hazardous materials are introduced into the environment every year. For example, in 2001, more than six billion pounds of the 522 chemicals listed on the Toxics Release Inventory were released both on- and off-site in the United States.

Green chemistry can improve this situation by minimizing the amounts of hazardous substances used and released into the environment. Since 1996, the winners of the Presidential Green Chemistry Challenge Award have collectively accomplished the following on an annual basis:

- eliminated 57 million pounds of carbon dioxide emissions,
- saved 55 million gallons of water, and
- eliminated 140 million pounds of hazardous substances.

The chemical industry focuses on sustainable development through its Responsible Care program, which emphasizes improved environmental, health, safety, and security performance.

What can you, as an undergraduate student, do to increase awareness and understanding of green chemistry? Your Student Affiliates chapter is the perfect way to reach out to your classmates, your professors, and your local community! Student Affiliates have developed many creative mechanisms to promote green chemistry, some of which are highlighted in the article by Kathryn Parent. Be sure to share your green chapter activities in your annual report — if your chapter meets the criteria, it could be selected as a green chapter, just as was Virginia Wesleyan College.

Programming at ACS national and regional meetings is another way to learn more about green chemistry technologies. In addition, the ACS Education Division has produced some excellent educational resources, which are featured online at http://chemistry.org/education/greenchem.

If you wish to work on research problems with a green chemistry focus in graduate school, you can check out a list of schools with green chemistry programs on the ACS Green Institute's website at www.greenchemistryinstitute.org. The institutions listed there are home to faculty members with research interests in green chemistry. As a graduate student or post-doc in any area of chemistry or chemical engineering, you will also be eligible to attend the ACS Summer School on Green Chemistry, as contributor Stephanie Gould has done.

You are learning chemistry at a very exciting time in the profession. New approaches to teaching are being explored (after all, chemists do like to experiment)! New research problems are being investigated by increasing numbers of undergraduates. And new, multidisciplinary topics, such as green chemistry, are being introduced into the curriculum. As chemists, I believe we have an obligation to practice our profession in the most ethically and environmentally responsible manner possible — and green chemistry provides one mechanism for doing so. It may not be easy being green, but it is definitely worthwhile! IC

Mary M. Kirchhoff is acting director of the ACS Education Division. She holds a Ph.D. in organic chemistry from the University of New Hampshire, and was vice president of her Student Affiliates Chapter as an undergraduate at Russell Sage College.

Always wanted to know what other chapters are doing…but never had the opportunity to ask? Chapter Spotlight asks those questions you've always wanted answered and more. Each issue of in Chemistry *features a series of questions designed to inform and inspire chapters as your plan and execute activities. We encourage you to contact the chapters below to find out more!*

Central Missouri State University, Warrensburg

Chapter president: Anthony Kammerich
Faculty advisor: Renee Cole
Institution environment/composition: Small, rural, public, 4-year institution
Number of chapter members: 15
Number of ACS Student Affiliates: 6


COURTESY OF CENTRAL MISSOURI STATE UNIVERSITY

Q What is your most successful recruiting event/method?
A Within the first few weeks of each semester, we hold a welcome/recruitment meeting. We announce it to all chemistry classes, and our officers make brief presentations about ACS. We also serve pizza and answer questions from prospective members.

Q What is your most successful chapter activity?
A Our most successful activity is our tutoring service project. Members set up times when students can get help with homework. Tutoring takes place in the department, dorm libraries, and the campus library.

Q How often does your chapter meet?
A The chapter meets twice per month. Typically, the first is a business meeting and the second is an activity.

Q What methods of communication are used to inform chapter members of chapter activities?
A Our secretary e-mails information to all members and faculty and posts flyers to attract new members. We encourage faculty to announce activities in their classes. Finally, we post the tutoring schedule and announcements on our chapter bulletin board.

Glenville State College, WV

Chapter president: Brenton Drake
Faculty advisor: Kevin L. Evans
Institution environment/composition: Small, rural, public, 4-year institution
Number of chapter members: 16
Number of ACS Student Affiliates: 6

Q What is your most successful recruiting event/method?
A On the first lab day of introductory chemistry, we take the first 30 minutes to perform chemical demonstrations. We show the students a side of chemistry that they will not see in the normal lab experience — i.e., explosions, controlled violent exothermic reactions, and many more.

Q How do you retain members from year-to-year?
A Get them involved! Many of our activities use demonstrations to encourage public school students to pursue post secondary education in the sciences. New members begin by watching veteran members in action. They then slowly move to the forefront, becoming more and more involved.


COURTESY OF GLENVILLE STATE COLLEGE

Q What is your most successful chapter activity?
A Our most successful activities are public school demonstrations. We travel throughout central West Virginia, encouraging students to attend college in the sciences. We follow each demonstration with explanations of the chemical and physical changes. These demonstrations advertise our college, offer public speaking opportunities for members, provide lower division students a fuller understanding of what they are learning, and expand the repertoires of future teachers.

Q How often does your chapter meet?
A We meet once a week to consider proposals and decide which activities to undertake in upcoming weeks. Selecting demonstration locations, inviting guest speakers, attending upcoming meetings, writing grants, participating in on-campus activities, setting party dates, and identifying new opportunities are the normal topics.

Q From what sources does your chapter receive its operating funds?
A The majority of our funding is from grants. Every year, we submit proposals to the Northern West Virginia Section of ACS for food expenses and chemicals, and to the Education Department at Glenville State for travel and chemical expenses. We also sell cold drinks and safety glasses.

Pepperdine University, Malibu, CA

Chapter president: Celeste Honaker
Faculty advisor: Douglas Mulford
Institution environment/composition: Small, suburban, private, 4-year institution
Number of chapter members: 34
Number of ACS Student Affiliates: 12

Q How do you retain members from year-to-year?
A The majority of our current members are the highly devoted and energetic people who recently reactivated the chapter. We are retaining them and attracting new members through résumé-building activities like our recent tour of the Getty Museum labs.


COURTESY OF PEPPERDINE UNIVERSITY

Q Does your chapter participate in NCW? What types of activities do you sponsor?
A Our chapter does an annual demo show open to everyone on campus. We promote the show by decorating our campus rock (which is repainted each day by a different group on campus) with a fun message involving chemistry. We have turned the rock into such things as a large mole with a periodic table made of sandbags and a volumetric flask that produces dry ice smoke. We also promote chemistry to the community through additional demo shows and experiments at local elementary schools.

Q From what sources does your chapter receive its operating funds?
A Our club has raised approximately $400 per semester through goggle sales. We have also had surprisingly good results from T-shirt sales (we had to order shirts twice)! The department donates demo materials and reimburses educational trips to such destinations as ACS meetings. Finally, we get approximately $300-500 each year from our student government.

If your chapter would like to be featured in the SAACS Chapter Spotlight, please contact Alicia J. Chambers at 800-227-5558, ext. 6176 or a_chambers@acs.org.

Faculty Advisors Share Strategies and Advice

COMPILED BY ALICIA J. CHAMBERS

Faculty advisors are essential to the success of SAACS chapters. From the novice advisor to the veteran, their guidance in cultivating future leaders and scientists impacts both the student and the greater chemistry community. In this issue, we celebrate and highlight SAACS faculty advisors and their commitment to students around the country!

James Duchamp - 7 years

Emory & Henry College,
Emory, VA

Why/how did you become a faculty advisor?
In my third year of teaching at Emory & Henry, I was approached by a transfer student who wondered why we didn't have a student affiliates chapter. She got the ball rolling, obtaining a charter in 1998, and I have been a faculty advisor ever since.

What is your role as a faculty advisor?
I focus on three things: supporting our chapter leaders, helping to obtain resources, and working to ensure chapter continuity as student leadership changes.

What challenges have you faced in your position?
From time to time, students look to me for leadership decisions that they should be making. It is important to resist the urge to direct the chapter. As I tell the students, running a chapter is not a course directed by the professor. Since the chapter is a student organization, the students need to be making the decisions. This helps chapter members develop leadership skills and gives them a sense of ownership.

What has been the most rewarding aspect of your service as a faculty advisor?
I enjoy watching the students present demonstrations during NCW and community events. It is very rewarding to see students giving back to the community.

COURTESY OF EMORY & HENRY COLLEGE

James Duchamp, left.

What advice can you offer those new to the advisor position?
Resist the urge to direct the chapter yourself and work to make the chapter a very student-centered group. It is important to allow the occasional failed activity. Ironically, the leaders often learn more and become better leaders as a result of something that didn't work as planned. Also, I'd encourage new advisors to be patient; at Emory & Henry, it took a few years before the students established the traditions that have made their chapter successful.

Keep in the loop with FANmail (the Faculty Advisor Network newsletter), available at http://chemistry.org/education/saprogram.html. Faculty advisors wanting to be notified when each issue of FANmail posts should e-mail saprogram@acs.org.

Renee Cole - 1 year

Central Missouri State University,
Warrensburg, MO

Why/how did you become a faculty advisor?
I was active in SAACS as an undergraduate student (I served as president of an award-winning chapter my senior year) and got involved with the CMSU SAACS chapter during my second year as a faculty member. When the previous faculty advisor decided to pass on the torch, I was happy to accept. I enjoy working with the students and encouraging them in their endeavors.

What is your role as a faculty advisor?
I try to attend all chapter meetings. I've helped coordinate activities, particularly those involving the local school districts. I've assisted the students in putting together the demo show they do each year. I also offer ideas and serve as a springboard for their ideas. My primary role is encouraging the students to get involved and achieve their goals.

What challenges have you faced in your position?
The biggest challenge comes from having a limited number of chemistry majors. Our numbers are small, so it makes it harder to accomplish all the projects the students want to do. There aren't as many people among whom to divide work. Related to this challenge has been that of recruiting students and getting them involved in the organization. Most of our students carry a full load and also work, so time is a big issue for them.

COURTESY OF CENTRAL MISSOURI STATE UNIVERSITY

Renee Cole, front row, center.

What has been the most rewarding aspect of your service as a faculty advisor?
The most rewarding aspects are interacting with the students and seeing them explore all the possibilities that go along with being a chemistry major. I also find it very rewarding to see the students involved in outreach, feeling the satisfaction of informing the community, and helping younger students succeed in science.

What advice can you offer those new to the advisor position?
My first piece of advice is to jump in with both feet and don't be afraid to try new things. Our students are great about taking the initiative and doing good things with just a little direction and encouragement. Having students establish their goals for the year and decide how they are going to accomplish them helps give them a focus for activities and overcoming inertia. Encouraging students to suggest speakers for departmental seminars or to go on field trips are other good ways to get students involved and help them explore career options.

Have faculty advisor tips and information you'd like to share? Contact Alicia J. Chambers, a_chambers@acs.org.

Anne Marteel-Parrish - 1 year

Washington College,
Chestertown, MD

Why/how did you become a faculty advisor?
As a Ph.D. graduate student at the University of Toledo, I was actively involved in the SAACS chapter activities. It was a lot of fun and, when I joined Washington College as a faculty member, it did not take me very long to assume the role of the advisor. I love it!

What is your role as a faculty advisor?
I give advice to students and guide them in the right direction, but let them decide what they want to do — without being the leader and without imposing my ideas. I always try to find fun activities that incorporate science in some way. Having fun while learning is the best way to retain knowledge!

COURTESY OF WASHINGTON COLLEGE

Anne Marteel-Parrish.

What challenges have you faced in your position?
Recruiting new students and meeting regularly are major challenges. Students are involved in so many different activities that it is very difficult to find a common time for members to meet and be involved.

What has been the most rewarding aspect of your service as a faculty advisor?
When members of the SAACS chapter and the other participants have fun and are smiling. The best reward is when our students perform a chemical demonstration for the local school students. I see the joy in these little kids' eyes and it really makes my day!

What advice can you offer those new to the advisor position?
Take one event at a time. Do not try to tackle too many tasks at once. You are more likely to achieve goals when your energy is dedicated to a few select activities. Quality prevails over quantity!

Questions about SAACS? Call the ACS representatives listed below. (800-ACS-5558)

- **Internships, study abroad, careers, and graduate school**
  Adam M. Boyd, *ext. 6188*
- **Chapter and regional meeting grants, chapter retention, and recruitment**
  Alicia J. Chambers, *ext. 6167*
- **General SAACS information and chapter activation**
  Robin Y. Lindsey, *ext. 4480*

LOOKING FOR CHAPTER ACTIVITY IDEAS?

COMPILED BY ROBIN Y. LINDSEY

ACS Student Affiliates chapters across the U.S. and Puerto Rico are engaged in exciting, innovative, and educational activities. In order to give all chapters the opportunity to expand their activities, we will continue to highlight chapters and their work as reported in their annual reports. Submit your report with a good description of your activities, and your chapter's activity just might appear in a future issue of in Chemistry. If you have questions about any of the activities listed below, or would like further information on how to implement them, please contact the SAACS chapter directly. Good luck!

Community Service

Lafayette College, Easton, PA

The SAACS chapter at Lafayette College hosted a table at Eggstravaganza, an event sponsored by Alpha Gamma Delta. Children constructed "molecules" using gumdrops, marshmallows, and toothpicks.

How long did it take to plan the activity and what was involved?
Planning for the activity took place during two meetings.

What planning resources did you use?
No planning resources were used.

How many SA participated?
Ten Student Affiliates who participated over the course of the event.

How many people attended the event?
Approximately 100 people attended.

What was the age range of the audience?
The children ranged in age from 3 to 10 years old.

How long did it last?
The event was held from 10 a.m. to 2 p.m.

What safety equipment was required?
No safety equipment was necessary.

For more information, contact Chip Nataro, faculty advisor, nataroc@lafayette.edu.

St. Cloud State University, St. Cloud, MN

The SAACS Chapter at St. Cloud State University participated in the Relay for Life, raising $1,300 for the American Cancer Society. One team competed in the race, while a second team performed activities with children.

How long did it take to plan the activity and what was involved?
Planning took three months and involved meeting with the Medical Professions Association, going door-to-door to collect donations, and organizing hands-on chemistry demonstrations.

What planning resources did you use?
Our team captain attended monthly meetings, and the officers met with our faculty advisor to discuss possible chemistry demonstrations.

How many SA participated?
Eleven members participated.

How many people attended the event?
Over 300 people attended Relay for Life.

What was the age range of the audience?
The audience for the chemistry demonstrations was elementary school students, ranging in age from 6 to 12.

How long did it last?
The demonstrations lasted approximately two hours.

What safety equipment was required?
Our faculty advisor and another chemistry professor were on-hand to assist with any emergencies, and the room was equipped with a fire extinguisher.

For more information, contact Mark Mechelke, faculty advisor, mfmechelke@stcloudstate.edu.

Department/College Service

University of Louisiana-Lafayette, Louisiana

The SAACS members at the University of Louisiana-Lafayette created a study room. The completion of this room was celebrated with a grand opening.

How long did it take to plan the activity and what was involved?
This activity took about two months to plan. We had to get approval from the department to use an empty room. We next asked the university to donate four used computers so we could set them up for use with chemistry software programs and Internet usage. Our next step was networking the computers which was done by our advisor, Son Do. Finally, the room was painted by the SAACS members, including Periodic Table graffiti of the elements on the walls.

What planning resources did you use?
All the SAACS officers and our advisors, Son Do and August Gallo, helped to contact the appropriate University personnel to get their approval. The computers and paint were donated.

How many SA participated?
About 18-20 SAACS members and the advisors helped plan and carry out the renovation.

How many people attended the event?
The grand opening of the room was at the end of the fall semester and was held in conjunction with a departmental Christmas social. There were 40-45 people present, including SAACS members, our advisors, chemistry majors, faculty, and guests. Dinner was prepared by our advisor, Son Do.

What was the age range of the audience?
The age range of those attending the grand opening was 13-70.

How long did it last?
The grand opening lasted for two hours.

What safety equipment was required?
No safety equipment was necessary.

For more information, contact August Gallo or Son Do, faculty advisors, gallo@louisiana.edu or son@louisiana.edu.

Washington State University, Pullman, WA
The SAACS chapter at Washington State University planned tutoring sessions for organic students.

How long did it take to plan the activity and what was involved?
Overall, planning and setting up the sessions took about two weeks at the beginning of the semester. The sessions were generally held on weekdays in the evenings to avoid conflicts with classes. One hour a week was required for scheduling tutors and looking at upcoming homework sets each week.

What planning resources did you use?
Planning began with contacting the organic faculty, who provided class schedules and access to homework problems. We set up a tutoring schedule that corresponded to exams and homework deadlines. We worked with the department to schedule rooms and times. After scheduling was complete, we announced the sessions to the organic students. Flyers were posted in the department and in the dorms, and participating faculty announced the sessions in their classes.

If you'd like your chapter activity to be included here, e-mail saprogram@acs.org

How many SA participated?
Club members who offered their services as tutors were junior and senior level chemistry students, many of whom were also teaching assistants in the organic classes. A total of six Student Affiliates were involved with this activity along with several other students.

How many people attended?
Attendance at the sessions averaged 10-20 students on most nights and 40-50 students on nights before exams.

How long did it last?
Sessions were generally one to two hours in length. Volunteers were scheduled in pairs and worked in one- or two-hour shifts. Exam tutoring sessions lasted approximately three hours and often required more tutors and on several occasions the club advisor would volunteer his time at the sessions.

For more information, contact Guy Patrick Meier, faculty advisor, meiergp@wsu.edu.

Brigham Young University, Provo, UT
The SAACS members at Brigham Young University conducted Graduate School Recruiting Night. Other SAACS Chapters attended the recruiting event.

How long did it take to plan the activity and what was involved?
Since this was the second Graduate School Recruiting Night our chapter had held, we built off of the first one and it was a lot less work. We started planning six months in advance, sending invitations to the schools. A few months later, we sent out information packets. We scheduled rooms, arranged for refreshments, helped set up booths, compiled information sent from schools unable to attend, and took the recruiters out to dinner when they arrived.

What planning resources did you use?
We stayed in close contact with the faculty of our own university and they turned out to be a huge help.

How many SA participated?
I'm not sure. Certainly everyone at our university who is a SA came!

How many people attended the event?
About 125-150 chemistry, biochemistry, microbiology, and neuroscience majors attended.

What was the age range of the audience?
The age range was from 19-25 years old.

How long did it last?
The recruiters arrived early to set up their booths and have dinner with us, but the actual event was two hours long.

What safety equipment was required?
None! The only risk was eating too many delicious cookies, and that was a risk we were willing to take.

For more information, contact Eric Sevy, faculty advisor, esevy@byu.edu. iC

Robin Y. Lindsey is a lead program assistant in the ACS Education Division.

ACS RESOURCES AND SERVICES FOR STUDENT AFFILIATES AND SAACS CHAPTERS (PART 2)

IT'S Right UNDER YOUR Mouse!

By Alicia J. Chambers

IN OUR LAST ISSUE, WE HIGHLIGHTED THE products and services of the ACS Education and Publication Divisions. In this issue, we discuss the services and programs offered by the Membership Division and the Green Chemistry Institute.

Membership Division

In many ways, there is little distinction between an ACS member and an ACS Student Affiliate. All who consider themselves as part of ACS are valuable to the Society, and are important partners in our mission. The Membership Division, in particular, is committed to supporting both Society members and Student Affiliates, individually and collectively, through a team effort that emphasizes innovation, creativity, and relevance.

The ACS Membership Division is divided into three areas: Member Outreach Programs, Scientific & Professional Advancement, and Marketing & Administration. Depending on your current needs as an affiliate, and on your future needs as an ACS member, you will probably interact with all three of these areas at some point.

Reaching out

Member Outreach Programs is the area with which you've probably had the most contact. Diversity Programs, Industry Member and Awards Programs, and Local Section and Community Activities all fall under this section of the Membership Division.

The Department of Diversity Programs promotes and facilitates programs, products, and services that increase the participation of members of underrepresented groups, including chemists with disabilities, underrepresented minority groups, women, and chemists under the age of 35. A variety of services are offered, including ACS Scholars **(http://chemistry.org/scholars)**, a scholarship program for African American, Hispanic/Latino, and American Indian students seeking to pursue undergraduate college degrees in chemical sciences and chemical technology. Now in its 12th year, the ACS Scholars Program has identified over 1,600 scholarship recipients and disbursed more than $8.2 million since inception. The members of the Women Chemists Committee **(http://membership.acs.org/W/WCC/)** are leaders in attracting, developing, and promoting women in the chemical sciences. Through online mentoring programs, awards, and travel grants, WCC is advancing gender diversity. Meanwhile, for SAs wanting to increase networking opportunities and continue developing leadership skills after graduating, the Younger Chemists Committee **(http://membership.acs.org/Y/YCC/)** is the next step. YCC members collaborate to identify the needs and concerns of younger chemists and to develop effective programs in response.

If a career in industry is in your future, the Department of Industry Member and Awards Programs offers insights into the corporate world. At each regional meeting, SAs are invited to attend the Regional Industrial Innovation Symposia/Awards programs to hear about cutting-edge industrial research and meet the people behind the papers. For more personal interaction, we encourage SAs to attend the ACS spring national meetings to get "up close and personal" with members of industry at a special Corporation Associates reception.

The Department of Local Section and Community Activities offers a range of resources via two offices.

The Office of Local Section Activities **(http://chemistry.org/localsections)** encourages students and professionals to form and maintain local connections and to promote chemistry in their communities. With 189 local sections in the continental US, Alaska, Hawaii, and Puerto Rico, members and affiliates can interact with other local professionals and organize community programs. The Office of Community Activities **(http://chemistry.org/oca)** provides local sections the tools with which to fulfill their outreach goals. National Chemistry Week **(http://chemistry.org/ncw)** is the most well known of the outreach programs supported by the Office of Community Activities. Celebrated each October, NCW enhances public awareness about chemistry's contributions to society and our everyday lives. The Salutes to Excellence Program allows local sections to recognize the positive impact on everyday life made by a product, practitioner, or place of importance related to chemistry. And Chemvention is a yearly event in which SAACS chapters compete against each other to solve a common problem. As the name implies, chapters must use their chemical intuition to invent a device or method that works better, and is cleverer, than their competitors' offerings.

Getting ahead

One of the best ways to enhance your chemical sciences knowledge is to learn about the latest in research. The ACS Scientific & Professional Advancement Department offers a variety of ways to do so, including attending national and regional meetings. At these events, you can also advance your career by taking advantage of programs and services to help develop "soft skills."

ACS Meetings and Exposition Services **(http://chemistry.org/meetings)** offers affiliates and members the opportunity to network with scientific professionals on a global scale. Twice a year, ACS sponsors five-day national meetings that include an exposition, symposia, technical sessions, workshops, short courses, and social events for those interested in chemistry, chemical engineering, and related sciences. If attending a national gathering is not possible, a great alternative may be to attend regional meetings.

The Department of Career Services **(http://chemistry.org/careers)** gives SAs and members the tools to manage their careers from start to finish. While you're an affiliate, ACS Career Services offers you a variety of specialized services to help in résumé preparation, interviewing skills, and job searches. After graduation, the services continue with the Career Consultant Program, personalized coaching, salary information, workshops, and publications. A number of resources are free and available online.

Spreading the word

Communicating with members takes a lot of work and dedication, but the Department of Marketing & Administration **(http://chemistry.org/membership)** gets it done! Once you've graduated, these folks are ready to welcome you as a full ACS member. They also keep you informed about ACS news and events through a variety of communication channels — including *Chemistry* **(http://chemistry.org/chemistry)**, a quarterly online tabloid for ACS members, affiliates, and others interested in learning more about the chemical sciences and ACS.

Green Chemistry Institute

As members of the ACS Green Chemistry Chapters know, GCI is the place to turn for advice and resources **(www.greenchemistryinstitute.org)**. Chemists in industry, academia, and government have found the same to be true. Since its mission is to advance the implementation of green chemistry principles into all aspects of the chemical enterprise, GCI has something for everyone.

The GCI Web page serves as a clearinghouse for a wide range of education resources. Whether you are looking for outreach materials for elementary schools or graduate programs with a green chemistry emphasis, this is the place to look. Visitors to the GCI web page can also find links to recent news articles, updates on current events, and archives of green chemistry in the news.

GCI also promotes research in green chemistry. Efforts span the spectrum from theory and basic research through application and commercialization of science and technology. If you are looking for examples of where green chemistry is happening, visit the awards section of the GCI web page or attend one of the conferences listed.

Whatever your interests in chemistry, remember that there is no need to search high and low for resources. You can find it all right under your mouse, at **http://chemistry.org**! IC

Alicia J. Chambers is an associate editor for **in Chemistry** and a senior education associate in the Undergraduate Programs Office.

Reprinted from the April/May 2004 web edition of in Chemistry.

Quick Tips for Writing CISA and IAG Proposals

The application season for Community Interaction-Student Affiliates (CISA) grants and Innovative Activities Grants (IAG) is about to begin. To submit the best proposal possible, follow these proven tips.

APPLYING FOR A CISA OR IAG GRANT

Begin the application process by discussing your project idea with your faculty advisor. Once your project has been approved and the necessary logistics have been arranged, submit the appropriate application using the current forms.

After your proposal is received, volunteer faculty advisors from other SAACS chapters will review it to determine whether it is eligible for funding. It takes an average of three months from the time an application is received until the Society Committee on Education (SOCED) approves a project for a grant award.

In all cases, whether a proposal is rejected or accepted, the review committee explains its conclusions. A summary statement with these comments and a notification letter is mailed to each applicant. Copies are kept on file in the Undergraduate Programs Office in case of questions/concerns.

PLANNING/SUBMITTING YOUR PROPOSAL

Here are some suggestions to consider as you complete your proposal:

Thinking Ahead

- Start early — well before the deadline (usually mid- to late June) — reviewers expect you to have taken the time needed to think through your proposal.
- Be focused — it's usually better to plan one great event than several small or mediocre events.
- Be on-target — make sure your project qualifies; funding is provided for group/chapter activities, but individual research projects are not eligible.
- Don't expect on-going support — reviewers give preference to chapters that have not received funding in the last two years.
- Give it your best shot — remember that all proposals are reviewed together. To be competitive with the other proposals, you should submit your very best.

Getting Started

- Start with a good idea! Avoid recycling or renaming previously-funded proposals. Originality is your best friend!
- Do your homework and know the issues, questions, and the community you want to serve. Investigate additional sources of funding and possible co-sponsorship.
- Read and familiarize yourself with all components of the application (cover sheet, budget, etc.). Incomplete proposals will not be reviewed.
- Discuss potential problems and pitfalls. Describe alternate strategies.
- Spend a fair amount of time planning and reviewing your budget. Try not to request funding for materials and services that can be reasonably provided by other sources. For example, you can probably get help from your school or department for any photocopying and office supplies needed, and you can ask local businesses or community groups for assistance with food and advertising.

Pulling It All Together

- Reread your application. Make corrections. Have your faculty advisor read it. Read it again.
- Create a single "voice" for your proposal. If your application is a collaborative effort, assign one person to do the final editing.
- Submit a legible, neat proposal.

COURTESY OF UNION UNIVERSITY

The Union University, Jackson, TN SAACS Chapter used their CISA grant to help **Keep Jackson Beautiful**, replacing trees lost in recent storms.

Quick Tips for Writing CISA and IAG Proposals, *continued.*

COMMUNITY INTERACTION-STUDENT AFFILIATES GRANTS

Intent

The primary purpose of CISA grants is to support interactions and projects that will benefit minority students in grades K–12, critical years during which children can learn and become enthusiastic about the chemical sciences. The proposed projects should seek to:

- Identify projects that actively involve minority children at the K–12 levels, their teachers, and/or parents in hands-on science activities;
- Enhance the involvement of SAACS chapters in hands-on science education activities, specifically targeting underserved minority children; and
- Strengthen SAACS interaction with ACS local sections and other groups in the community.

Minority communities include African-American, Hispanic, Native American, and Pacific Islander students.

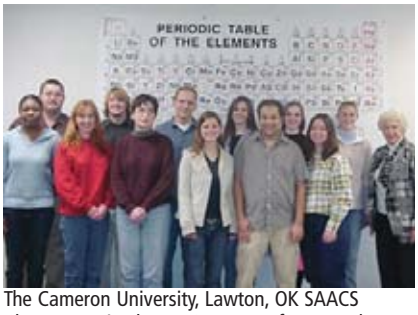
Proposal

Each CISA proposal should address the following topics in detail:

- Project rationale – state why the project is necessary. Give as many details as you can about the community, including (but not limited to): community demographics, community location, and school demographics.
- Project description – one of the most important parts of your proposal, this should be the bulk of your application. Be as thorough as possible. Specify your intended audience. Provide timelines, detailed budgets (including matching funds, if applicable), and any additional information, including the number of chapter participants.
- Partnerships – provide letters of support from supporting/collaborating groups or organizations.
- Staff qualifications – list the project directors' or supervisors' experience in administering activities comparable to those outlined in the proposal.
- Safety considerations – outline all safety measures that will be taken.
- Evaluation – indicate how you will determine whether your project has been a success.

Funding/Award

Matching funds are not a requirement for CISA grants; however, chapters are encouraged to seek matching funds.



COURTESY OF CAMERON UNIVERSITY

The Cameron University, Lawton, OK SAACS Chapter received an IAG grant to focus on the chemistry of space travel.

INNOVATIVE ACTIVITIES GRANTS

Intent

The primary purpose of each IAG grant is to support new and/or creative projects for SAACS chapters.

Proposal

Each IAG proposal should address the following topics:

- Innovation – proposals should request grants for projects new to the chapter (and relatively new to the Student Affiliates Program) rather than for activities that have been independently and successfully funded in the past.
- Relevance – each project must be relevant to chemistry. Community service, research, or educational programs qualify.
- Involvement – to maximize participation, Student Affiliates chapters are encouraged to do projects in conjunction with other schools or sister professional societies (e.g., the American Institute of Chemical Engineers, the American Indian Science and Engineering Society, the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, and the Society for Advancement of Chicanos and Native Americans in Science).

Funding/Award

IAG projects MUST have matching funds (that is, some additional source of funding for 50% or more of the total expected cost). Please provide a letter of verification/intent from source of matching funds, if other than the chapter's treasury.

Good luck writing those proposals!

Want to see what other chapters have done?
Visit chemistry.org/education/student, click on Student Affiliates and the desired grant.

For more information about Chapter Grants contact the Student Affiliates Program at 800-227-5558, ext. 4480 or saprogram@acs.org.

building awareness of green chemistry

ONE SCHOOL AT A TIME!

By MariCarmen Korngiebel-Rosique

LAST YEAR AT THE SPRING 2005 ACS national meeting, I watched as student representatives walked across the stage during the Student Affiliates Chapter Awards Ceremony. Numerous certificates and plaques were handed out, but one specific honor stood out: the Green Chemistry Chapter Award.

For years, our institution, Virginia Wesleyan College, Norfolk, has promoted environmental consciousness and awareness. From becoming a bird sanctuary, to installing bat-housing boxes, to placing recycling containers around campus, Virginia Wesleyan has proven its dedication to conserving and preserving the environment. After chapter members attended the 2004 Green Chemistry Workshop, we invited a green chemistry speaker. But after hearing about the successful achievements of other chapters, we felt sure that we could more fully bring green chemistry to our campus – and become an officially recognized Green Chemistry Chapter.

Setting the foundation

Initially hesitant as to how to begin, our Student Affiliates Chapter (known on campus as the "Science Club") soon turned to the greatest resource available: the Green Chemistry Institute (GCI). We obtained a wealth of information.

Our first goal was to impact the entire campus community at our 2005 Earth Day Celebration. Using banners, posters, balloons, and freebies, the Science Club displayed information and answered numerous questions about what green chemistry was and how it could improve our lives. Based on the audience's interest, we felt that green chemistry was becoming our new "home" – and that we had just poured the foundation.

COURTESY OF VIRGINIA WESLEYAN COLLEGE

MariCarmen Korngiebel-Rosique, Braden Miller, and Wendy Schafer (left to right) at the Green Chemistry display table for Earth Day.

Building the walls

Next on our agenda was hosting a speaker at the Division of Natural Sciences and Mathematics Seminar Series. We contacted Lauren Heine, director of applied science at GreenBlue, in Charlottesville, Virginia, who agreed to present her lecture on the challenges and opportunities surrounding green chemistry.

When Heine came to campus, the organic chemistry class taught by the Science Club's faculty advisor, Joyce Easter, was studying the effects and benefits of green chemistry. Prior to the seminar, Heine was treated to an informal roundtable luncheon/discussion with the Science Club and organic chemistry students. Topics ranged from employment opportunities to widespread media attention.

Those attending the roundtable and seminar gained a strong understanding of the necessity of finding safer ways to synthesize various chemical products. After Heine's departure, our members could see that our goal was well within reach; for we now knew that the walls of our green chemistry "home" had been firmly established.

Adding the roof

The next step was to make sure that green chemistry remained on the minds of students, staff, and faculty. Flyers, banners, and posters have worked for other clubs and organizations. Why not, we wondered, use these simple means of communication?

Students in Easter's organic chemistry class were asked to submit their own creative interpretations of the "12 Principles of Green Chemistry." The submissions ranged from crayon sketches to computer-generated images, which we posted on a central bulletin board in the science building. Pamphlets about ACS and GCI were placed nearby. Now, our new "home" had a roof and was nearly complete.

Expanding our home

So, where are we today in our quest? At the fall 2005 ACS national meeting, we were invited to present our accomplishments in green chemistry. After the presentation, we were informed that we had been selected to receive one of the 2004-2005 Green Chemistry Chapter Awards, to be awarded at the spring 2006 ACS national meeting. We had reached our goal!

Just one year ago, we watched as other schools were recognized for their green chemistry achievements. This year, we'll stand proudly beside them. We have laid the foundation, built the walls, added the roof, and are now expanding our green chemistry "home." Care to share the space with us? iC

MariCarmen Korngiebel-Rosique is president of the Virginia Wesleyan College Science Club, a senior, and a double major in chemistry and biology.

The Greening of Chemistry and Student Affiliates Chapters

By Kathryn E. Parent

CHEMISTS are designers with the unique ability to affect molecules, materials, products, processes, and systems at the earliest possible stages of development. Chemists have been isolating natural elements and compounds and creating new chemicals since even before Antoine Lavoisier discovered nitrogen and began his historic examination of organic compounds.

With the ability to design and make chemicals came the power to affect human health and the environment, both positively and negatively. The discipline of environmental chemistry was developed to recognize, understand, and treat the growing problem of environmental pollution.

Environmental chemistry detects chemicals in the environment and studies their interactions and effects on nature. It is interdisciplinary, drawing on chemistry, biology, and physics to understand the interplay of chemicals in air, soil, water, plants, and animals.

In contrast, green chemistry seeks to prevent, rather than study, pollution. The main objective of green chemistry is to use alternative, safer chemicals and chemical processes that will not harm the environment in the first place. Green chemistry was born in large part in response to the Pollution Prevention Act of 1990. Chemists were encouraged to develop innovative ways to reduce and eliminate the use and generation of hazardous substances, and thereby promote a sustainable chemical enterprise. In 1998, Paul Anastas and John Warner provided a framework for designing new materials and processes, writing the "12 Principles of Green Chemistry,"(see inside back cover).

Systematic integration of these principles is needed to achieve genuine sustainability for the benefit of the environment, economy, and society.

Sometimes green chemistry is described as 'benign by design.' More specifically, explains Anastas, director of the ACS Green Chemistry Institute, "Green chemistry is an innovative way to design molecules and chemical transformations for sustainability." The concept of sustainability was defined by the World Commission on Environment and Development as, "meeting the needs of current generations without sacrificing the ability to meet the needs of future generations."

The 25 Green Chemistry Chapters Recognized Since 2002

- Arkansas State University
- Barry University
- Baylor University
- Bridgewater State College
- Ferris State University
- Fort Lewis College
- Florida Southern College
- Hendrix College
- Illinois Wesleyan University
- Lane Community College
- Millikin University
- Shepherd College
- South Dakota School of Mines and Technology
- Stern College for Women - Yeshiva University
- Suffolk University
- Union University
- University of Colorado at Denver
- University of Detroit-Mercy
- University of Oregon
- University of Pittsburgh
- University of Puerto Rico - Río Piedras
- University of Tennessee at Martin
- University of Toledo
- Virginia Wesleyan College
- Xavier University of Louisiana

ACS goes green

Since 2001, the ACS Education Division and the ACS Green Chemistry Institute have promoted student understanding and engagement in green chemistry. ACS has published several resources, including green chemistry lab manuals, available at chemistry.org. The Society's website also includes general information on green chemistry at http://chemistry.org/education/greenchem, and additional information is available at www.greenchemistryinstitute.org.

Since 2002, ACS has selected Green Chemistry chapters through its Committee on Education and Green Chemistry Institute. Qualifying chapters receive recognition at a ceremony held during spring ACS national meetings, as well as complimentary green chemistry educational materials, information on green chemistry internships and research opportunities, and connections to faculty engaged in green chemistry research. Past winners of the Green Chemistry Chapter Award are listed on the left.

How can my chapter go green?

■ Know the criteria

The key to achieving the Green Chemistry Chapter designation is understanding the program criteria before you plan your activities. Just as importantly, you must summarize the activities in your chapter's annual report to ACS. Fortunately, there's an easy-to-use resource that will help you do both. In the Green Chemistry section of the annual report form are criteria to help you as you plan activities — and later, as you prepare your report. (See also, "The Keys to Success," in the February-March 2006 issue of *in Chemistry*.)

■ Make sure activities are truly green

There are many activities, such as Earth Day celebrations, that may be good for the environment and the local community — and yet are not green chemistry. Remember, green chemistry focuses on pollution prevention, not remediation. The chapter report must clearly explain the green chemistry aspect of the activities. Environmental science activities such as water testing, recycling drives, or clean-up efforts are commendable, but do not qualify as green chemistry activities.

■ Participate in at least three distinct activities

To receive a Green Chemistry Chapter Award, your chapter must participate in a minimum of three distinct green chemistry activities during the academic year, at least one of which is planned by the chapter. A few suggestions are listed below and in the box above.

Many Green Chemistry chapters visited local elementary and high schools to share videos and/or hands-on laboratory experiments related to green chemistry. Others assessed, redesigned, and developed greener laboratory experiments for courses at their universities. Most Green Chemistry chapters developed bulletin boards, newsletters, and Web pages. Attendance at ACS Green Chemistry Workshops, which are held periodically at ACS spring national meetings, was another common activity. Please note that chapters must have a variety of green activities — so having three seminar speakers, even at different events, would not meet the criteria. Activities should also be new or expanded from previous years; the same Web page or newsletter does not qualify in succeeding years.

Creative activities have included:

- Organizing a green chemistry poster session at a local conference
- Doing a green chemistry service-learning project
- Producing a green chemistry coloring book for elementary school students
- Painting with a non-volatile paint formulation and explaining the green chemistry innovation
- Demonstrating green chemistry cleaning products at a campus fair
- Writing and performing a green chemistry skit for high school students
- Partnering with a local museum to offer green chemistry activities for Science Day
- Writing an article about green chemistry projects for *in Chemistry*
- Making a presentation about green chemistry SAACS activities at an ACS national meeting

■ Maximize the impact

Successful Green Chemistry chapters organized events that involved participation from many chapter members. For instance, a green chemistry research project by one chapter member alone would not qualify. However, if the chapter member were to give a presentation at one of the chapter meetings or a department seminar, then that would qualify as a green chemistry activity for the chapter.

At least one event should involve non-members and the general community. Many past winners worked together with ACS local sections and other local organizations to integrate green chemistry into public or university events. In addition, Student Affiliates chapters often applied for ACS Innovative Activities Grants to support green chemistry activities in research and community-oriented activities.

Green Chemistry Institute

Need help?

You can learn more about green chemistry and the Green Chemistry Institute at, www.greenchemistryinstitute.org.

The staff of the ACS Green Chemistry Institute is always excited to hear about new green chemistry initiatives and will provide guidance and support to individual SAACS chapters. Please contact the Institute at gci@acs.org with your news and questions. IC

References

Anastas, P.T. Personal interview, 2005.

Anastas, P. T.; Warner, J. C. *Green Chemistry: Theory and Practice*, Oxford University Press: New York, 1998.

Sitarz, D., Ed. *Sustainable America: America's Environment, Economy and Society in the 21st Century*. Earthpress: Carbondale, IL, 1998.

Wikipedia contributors (2005). Green chemistry. Wikipedia, The Free Encyclopedia. Retrieved January 3, 2006 from http://en.wikipedia.org/w/index.php?title=Green_chemistry&oldid=32269764.

Wikipedia contributors (2005). Environmental chemistry. Wikipedia, The Free Encyclopedia. Retrieved January 3, 2006 from http://en.wikipedia.org/w/index.php?title=Environmental_chemistry&oldid=32233522.

Kathryn E. Parent is a staff associate for the Green Chemistry Institute at the American Chemical Society.

GREEN IMPACT

Discovering opportunities for green chemistry in research and education

BY STEPHANIE L. GOULD

BREAKTHROUGHS IN SCIENCE ARE OFTEN THE result of someone looking at a situation with a different perspective. In my own career, the big breakthrough came when I started thinking about how the experiences and beliefs of my family related to what I was doing in the laboratory. What I discovered is an approach that any chemist can apply, along with a program that encourages chemists to make a difference.

Starting with synthesis

My undergraduate experience followed a fairly typical trajectory for a chemistry major. I attended Rose-Hulman Institute of Technology and became very interested in synthetic organic chemistry, taking all of the electives in this area that I could.

A series of undergraduate research experiences allowed me to study organic synthesis in more detail. While conducting research at Rose-Hulman, the University of Nebraska-Lincoln, and Pharmacia & Upjohn (now Pfizer), I synthesized Sattabacin (a novel antiviral compound) and (R)-10, 16-dehydroxyhexadecanoic acid, and explored alternative synthetic pathways to a target drug in a process design group.

By the time I had finished my bachelor's degree, all I wanted to do was synthesis. I enjoyed being in the lab, liked making new compounds, and wanted more experience. So I decided to pursue a graduate degree. After being accepted at Arizona State University, I dove into synthesis once again, working in a physical organic group where I synthesized new reaction centers to be used in a liposomal-based artificial photosynthesis.

Asking bigger questions

In my third year of graduate studies, I started to re-evaluate all of the work that I was doing. I had been studying traditional synthetic techniques that were very effective, but I had never considered their inherent risks. I began thinking about my mother's passion for environmental issues and my mother-in-law's experience with cancer. I began asking questions about the byproducts generated when compounds are synthesized and used. Ultimately, the answers I found to these questions changed my aspirations. I now realized that I wanted to pursue chemistry in a way that would minimize risks to the environment and the human body.

GETTY IMAGES, SCIENCE CONCEPTS

Seeing green

When I started doing research on the risks associated with chemistry, I had barely heard of green chemistry. I knew that it involved considering the environment when doing chemistry, but was not sure what that really meant. Then I found the ACS Green Chemistry Institute Web site, where I learned about the upcoming ACS Summer School on Green Chemistry. I was intrigued. After applying and being accepted, I was off to Pittsburgh, to learn more about "designing chemical products and processes that reduce or eliminate the use and generation of hazardous substances."

At the summer school, I learned about all aspects of green chemistry, from applications to the current research. Experts from academia and industry presented their research and talked about integrating green chemistry into their work. Some presenters focused on new techniques, while others shared ways to improve current technology.

The more I learned, the more it became clear that the "12 Principles of Green Chemistry" (see inside back cover) could

GREEN CHEMISTRY INSTITUTE

Participants in the 2004 ACS Summer School on Green Chemistry.

be applied to any aspect of chemistry, especially the organic synthesis that interested me.

A section of the summer school focused on green chemistry opportunities in education. Being interested in undergraduate education, I appreciated learning about what others were doing to integrate green chemistry into coursework and the resources available. Lectures were presented on current issues in education, but the most beneficial activities were the actual hands-on experiments we performed. These lab experiences really showed what is possible when green chemistry is applied to undergraduate education.

By the end of the 10-day summer school, I knew that that green chemistry would play an important part in my career!

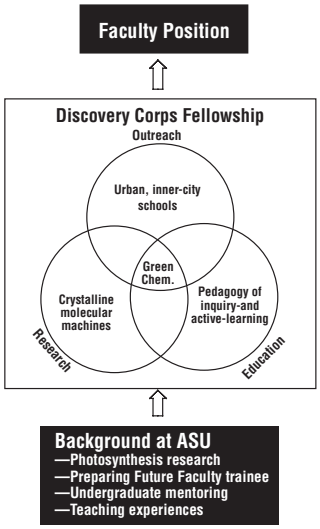
Expanding opportunities

After returning from the summer school, I began looking for ways to incorporate green chemistry into my two primary interests: synthetic chemistry and education. I also needed to make a decision about what to do after earning my Ph.D.

The first thing I did was to obtain a postdoctoral position with Miguel Garcia-Gariby at the University of California, Los Angeles, where I would be synthesizing and studying molecular rotors and gyroscopes — compounds that maintain some well-ordered motion in the crystalline state.

Because I also knew that having an independent funding source would greatly expand my postdoctoral opportunities, I applied for a National Science Foundation Discovery Corps Postdoctoral Fellowship. This pilot program, funded by the Division of Chemistry, supports the development of new postdoctoral models that make different types of experiences and skills accessible to the fellow.

Given my long-term goals, I proposed integrating pedagogy, green chemistry, and molecular machines into a two-year fellowship. The nature of my plans made it easy to explain how I would meet NSF's criteria for intellectual merit and broader impact. Having received a grant in early 2005, I was able to bring my own salary and research funds to UCLA, where I now pursue both synthetic research and educational activities — and incorporate green chemistry into both.



Multiple roles

In Garcia-Garibay's lab, I am applying my knowledge of synthesis and photoactive compounds to the synthesis of new molecular machines with unique solid state properties. At the same time, I am applying greener techniques in my synthetic work and, at times, developing new ones.

I am also learning about the pedagogy of inquiry and active learning by working with Arlene Russell and the NSF-sponsored Graduate Teaching Fellows in K-12 Education program at UCLA. Several graduate students and I are helping develop and implement a new high school chemistry curriculum by working with schools in the Los Angeles Unified School District. The curricular resources will significantly enhance the science education of the district's students, encouraging them to expand their knowledge and consider careers in science.

In my role as a program fellow, I am responsible for developing seven lessons per year, working with the teachers and students to ensure the lessons are appropriate. When designing lessons, I must keep in mind several parameters. The lessons need to utilize inquiry and active learning. They also must be aligned with the state of California's science standards. Finally, they must be appropriate for an urban school serving a predominantly low income community. By involving green chemistry, I am often able to decrease the amount of waste generated and the cost of materials, while capturing the interest of students.

Following my career path

During the second year of my postdoctoral fellowship, I will need to make my next career move. As I pursue opportunities to teach and do research with undergraduate students, I will be sure to apply what I have learned over the past several years. Among other things, I will be seeking:

- Interesting questions from unexpected places. The best research and education cannot happen in a vacuum.
- Opportunities to tap into the power of green chemistry. It is not a separate field of chemistry, but rather a methodology that can be adapted across the discipline — significantly enhancing the impact and perception of both research and education.
- Ways to strengthen our educational system. There are many ways in which secondary and post-secondary programs can be enhanced by working together and sharing strategies and expertise.
- Opportunities to make a broader impact. Introducing chemistry to those who are not familiar with it engages a whole new audience.

Finding the time and resources to develop partnerships and appropriate material after my postdoctoral fellowship ends will be a challenge, but the payoff in terms of fun and satisfaction will be worth it! iC

Stephanie L. Gould earned her B.S. in chemistry from Rose-Hulman Institute of Technology and her Ph.D. in organic chemistry from Arizona State University. She is a NSF Discovery Corps Postdoctoral Fellow at University of California, Los Angeles.

Reprinted from the Journal of Chemical Education, *Vol. 82, pp 974-976. July 2005.*

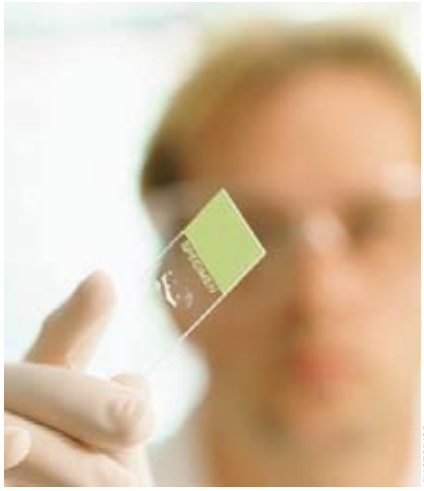
Going Green:

Lecture Assignments and Lab Experiences for the College Curriculum[1]

By Julie A. Haack, James E. Hutchison, Mary M. Kirchhoff, and Irvin J. Levy

GREEN CHEMISTRY, THE design (and redesign) of chemical products and processes to eliminate hazards to human health and the environment, provides unique opportunities for innovation in the chemistry curriculum and for engaging a broad spectrum of students in the study of chemistry. Although many faculty and students recognize the benefits of a greener curriculum, widespread incorporation has been limited by the availability of green chemistry educational materials and the scarcity of successful models for integrating green chemistry into the classroom and laboratory.

The green chemistry community is expanding efforts to develop educational materials for students at multiple levels and for a broad range of chemistry subdisciplines. These new tools enable educators to share their enthusiasm for chemistry with a receptive student and public audience that appreciate the ability to combine their interests in chemistry with a desire to protect human health and the environment. Green chemistry is a useful tool to increase awareness and teach sophisticated problem solving skills in a chemistry context.


PHOTODISC

A symposium held at the ACS national meeting in San Diego in March 2005 illustrated the creative approaches faculty members are taking to introduce green chemistry concepts to their students. *Going Green: Lecture Assignments and Lab Experiences for the College Curriculum* featured new materials and methods developed by 26 educators from around the world. Their presentations effectively highlighted the gathering momentum for the development and implementation of greener education materials *(1)*.

A recurring theme throughout the symposium was that green chemistry provides a flexible framework for the development of new educational materials. The interdisciplinary nature of green chemistry and its important role in pollution prevention provide educators with a variety of opportunities to incorporate green chemistry principles throughout the curriculum. In addition, educators and students at all levels feel empowered to explore the connections between green chemistry and their local environment.

Greening Existing Courses

One of the most efficient strategies for introducing green chemistry is to infuse green chemistry examples into existing courses. The use of real world case studies from academia and industry illustrates specific green chemistry concepts related to topics already being covered in the curriculum. For example, faculty members at the University of Scranton have developed a set of nine educational modules, available on the Internet *(2)*, that can be used to incorporate green chemistry principles into courses ranging from general chemistry to biochemistry to industrial chemistry. At Central

Carolina Technical College, students study gases by focusing on Freon replacements, while the relationship between energy and the environment serves to highlight green chemistry principles for a multi-level course in honors physical science at Middle Tennessee State University. Faculty members at National Taiwan University creatively blend chemistry content with green examples, which are often lacking in textbooks.

Another approach to integration is the creation of advanced courses for majors, including special topics or capstone courses, such as those offered at Washington College and Northeastern Illinois University. Green chemistry serves as a theme to facilitate an integrative and interdisciplinary learning experience, where students use their critical thinking and communication skills to address complex problems facing the chemical enterprise. These courses also provide a unique opportunity to highlight ethical considerations that may be encountered when addressing complex problems.

Students often ask, "How green is green?" The use of metrics can assist students in developing an appreciation for the tools and methodologies involved in characterizing a complex chemical process. Presentations from Simmons College, Millikin University, and Gordon College described how to measure the greenness of undergraduate laboratory experiments by comparing the amount of materials (reagents, solvents, catalysts) used during a chemical reaction with the amount incorporated into the final product. Through this process students can also learn to estimate the cost of manufacturing a chemical.

Green Chemistry in the Teaching Laboratory

During the last few years there has been rapid growth in the number of greener laboratory exercises developed. The greening of organic chemistry is well underway, representing about half of the presentations during the symposium. Participants described a number of new lab experiments that eliminate or reduce the use of organic solvents, utilize more benign reagents, and enhance reaction efficiency. Ionic liquids, for example, are used at Roosevelt University to study the thermodynamic and kinetic control of regioselective enolization. Microwave ovens are employed as an alternative energy source in experiments at Simmons College, Spring Arbor University, and New York City College of Technology. Organic syntheses are conducted in non-traditional solvent systems, such as the fluorous solvents used in organic chemistry courses at Nova Southeastern University. Students have been active participants in developing greener synthetic methodologies at both Simmons College and the University of Oregon.

Laboratory experiments for introductory and general chemistry have also been developed. A cooperative project coupling the University of Massachusetts, Boston with Dedham High School in Massachusetts uses guided inquiry to illustrate green chemistry principles and teach report writing in the general chemistry curriculum. Hendrix College employs green instrumental methods to teach analytical environmental chemistry to introductory chemistry students. And while most of the development has focused on the first two years of the chemistry curriculum, new engineering-based laboratory experiences incorporating green chemistry have also been implemented. Students at Washington University use a bench-scale fermentor to produce bioethanol, a renewable source of energy, while chemical engineering students at San Jose State University conduct a gene subcloning experiment that illustrates the industrial use of biocatalysts as a route to green processes.

Green Chemistry Across the Curriculum

Green chemistry engages the imagination of learners in a way that is not common in chemical education. The incorporation of green chemistry into the K-12 curriculum is a co-requisite to the

Green Chemistry Experiments in JCE

Green chemistry experiments that have been published in the *Journal of Chemical Education* during the past five years include:

Solvent-Free Synthesis of Chalcones. Daniel R. Palleros; **2004**, *81*, 1345.

An Asymptotic Approach to the Development of a Green Organic Chemistry Laboratory. Thomas E. Goodwin; **2004**, *81*, 1187.

One-Pot Synthesis of 7-Hydroxy-3-carboxycoumarin in Water. Francesco Fringuelli, Oriana Piermatti, Fernando Pizzo; **2004**, *81*, 874.

Patterning Self-Assembled Monolayers on Gold. Green Materials Chemistry in the Teaching Laboratory. Lallie C. McKenzie, Lauren M. Huffman, Kathryn E. Parent, James E. Hutchison, John E. Thompson; **2004**, *81*, 545.

Alkene Isomerization Using a Solid Acid as Activator and Support for a Homogeneous Catalyst. Andrew J. Seen; **2004**, *81*, 383.

Caring for the Environment While Teaching Organic Chemistry. Elvira Santos Santos, Irma Cruz Gavilan Garcia, Eva Florencia Lejarazo Gomez; **2004**, *81*, 232.

Greening the Blue Bottle. Whitney E. Wellman, Mark E. Noble; **2003**, *80*, 537.

Micelle-Mediated Extraction of Heavy Metals from Environmental Samples: An Environmental Green Chemistry Laboratory Experiment. Dimosthenis L. Giokas, Evangelos Paleologos, Militiades I. Karayannis; **2003**, *80*, 61.

Chiral Compounds and Green Chemistry in Undergraduate Organic Laboratories: Reduction of a Ketone by Sodium Borohydride and Baker's Yeast. Nicola Pohl, Allen Clague, Kimberly Schwarz; **2002**, *79*, 727.

Organic-Solvent-Free Phase-Transfer Oxidation of Alcohols Using Hydrogen Peroxide. Martin Hulce, David W. Marks; **2001**, *78*, 66.

Green Chemistry in the Organic Teaching Laboratory: An Environmentally Benign Synthesis of Adipic Acid. Scott M. Reed, James E. Hutchison; **2000**, *77*, 1627.

research performed by students at the University of Massachusetts, Lowell. Undergraduate students from Bridgewater State University introduce students to green chemistry through their outreach efforts.

Although full integration of green chemistry into the undergraduate curriculum is challenging, a number of institutions are pursuing this approach because of the benefits ranging from cost and energy savings to increased student interest, recruiting, and enrollment. At the University of Oregon, the two-term organic chemistry laboratory sequence is completely centered on green chemistry. The experiments used in this course are an excellent resource for faculty who wish to more fully incorporate green chemistry into the organic laboratory curriculum *(3)*. St. Olaf College is coupling the construction of a new, greener science building with the development of a greener curriculum. At Hendrix College, educators have successfully introduced green chemistry more gradually by focusing on continually improving their organic laboratory experiments.

Green Chemistry Resources

In order to facilitate the development of green chemistry educational materials and their incorporation into the chemistry curriculum, educators need choices. A handful of textbooks provide excellent background material for educators and students, and ACS offers a variety of introductory materials, videos, and laboratory exercises that can be incorporated at both the high school and undergraduate levels. This Journal has published a number of green laboratory experiments that enable educators to integrate environmentally friendly exercises into the existing laboratory curriculum (see box on previous page). The debut of the University of Oregon's interactive, Web-based database of Greener Education Materials (GEMs) in summer 2005 will facilitate the exchange of information related to green chemistry and the engineering curriculum; the URL for the GEMs site is expected to be *http://greenchem.uoregon.edu/gems.html*. Opportunities to learn more about green chemistry include the ACS Summer School on Green Chemistry for graduate and post-doctoral students (at *http://chemistry.org/greenchemistry/summer.html*, accessed Apr 2005), and the Green Chemistry in Education Workshop for organic chemistry faculty hosted by the University of Oregon (at *http://greenchem.uoregon.edu/*, accessed Apr 2005).

Since resource sharing was a key goal in the design of this symposium, most presenters have made their papers, handouts, and other useful material available via the GEMs site *(1)*. The opening presentation, outlining educational resources available in green chemistry, will be of special interest for those seeking more information or simply some guidance on getting started.

The term "green chemistry" has been around for about 15 years and, like most new concepts, will take some time to become fully integrated into the foundation of chemistry. However the tools and strategies discussed during the symposium in San Diego serve as valuable resources for faculty members and institutions that aspire to introduce green chemistry into the curriculum. Teaching chemistry in an environmentally responsible manner will benefit both our students and the environment, and will enrich the curriculum by connecting our science to global issues. JC

Note

1. This article is based on a symposium presented at the American Chemical Society's 229th National Meeting, March 2005, in San Diego, CA. The Division of Chemical Education was the sponsor, the Division of Industrial and Engineering Chemistry was the cosponsor.

Literature Cited

1. Presentations made at the symposium may be accessed at the GEMS Web site at http://greenchem.uoregon.edu/ (accessed Apr 2005)
2. The modules developed by the University of Scranton may be found at http://academic.scranton.edu/faculty/CANNM1/dreyfusmodules.html (accessed Apr 2005)
3. Doxsee, K. M.; Hutchison, J. E. Green Organic Chemistry: Strategies, Tools, and Laboratory Experiments; Thomson Brooks/Cole: Belmont, CA, 2004.

JULIE A. HAACK is in the Chemistry Department at the University of Oregon, Eugene, OR 97403; jhaack@uoregon.edu. JAMES E. HUTCHISON is the Director of the Materials Science Institute, University of Oregon, Eugene, OR 97403; hutch@uoregon.edu. MARY M. KIRCHHOFF is Assistant Director for Special Projects, Education Division, American Chemical Society, Washington,DC 20036; m_kirchhoff@acs.org. IRVIN J. LEVY is in the Chemistry Department at Gordon College, Wenham, MA 01984; ijl@gordon.edu.

With Chemistry, the Grass Really Is Greener

By Adam M. Boyd

IT'S A STORY PAMELA MARRONE doesn't mind repeating. When she was eight, she remembers, her father used a chemical insecticide to exterminate gypsy moths that were threatening the life of a dogwood tree in the family yard. After the insecticide was applied, Marrone and her mother went to investigate. As they carefully surveyed the dogwood, they noticed something unexpected: the insecticide had killed more than gypsy moths. There were bees and lady beetles — unintended targets — that had also been killed. Still in grade school, Marrone made up her mind that she would do everything she could to learn about environmentally-friendly insecticides.

"At the age of eight, I wrote to the Department of Agriculture to try to find out everything I could about biocontrol," she recounts with a laugh, "I was unusual."

Marrone was headed for a collision with green chemistry.

Seeing opportunities

Beginning in 1983, Marrone worked with the insect biology group at Monsanto. Among their pioneering environmental projects was one on microbial pesticides. With direction from management, she led a team that started to screen for natural chemicals produced by microbes and plants. Marrone cites this experience as confirmation of her hope that her career would always involve working with green chemistry.

"The key was the chemistry," explains Marrone. "That was the most fun part of what I did at Monsanto, and it solidified for me that I was going to spend my career doing that. It was really going to be green chemistry."

Leading the insect biology group at Monsanto, Marrone and her collaborators wondered why the pharmaceutical industry so often turned to nature, while the agricultural industry seldom did. If effective medicines were often synthesized by mimicking naturally-occurring compounds, why couldn't the pesticide industry do the same? Her team set out to reconcile that difference, using chemistry as its avenue of inquiry.

Typically, those few companies that did try to develop biopesticides focused too heavily on the biological aspect of product development. Though they might discover a microbe with a novel behavior, they often wouldn't take the next step of discovering the chemistry behind it. This would lead to inconsistent results, explains Marrone.

"Most biopesticide companies did not focus on characterizing the chemistry, and hence, missed a whole portion of the product development."

Teaming with bacteria?

Today, Marrone has leveraged her familiarity with chemistry into a distinct competitive advantage for AgraQuest, the company of which she is president and founder. In addition to controlling insects, AgraQuest develops products

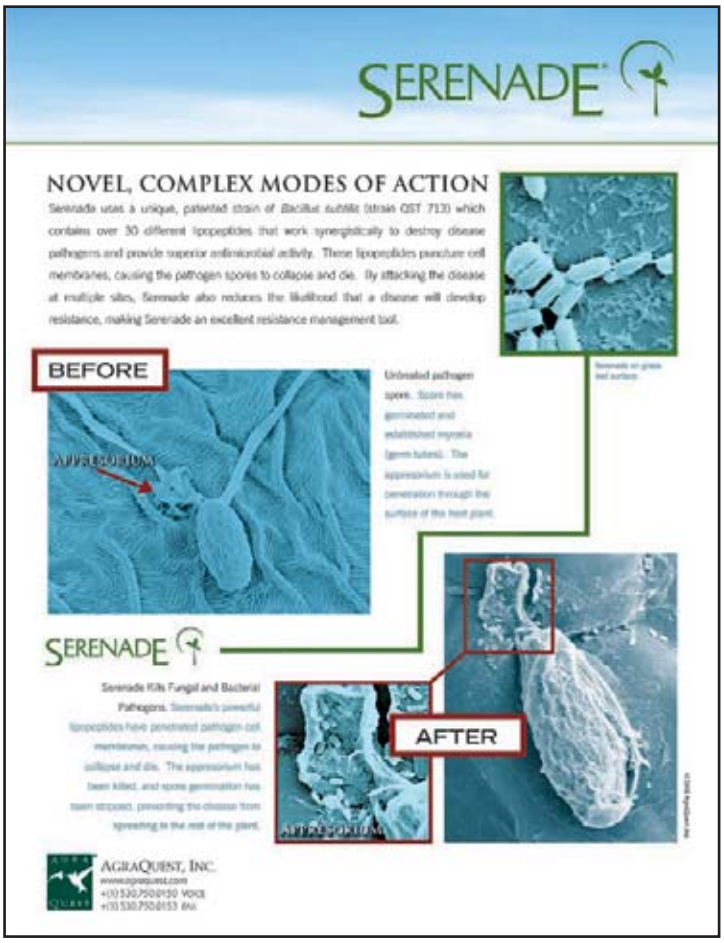
Pamela Marrone showcases her work at AgraQuest.

that fight other agricultural nuisances: fungal and bacterial diseases. Rather than synthesizing chemicals in a lab, Marrone and her team of experts go hunting for naturally-occurring bacteria and fungi capable of producing compounds that fight pests. After "collecting," they return to the lab to conduct an in-depth search for novel microbial action, and seek to understand the chemistry behind why a certain species of bacteria or fungus behaves in a specific fashion.

One of AgraQuest's most notable accomplishments resulted from observations made while surveying a peach

orchard in California. Together with other experts on her team, Marrone was able to identify one particular tree in the orchard that seemed immune to several types of infections. After taking a sample of soil from around the base of the tree, AgraQuest scientists discovered the soil was host to a specific strain of bacteria that produces natural antifungal products called lipopeptides. It is this patented strain of *Bacillus subtilis* that AgraQuest scientists formulated into Serenade — the biofungicide that won them the Presidential Green Chemistry Award for small business in 2003.

The patented strain of *Bacillus subtilis* on which Serenade is based produces over 30 lipopeptides. The "lipo" part of the term refers to the fatty acids that characterize lipopeptides, while "peptide" refers to their amino acid chains. These 30 lipopeptides can be divided into three groups: surfactins, agrastins, and iturins — all of which have unique fatty acids and amino acid chains. These lipopeptides work synergistically to deliver the levels of metabolites needed to effectively battle plant diseases.



Information sheet about the biofungicide for which AgraQuest received the Presidential Green Chemistry Award for small business in 2003.

Unlike other companies that develop products based on microbial pesticides, AgraQuest makes it a priority to understand the chemistry behind the antifungal or pest control properties of the microbes they discover. Where others have taken novel microbial action at face value, Marrone and her team have sought to understand why certain microbes behave in specific fashions.

"The whole approach is unique in that other companies that develop microbial pesticides have typically relied on the work of biologists, and thus didn't have the chemistry part of it. What makes AgraQuest unique is that we're really the first biopesticide company to take a newly-discovered microbe and develop an analytical method to identify the compounds and set the specification of the product, not only on the microbe, but also on the chemistry. Nobody else has done that, and it really is our fundamental difference and competitive advantage."

Challenging old ideas

As Marrone knows, old beliefs die hard. Despite the rising demand for organic products, makers of biopesticides, including AgraQuest, sometimes find themselves battling for legitimacy — trying to convince consumers and farmers that biopesticides can be both environmentally friendly and effective. In the past, "these products have been perceived as 'snake oil,'" Marrone observes. To succeed, "you really have to change the paradigm of agriculture, and have a real passion for what you do."

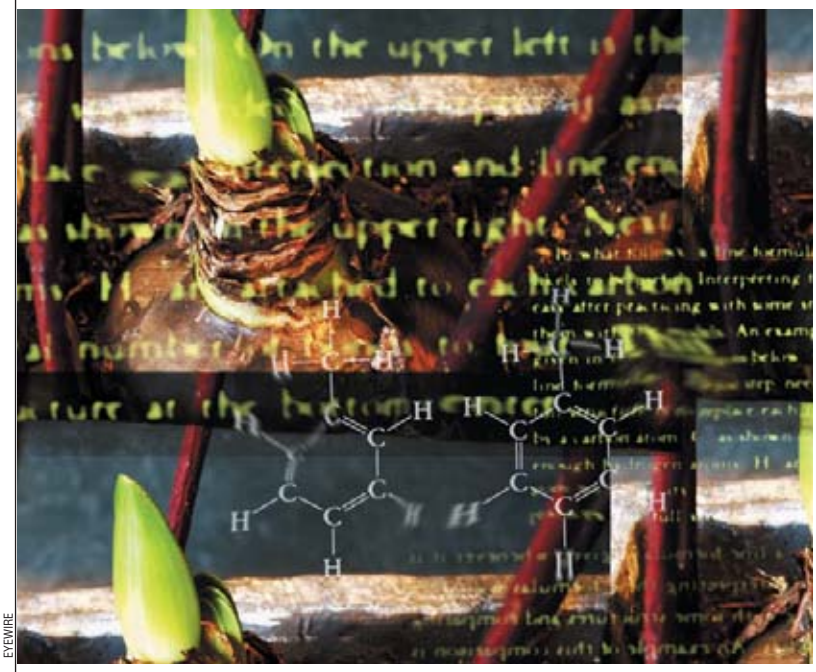
Still, Marrone believes that even obstacles such as this shouldn't keep aspiring green chemists from pursuing a career that involves protecting the environment. In fact, there has never been a better time for it, she claims. Roadblocks and pitfalls acknowledged, Marrone sees a "wave of green chemistry opportunities" breaking on the shore of sustainability and economic demand. She encourages young chemists to pursue a career with an environmental focus — especially now, when more companies are developing sustainability strategies, and many are pursuing green chemistry initiatives.

"If someone is passionate about the environment and they want to combine their environmental focus with chemistry, then they should find what they like to do and pursue it."

That's what Pam Marrone has been doing since she was eight years old. She still remembers that dogwood tree, which survives to this day at her parents' home in Connecticut. After giving up on chemical insecticides at the insistence of her mother, Marrone recalls her father saying that he wasn't sure whether biopesticides worked, but he knew they were good for the environment.

"Ironically," she says with a laugh, "that's the perception that I've tried to change with AgraQuest." iC

Adam M. Boyd is an associate editor of **in Chemistry** and is an education associate in the ACS Undergraduate Programs Office.



EYEWIRE

Looking for a Natural Fit?

Consider a Career in Environmental Chemistry

INTRODUCTION BY ADAM M. BOYD

YOU MAY BE WONDERING: in a publication dedicated to green chemistry, why include a career brief on environmental chemistry? Though it is true that the principles of green chemistry extend into all chemical disciplines, environmental chemists have many special opportunities to highlight the need for green chemistry and to clarify its importance. In this way, environmental chemistry occupies a special position in the field of chemistry, by encouraging other sub-disciplines to incorporate green principles into their practices. How does it do so?

Environmental chemistry is a unique sub-discipline concerned with environmental impact of chemical processes. As incentives mount for companies to adopt environmentally friendly approaches to chemistry, environmental chemists perform the important function of documenting the effects of those processes that lag behind. Indeed, dedicated environmental chemists can quantify exactly how much better for the environment a green approach may be compared to the conventional method. Environmental chemists also help to uncover which processes most adversely affect the environment, and as a result, are most in need of a "green overhaul."

Because environmental chemists study the impact of all kinds of chemicals on all aspects of the environment, they serve as ecological journalists — documenting nature's response to chemicals with precision and accuracy. The reports they generate can provide the impetus for members of other chemical disciplines to adopt the green chemistry philosophy when designing experiments, syntheses, or products. Through careful testing and analysis, they tell the world which chemicals or byproducts are harmful to nature; they give the environment a voice.

With such an expansive and diverse environment to study, environmental chemistry offers employment opportunities that intersect with many other fields. In fact, an important characteristic of a good environmental chemist is the ability to understand how his or her work relates to biology, geology, ecology, mineralogy, genetics, and many other fields.

If you want to contribute to environmental awareness and demonstrate the need for green approaches, then a job as an environmental chemist might be right for you. To learn more, read on.

Chemical Careers in Brief

This career brief on Environmental Chemists is part of a set of 30 such reports intended to educate teachers and students about job opportunities in the chemical sciences. Other briefs in the series include: chemical education, chemical sales, medicinal chemistry, science writing, and many more. Paper copies of the career briefs are available to Student Affiliates by contacting epic@acs.org. All students can access free copies of any or all of the career briefs by visiting www.chemistry.org/vc2/3wk/wk3.html. The Chemical Careers in Brief series is made possible by a grant from the Alfred P. Sloan foundation.

Environmental Chemists ...

Are concerned with environmental impact

What happens to the chemicals in an industrial cleaner after you pour it into the sink? When you see black smoke pouring out of the chimney at an industrial complex, what impact is it having on the atmosphere? These are the types of

questions environmental chemists seek to answer.

The fate of chemicals in the environment and their effects are matters of increasing concern to specialists in environmental management. "Fate" involves studying where chemicals show up in streams, rivers, and air. Such pollution contains molecules that have not been removed in water treatment plants, caught by the filters in industrial smokestacks, disposed of properly, or successfully sealed in containers.

As concerns about geochemistry and the natural environment increase, environmental chemists also study the processes that affect chemicals in the environment. Gases emitted by a pine forest may create a mist when mixed with car exhaust, for example. In other instances, the environment may have effects on chemicals that can be toxic. Environmental chemists examine the ways both chemicals and the environment are changed by interacting.

Manage our environment

Until about 20 years ago, those studying environmental contamination focused almost exclusively on the fate and effects of chemicals because the technology to measure the damage did not exist. As the technology for measuring leakage from landfills was developed, for example, industry recognized the potential for chemicals to negatively impact the environment — and the attendant social, political, and economic ramifications. As a result of these new data, chemists were able to help design pollution abatement systems that minimize the unwanted elements escaping into the environment. They also applied their knowledge to develop remediation systems to clean up contaminated areas.

As industry takes an increasingly proactive approach to environmental management, chemistry's role should continue to grow. For many chemical companies, this may involve redeveloping a chemical product to come up with functional groups or compounds that are more compatible with the environment. For example, one major corporation has used catalysts to develop a new production process for methylisocyanate, a highly flammable and hazardous material that is dangerous to transport. The new production process allows the chemical to be manufactured at the site where it is used, avoiding the risks of shipping and storing.

As waste disposal has become increasingly expensive, industry also has grown more interested in finding ways to solve waste problems. Many solutions involve making industrial processes more efficient, which cuts costs. In addition, environmental chemists study the effects of chemicals other than pollutants on the environment.

Work in a broad-based discipline

Because our environment is so complex, environmental chemists always underscore the interdisciplinary nature of their field. Environmental chemists must be able to understand and use the terminology of a range of other disciplines, including biology, geology, ecology, sedimentology, mineralogy, genetics, soil and water chemistry, math, and engineering.

GETTY IMAGES

They may be involved in analytical testing, new product development in the lab, fieldwork with users of chemicals, and safety and regulatory issues. Many opportunities exist to move into different areas of expertise, often outside the lab. Many chemists return to school to study public policy, law, or business — applying their chemistry know-how in new ways. For example, knowledge of chemical processes is often vital for an individual who works in a corporation's regulatory affairs department and must ensure compliance with government regulations.

Environmental management is becoming a popular career track. Students who hold degrees in environmental sciences are finding jobs throughout the chemical industry, often working alongside geologists, biologists, and chemists.

Most environmental chemists emphasize that a solid foundation in chemistry is important to this work. Chemistry students interested in applying their training to an environmentally oriented job are encouraged to take courses in environmental studies. Potential employers look favorably on this as an indication of interest and ability to think in an interdisciplinary manner.

FACT FILE: Environmental Chemists

WORK DESCRIPTION — "Environmental chemist" is a general term. In fact, most chemists in the field would probably describe themselves more specifically by the work they do. This work may focus on collecting and analyzing samples, developing remediation programs, changing production processes to yield a more environmentally friendly product, providing expert advice on safety and emergency response, or dealing with government regulations and compliance issues.

WORKING CONDITIONS — Work is often done in an indoor lab environment. However, when studying chemicals in the environment, a riverbed or stream may become the lab. Some companies have sophisticated indoor ecosystems in which they test their products. Others collect data outdoors and miles away from their own production sites.

PLACES OF EMPLOYMENT — The chemical industry employs a huge number of environmental chemists to ensure that a given company is in compliance with government regulations. Government agencies such as the U.S. Departments of Agriculture and Defense and the U.S. Environmental Protection Agency hire chemists for environmental work. In addition, waste management companies

GETTY IMAGES

and consulting firms employ such chemists to do consulting or remediation work. Colleges and universities are hiring more environmental chemists as they establish programs in environmental chemistry.

PERSONAL CHARACTERISTICS — Because environmental chemistry is so interdisciplinary, it requires excellent interpersonal and communication skills along with the ability to express ideas efficiently to a nonscientific audience. The importance of the latter becomes apparent when chemists deal with regulations or with a company's sales and marketing staff. As the field of environmental management expands globally, chemists who speak other languages may experience additional success.

EDUCATION AND TRAINING — Environmental chemists come from various backgrounds, and there is no one path into the field. However, your college or university may have an ACS-Approved Chemistry Program with an Option in Environmental Chemistry, which is a good starting point. Exper-ienced professionals emphasize the competitive advantage of obtaining advanced degrees. However, because the field is growing so rapidly, opportunities exist for individuals with an associate's degree. Also, students are encouraged to take courses outside the traditional chemistry curriculum, such as advanced math and engineering courses.

Companies often hire graduates from schools with well-established programs. Employers also look for candidates who demonstrate the ability to broaden their skills and think in an interdisciplinary manner. Course work in subjects such as biology, geology, hydrology, or toxicology would be indications of such abilities.

JOB OUTLOOK — Because of increased government regulations, job opportunities for environmental chemists continue to grow. Despite downsizing, companies are placing greater emphasis on compliance and environmental processes. Opportunities exist for chemists to move into various areas of expertise outside a traditional job in the lab. For those also studying law, business, or public policy, opportunities can be found in the regulatory area as well as in health and safety.

Because environmental chemistry is so interdisciplinary, it requires excellent interpersonal and communication skills along with the ability to express ideas efficiently to a nonscientific audience.

The field is expanding to include nontraditional employers. Opportunities are expected to grow in contract labs and consulting, because businesses are increasingly outsourcing this work.

SALARY RANGE — The starting salary for a Ph.D. chemist is in the $70,000-per-year range in industry. For master's chemists, $40,000-$50,000 is an average starting salary. Bachelor's chemists can earn from the mid-$30,000s to the low $40,000s.

An individual going into the regulatory side of environmental chemistry is likely to start at a higher salary and continue to be paid more because these jobs are more high-profile and require taking responsibility for a company's liability. Although the work an analytical chemist does to reduce contamination is important, the chemist-regulator who negotiates a company out of trouble will receive more recognition and better compensation.

FOR MORE INFORMATION

American Chemical Society
Division of Environmental Chemistry
1155 16th Street, NW
Washington, DC 20036
800-227-5558
www.envirofacs.org

U.S. Environmental Protection Agency Regional Offices
(Check the goverment section in your local telephone book)

WHAT YOU CAN DO NOW — Because career choices abound, students should think about the type of work that interests them and what discipline, besides chemistry, they want to emphasize in school. Since many colleges have environmental sciences or environmental engineering programs, students can investigate potential employment areas before entering the job market. Environmental chemists in industry also suggest reading environmental journals such as the American Chemical Society's Environmental Science & Technology and taking courses in industrial chemistry and chemical engineering. iC

ADAM M. BOYD is an associate editor of **in Chemistry** and is an education associate in the ACS Undergraduate Programs Office.

Service Learning: Great for the Community ... and Your Career!

By Adam M. Boyd

IT'S 1 A.M., AND YOU'RE poring over course listings, trying to work out your class schedule for next semester, when you see something unusual. You check to make sure that you are, in fact, looking at chemistry courses. You reread it: Service Learning. Service learning … *in chemistry*? Isn't that, like, not possible?

Actually, it's very possible. Service-learning chemistry classes are popping up all over the country. But what exactly do they involve?

Connect community service to learning

Service learning gets students involved in activities that serve the community, and then connects those activities to classroom goals. Assignments require students to reflect on their experience and relate it to course content. In these courses, a student receives credit not for service activities, but rather for the learning that is evident in the student's reflections.

Chemistry can be used to serve your community in a wide range of ways. Often, service learning and chemistry intersect on issues dealing with the environment. For example, you may be asked to lend your analytical skills to help resolve a community waste issue, or provide chemical information to help your local government make an educated decision about pollution. You might test water samples or analyze paint samples to determine the amount of lead contained within them.

Undoubtedly, your community will benefit from your participation in service learning. But what's in it for you?

The ways in which you will benefit from service learning are numerous. If you ever find yourself searching for a course and stumble across a service-learning opportunity, or if you hear about a service-learning program being started at your school, consider the following ways in which your education will be enhanced by participating.

Obtain meaningful hands-on experiences

In contrast to traditional laboratory exercises, analyses that you perform in a service-learning class will have direct ramifications on others. You will be asked to faithfully complete a required task — whether presenting chemistry to elementary school students, quantifying pollutant levels in water, or countless other activities — and members of your community will be counting on you to perform your task to the best of your ability.

Participating in a service-learning activity will also give you the chance to experience what it might to be like to work as a professional chemist. Your activity may not only fascinate you, but actually open up professional or scholastic opportunities down the road. The hands-on experience provided by service-learning classes will be attractive to both graduate schools and potential employers.

Gain deeper understanding

Unlike volunteer work, which does not have any classroom connection, and academic research, which usually does not directly serve the community, service-learning classes in chemistry provide you with the chance to understand science in the context of community. You will be forced to consider scientific ethics and civic responsibility.

You will also benefit from the active learning promoted by service-learning projects. By taking ownership of your service project, you will delve more deeply into particular topics, and gain a more thorough understanding — as much out of necessity as by design. If you are tasked with tutoring middle school students, for example, you may be surprised

Service Learning Web Resources

www.compact.org
Campus Compact's website has many resources, including syllabi from service-learning courses in many different disciplines to information applying for grants and funding. In addition, you may order numerous books on service learning published by Campus Compact.

www.ipsl.org
The International Partnership for Service Learning offers programs for students to study abroad and perform community service in international settings.

www.learnandserve.gov
Learn and Serve America is a national service grant program that funds service-learning programs across the country. In addition to details on how to apply for their grants, the site also includes research materials and a directory of supported projects.

www.edb.utexas.edu/servicelearning/index.html
Learn, Serve, and Surf is an Internet resource kit for service-learning practitioners. It includes links to sites that help programs and professors establish and teach successful service-learning courses.

www.luc.edu/chemistry/faculty/fitch/fitchgroup/Service%20Learning.htm
Loyola University in Chicago has a well established chemistry service-learning program. This site includes information about the school's program, focusing on the ethical issues associated with service-learning.

at how well you internalize basic concepts as you teach them to others. Likewise, a service-learning project based on chemical analysis will help you master the instrumentation and techniques involved in the method.

In general, a service-learning class may give you the impetus to develop the creativity and flexibility you will need to solve unique problems you encounter later in your career. Regardless of your project, your basic knowledge and skill set will be enhanced.

Make a good impression

Finally, as an ambassador for the chemistry community, your participation in a service-learning project will provide you with the chance to make a lasting impression on members of your broader community. You will be able to show the value and importance of chemistry, and ways it can be helpful. In a world that is often science-phobic, you'll have the chance to demystify chemistry, making it more accessible to the community.

For all of these reasons and a great many more, service-learning classes that are coupled with chemistry offer invaluable opportunities to enrich your learning experience. Before you dismiss that course listing as a misprint, consider how much you could learn in a service-learning course, and how much it could help you make decisions about your future. Besides, it's 1 a.m. — don't you want to get some sleep? IC

ADAM M. BOYD is an associate editor of **in Chemistry** and is an education associate in the ACS Undergraduate Programs Office.

Want to Learn More?

"What is Service Learning?" (Wiegand, D.; Strait, M. *J. Chem. Educ.* 2000, 77, 1538-1539) provides an overview of service learning in chemistry. Used as a source for this article, Wiegand and Strait's piece provides examples of how service learning has been incorporated into courses and undergraduate research, along with recommendations from the Service Learning Blueprint Meeting.

Undergraduate Program

232nd ACS National Meeting
San Francisco, CA
September 10–14, 2006

The Society Committee on Education's Task Force on Undergraduate Programming invites you to join us for the 232nd ACS national meeting in San Franciso, CA. As you can see below, we have put together a terrific program that will offer you the opportunity to learn about cutting edge research, as well as present your own. Networking with others, including our Eminent Scientist, Nobel laureate Robert Grubbs from the California Institute of Technology, and participating in career workshops and graduate school events will help you prepare for your career in the chemical sciences.

I look forward to seeing you in San Francisco!

Sincerely,

Anna Cavinato

Anna Cavinato
2006 San Francisco Program Chair
Task Force on Undergraduate Programming

SUNDAY, SEPTEMBER 10

8:00 a.m.–5:00 p.m.
Hospitality Center

9:30–10:45 a.m.
How to be an Award-Winning Student Affiliates Chapter

11:00 a.m.–12:30 p.m.
Nanotechnology Symposium

1:00–3:00 p.m.
Kids and Chemistry Workshop

1:00–3:00 p.m.
Career Workshop: Preparing Chemists and Chemical Engineers for a Globally Oriented Workforce

3:00–5:00 p.m.
Graduate School Reality Check

5:00–6:30 p.m.
Graduate School Recruiting Ice Cream Social

MONDAY, SEPTEMBER 11

8:00 a.m.–5:00 p.m.
Hospitality Center

9:00–11:00 a.m.
Graduate School Recruiting Breakfast

11:00 a.m.–12:30 p.m.
Environmental Impact of Natural Disasters Symposium

12:30–2:00 p.m.
Eminent Scientist Lecture/Lunch
Featuring Robert H. Grubbs

2:30–4:30 p.m.
Undergraduate Research Poster Session

8:00–10:00 p.m.
Sci-Mix/Successful Student Affiliates Chapter Posters

For more information, contact the ACS Student Affiliates Program at 800-227-5558 or saprogram@acs.org.

2006 ACS Regional Meetings

35th Northeast Regional Meeting

October 5–7, Binghamton, NY
http://www.nerm2006.org/
An undergraduate program will be hosted by the Student Affiliates Chapter at Hartwick College, Oneota, NY.

FRIDAY, OCTOBER 6

Career Connections Symposium
Speakers will discuss career outlooks for students pursuing a chemistry degree. Alternative careers will be discussed.

Undergraduate Reception
Undergraduates will have the opportunity to interact with presentors from the Career Connections Symposium and ACS members.

Undergraduate Poster Session
Undergraduates will have the opportunity to present their current research.

SATURDAY, OCTOBER 7

Professional Recruiting Breakfast
Undergraduates will have an opportunity to interact with representatives from professional organizations and post-undergraduate programs in a professional setting.

Undergraduate Research Symposium
Undergraduates will give oral presentations of their research.

19th Rocky Mountain Regional Meeting

October 14–18, Tucson, AZ
http://www.rmacs2006.arizona.edu/
An undergraduate program will be hosted by the Student Affiliates Chapter at University of Arizona, Tuscon.

SATURDAY, OCTOBER 14

Dinner with Industry
Local industrial job recruiters will showcase the world of industrial job opportunities.

Chemical Solution
Undergraduates will have a chance to socialize and dance the night away!

SUNDAY, OCTOBER 15

Graduate School Breakfast
An opportunity for undergraduates to research graduate school requirements and explore post-graduation opportunities.

Liquid Nitrogen Ice Cream Social
Socialize under the hot Arizona sun with some good, free ice cream!

Undergraduate Poster Session
Undergraduates will have the opportunity to present their current research.

41st Midwest Regional Meeting

October 25–27, Quincy, IL
http://membership.acs.org/m/mwrm2006/
An undergraduate program will be hosted by the Student Affiliates Chapter at Truman State University, Kirksville, MO.

WEDNESDAY, OCTOBER 25

Undergraduate Poster Session
Undergraduates will have the opportunity to present their current research.

THURSDAY, OCTOBER 26

History Posters and Demonstrations

Student Affiliates will conduct outreach with local high school students.

FRIDAY, OCTOBER 27

Graduate School Roundtable Discussion

Graduate students will talk about their graduate school experience.

Undergraduate Award Session

Special awards will be given to undergraduates who attend.

61st Southwest Regional Meeting

October 19–22, Houston, TX
http://www.chem.uh.edu/swrm06/
The meeting will include a variety of activities symposia, workshops, and more.

58th Southeast Regional Meeting

November 1–4, Augusta, GA
http://www.sermacs2006.org/
An undergraduate program will be hosted by the Student Affiliates Chapter at Augusta State University, GA.

FRIDAY, NOVEMBER 3

Joe Vinson, University of Scranton

Vinson will share his research concerning chocolate and its many medicinal uses. A chocolate feast will follow!

SATURDAY, NOVEMBER 4

Undergraduate Poster Session

Undergraduates will have the opportunity to present their current research.

Don't forget...

Undergraduate programs will also be held at the following meetings. See the February/March 2006 issue of* in Chemistry *for more details.

38th Central Regional Meeting

May 16–20, Frankenmuth, MI
http://www.crm2006.org

37th Great Lakes Regional Meeting

May 31–June 2, Milwaukee, WI
http://alchemy.chem.uwm.edu/GLRM06

38th Middle Atlantic Regional Meeting

June 4–7, Hershey, PA
http://www.marm2006.org

Plan ahead...

Would your chapter like to plan an undergraduate program for a 2007 regional meeting? Look for the Request for Proposals (RFP) in the Chapter Activity Kit or e-mail saprogram@acs.org for more information.

Deadlines

Spring 2007 meetings
June 30, 2006

Fall 2007 meetings
October 31, 2006

All event dates are tentative. Please consult the final program for any changes.

graduate school links

Click on the web links below to get information about the schools listed.

Indiana University
www.chem.indiana.edu

South Dakota State University
www3.sdstate.edu/Academics/CollegeofArtsAndScience/ChemistryandBiochemistry/Index.cfm

Syracuse University
www-che.syr.edu/

Temple University
www.temple.edu/chemistry

University of New Orleans
www.chem.uno.edu/

University of Nebraska-Lincoln
www.chem.unl.edu/main/index.html

McMaster University
www.chemistry.mcmaster.ca/graduate

All URLs were accessed and accurate while this issue was in production.