

Community Outreach— What's at Stake?



ALSO IN THIS ISSUE • **The Entrepreneur Who Programmed His Own Career Path** PAGE 12

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Cover: University of Kansas "Frozen Flames" performance. 8

CONTENTS

■ ACS & YOU

EDITORIAL

Why Is Chapter Community Outreach So Important? By Thomas M. Connelly, Jr. 3

Atomic News Compiled by Jessica Roberts 4

251st ACS National Meeting Call for Papers. 6

Become an ACS Chemistry Ambassador: Receive Support, Recognition, and Extraordinary Ideas for Sharing Chemistry in Your Community By Doug Dollemore 8

■ FEATURES

Programming Your Own Career Path: ChemDoodle Creator Kevin Theisen's Inspiring Path to Entrepreneurship By Eric Stewart 12

Using Time Management Techniques to Study Smarter: How to Get the Grades You Want and Still Have a Life By David Masters 15

Internships Provide the First Step Toward Career Success: Through Internships, Companies Offer Chemistry and Chemical Engineering Students Work Experience That Can Lead to Postgraduation Jobs By Susan J. Ainsworth 18

Mind Over Matter By Veronica Berns back cover

■ CAREERS

COLLEGE TO CAREER

Public Outreach and Communication Careers By Nancy McGuire 20

Explaining Scientific Discoveries to the Masses: The Career of Alisa Machalek, Science Writer By Daryl Ramai 22

■ CHAPTERS

SPOTLIGHTS

University of Central Florida and Truman State University

Compiled by Robin Lindsey 24

Fostering an Active ACS Student Chapter By Kayode D. Oshin, Annie Cavalier, Megan Doherty, Megan Uekert, Morgan Matthews, and Courtney Weston 26

Infographic: Plan an Outreach Event for Boo at the Zoo 28



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EDITORIAL: Why Is Chapter Community Outreach So Important?

BY THOMAS M. CONNELLY, JR.

As the new Executive Director and CEO of the American Chemical Society, I am impressed by your outstanding public outreach efforts. Statistics from the 2014–2015 chapter reports show that ACS student chapters held nearly 10,000 outreach events that reached more than 850,000 people in your communities. This is quite an achievement!

Do you realize how vital your community outreach events are and why it's so important to continue them? *Science and Engineering Indicators 2014*, published by the National Science Foundation (NSF) earlier this year, measured the public's attitude and understanding of science and technology (<http://nsf.gov/statistics/seind14/index.cfm/chapter-7/c7h.htm>). The report revealed that while four out of five Americans say they are interested in new scientific discoveries, less than half believe they have an "excellent" or "good" understanding of what scientists and engineers do at work.

Educating young students who will grow up to make responsible decisions can affect our way of life, including our economy, health, and well-being. Unless we have a scientifically literate population, today and in generations to come, we cannot hope to compete on a global scale. The scientific literacy problem is too vast for any one organization or single scientific society to own and solve. Even so, we, as ACS members, can play an important role in helping to increase scientific literacy among nonscientists.

I urge all chapters to plan public



The annual Halloween Chemistry Magic Show at Saint Mary's College (Notre Dame, IN) attracts more than 200 children and adults from the greater Notre Dame community.

outreach events during National Chemistry Week (NCW) and encourage all student members to volunteer for these events. This year, NCW will be held October 18–24, and the theme will be "Chemistry Colors Our World". The week will include a presidential proclamation and a U.S. Senate resolution acknowledging the importance of NCW.

It is also important that you continue your outreach efforts after graduation, whether you enter the workforce or go on to graduate school. ACS local sections are a terrific way to get involved in your communities, thanks to the active engagement of many local sections in activities such as Chemists Celebrate Earth Day and Project SEED. Younger Chemists Committees, which offer programming tailored to ACS members who are early in their careers, are also active in many local sections.

Your efforts can have great impacts — teaching basic chemistry concepts to children and adults; inspiring children, particularly those who are under-represented minorities in STEM fields, to take a more active interest in science; or convincing someone in your community to more strongly support science and

science education. Perhaps most importantly, you also put a human face on chemistry as you go out into your community and interact with the public.

When I read about the wonderful results of your outreach events and see the enthusiasm of young people studying chemistry, I am so optimistic about the future of our science. Chemistry offers solutions to the challenges facing our planet, such as discovering new sources of renewable energy and providing clean drinking water and life-saving medications to the more than seven billion people on Earth. Your contributions as chemists help the ACS fulfill its mission of "Improving people's lives through the transforming power of chemistry."

Thank you for all you have done and will continue to do this academic year. **TC**



Thomas M. Connelly, Jr., is the Executive Director and CEO of the American Chemical Society. Dr. Connelly retired from DuPont in December 2014, where he was Executive Vice President, Chief Innovation Officer, and a member of the company's Office of the Chief Executive. At DuPont, Dr. Connelly led businesses and R&D organizations, while based in the U.S., Europe, and Asia.

ATOMIC NEWS

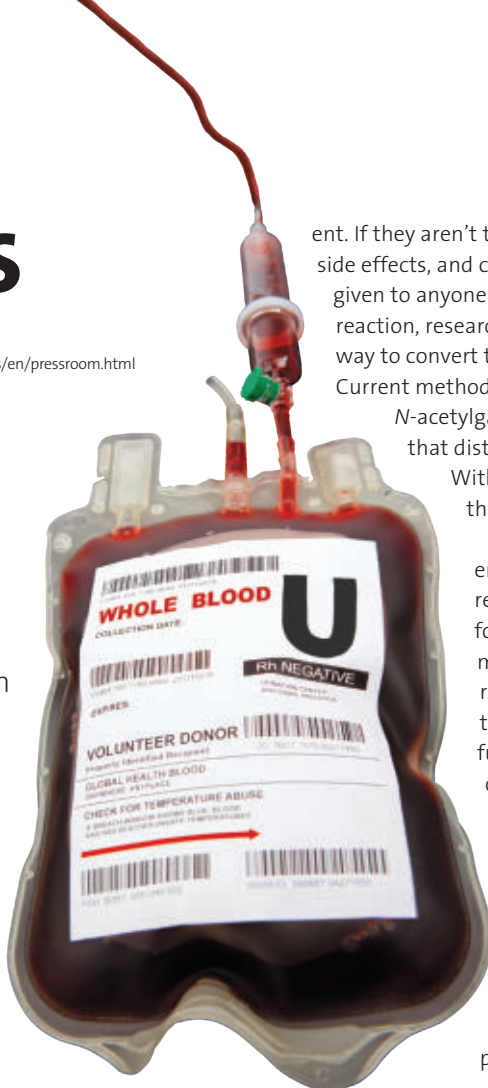
COMPILED BY JESSICA ROBERTS

Source: ACS Office of Public Affairs Weekly PressPac, www.acs.org/content/acs/en/pressroom.html

Transforming all donated blood into a universal type

Every day, thousands of people need donated blood. But only blood without A- or B-type antigens, such as type O, can be given to all of those in need, and it's usually in short supply. Now researchers are making strides toward fixing the situation. In the *Journal of the American Chemical Society*, they report an efficient way to transform blood types A and B into a neutral type that can be given to any patient.

Stephen G. Withers and colleagues note that currently, blood transfusions require that the blood type of the donor match that of the recipient.



ent. If they aren't the same, a patient can suffer serious side effects, and could even die. Since blood type O can be given to anyone because it doesn't provoke an immune reaction, researchers have spent years searching for a way to convert types A and B into an unreactive type. Current methods of enzymatic removal of the terminal *N*-acetylgalactosamine or galactose, the sugars that distinguish blood type, are inefficient.

Withers's team investigated ways to boost the enzymes' activity.

The researchers altered one of those enzymes and improved its ability to remove type-determining sugars by 170-fold, rendering it antigen-neutral and more likely to be accepted by patients, regardless of their blood type. In addition to making it easier to provide blood transfusions, the researchers say their advance could potentially allow organ and tissue transplants from donors who would otherwise be mismatched.

Read more about the research: "Toward Efficient Enzymes for the Generation of Universal Blood through Structure-Guided Directed Evolution," *Journal of the American Chemical Society*, 2015, 137 (17), pp 5695–5705.

Silk could be new "green" material for next-generation batteries

Lithium-ion batteries have enabled many of today's electronics, from portable gadgets to electric cars. But, much to the frustration of consumers, none of these batteries lasts long without a recharge. Now researchers report in the journal *ACS Nano* the development of a new, "green" way to boost the performance of these batteries, using a material derived from silk.

Chuanbao Cao and colleagues note that carbon is a key component in commercial lithium-ion energy storage devices, including batteries and supercapacitors. Most commonly, graphite serves as the source for

the carbon, but it has a limited energy capacity. To improve the energy storage, manufacturers are looking for an alternative material to replace graphite. Cao's team wanted to see if they could develop such a material using a sustainable source.

The researchers found a way to process natural silk to create carbon-based nanosheets that could potentially be used in energy storage devices. Their material stores five times more lithium than graphite can — a capacity that is critical to improving battery performance. It also worked for over 10,000 cycles with only a 9% loss in stability. Cao and colleagues

successfully incorporated their material into prototype batteries and supercapacitors in a one-step method that could easily be scaled up.

Read more about the research: "Hierarchical Porous Nitrogen-Doped Carbon Nanosheets Derived from Silk for Ultrahigh-Capacity Battery Anodes and Supercapacitors," *ACS Nano*, 2015, 9 (3), pp 2556–2564.



IMAGES USED IN ATOMIC NEWS ARE FROM SHUTTERSTOCK

Reducing greenhouse gas emissions with a more effective carbon capture method

Trapping carbon dioxide (CO₂) emissions from power plants and various industries could play a significant role in reducing greenhouse gas emissions in the future. But current materials that can collect CO₂ — from smokestacks, for example — have low capacities or require very high temperatures to work. Researchers are making progress toward a more efficient alternative, described in the ACS journal *Chemistry of Materials*, that could help make carbon capture less energy-intensive.

T. Alan Hatton and colleagues note that although industry and governments are increasingly turning to renewable energy sources such as wind and solar, the world will continue to rely on fossil fuels

for the foreseeable future — but at a cost. According to the International Energy Agency, burning fossil fuels emits more than 30 gigatons per year of CO₂, a primary greenhouse gas. Some solid systems that aim to capture these emissions, such as zeolites, are sensitive to water in the gas streams. Others, such as clays and metal oxides, have to be heated up to more than 900 °F, which requires a great deal of energy. Hatton's team wanted to find a way to cut this latter strategy's energy requirements.

The researchers studied a new class of materials, based on magnesium oxide (MgO), that can capture larger quantities of carbon at much lower temperatures than many other substances being investigated. They discovered that coating MgO particles with alkali metal nitrates boosted the amount of CO₂ the material could take up by more than 10-fold. The MgO captures a significantly higher amount of CO₂ (2–10 times) than other systems for a given volume. This translates into smaller equipment needs and lower plant costs. Additionally, the particles themselves are readily prepared with low-cost materials.

Read more about the research: "Alkali Metal Nitrate-Promoted High-Capacity MgO Adsorbents for Regenerable CO₂ Capture at Moderate Temperatures," *Chemistry of Materials*, 2015, 27 (6), pp 1943–1949.



How green tea could help improve MRIs

Green tea's popularity has grown quickly in recent years. Fans of this tea can drink it, enjoy its flavor in their ice cream, and slather it on their skin with infused lotions. Now, the tea could also have a new, unexpected role — to improve the image quality of MRIs. Researchers report in the journal *ACS Applied Materials & Interfaces* that they successfully used compounds from green tea to help image cancer tumors in mice.

Sanjay Mathur and colleagues note that recent research has revealed the potential usefulness of nanoparticles — iron oxide in particular — to make biomedical imaging better. But the nanoparticles have their own disadvantages. They tend to cluster together easily and need help getting to their destinations in the body. To address these issues, researchers have recently tried attaching natural nutrients to the nanoparticles. Mathur's team wanted to see if compounds from green tea, which research suggests has anticancer and anti-inflammatory properties, could fulfill this role.

Using a simple one-step process, the researchers coated iron oxide nanoparticles with catechins found in green tea and administered them to mice with cancer. MRIs demonstrated that the novel imaging agents gathered in tumor cells and showed a strong contrast from surrounding non-tumor cells. The researchers conclude that the catechin-coated nanoparticles are promising candidates for use in MRIs and related applications.

Read more about the research: "Enhanced In Vitro and In Vivo Cellular Imaging with Green Tea Coated Water-Soluble Iron Oxide Nanocrystals," *ACS Applied Materials & Interfaces*, 2015, 7 (12), pp 6530–6540.



403.26 Amount of CO₂ (in ppm) measured in the atmosphere at the Mauna Loa Observatory in April 2015. Recordings of CO₂ at the observatory first began in 1958, when CO₂ atmospheric levels were at 315.71 ppm.

21 Number of years National Chemistry Week has been celebrated. Originally beginning as National Chemistry Day in 1987, the celebration was expanded to a full-week event in 1993.

4 Number of female Nobel Laureates in Chemistry. Both Marie Curie and her daughter, Irène Joliot-Curie, were recipients of the prize.

1833 Year that the first enzyme was discovered and isolated by researchers in France. Diastase, now known as amylase, is part of a family of enzymes that catalyze the breakdown of carbohydrates into sugars.

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Become an ACS Chemistry Ambassador

Receive Support, Recognition, and Extraordinary Ideas for Sharing Chemistry in Your Community

BY DOUG DOLLEMORE

In his day, P.T. Barnum was the ultimate showman. Best known as the founder of the circus he dubbed “The Greatest Show on Earth,” he was always coming up with ingenious ways of promoting himself and his many ventures.

Once he used an elephant to plow a plot on his farm. Unimpressed, a neighboring farmer said, “I just want to know how much it can draw [through the soil]?” Barnum smiled and then replied, “I don’t know, but it can draw the attention of 20 million Americans to Barnum’s Museum.”

As Chemistry Ambassadors, we don’t need to be as grandiose as P.T. Barnum. Nor do we necessarily need to put on the “Greatest Show on Earth.” But a bit of showmanship, flair, and outside-the-box thinking can add a lot of pizzazz to your presentation and make sharing the wonders of our science in your community memorable for both you and your audience.

Here are a few novel ideas devised by ACS Chemistry Ambassadors to inspire you and your chapter to come up with outreach activities that will make a lasting impression on members of your community about the value of chemistry.

Building the Periodic Table is a snap

A few years ago, chemistry students at Spring Arbor University in Michigan concocted an idea that even they thought was a bit wacky. They decided to let kids build a Periodic Table of Elements made with Legos.

Using Excel, Kristen Lewis and fellow student Charles Schaerer got the project started by designing templates — essentially blueprints — outlining how to build each Lego element. With grant money, they purchased 5,890 Lego bricks. Then they recruited about 20 other students to help them create individual construction kits, consisting of the template, a baseplate, and the bricks needed to make the element. All of the materials were sealed in plastic bags.

At the Halloween in the Science Lab event, which takes place during National Chemistry Week, kids attending the event were allowed to choose a random bag or ask for a certain element as long as it hadn’t already been built. Students and parents were available to help out, but Lewis says most of the work was left to the children. In the end, although some of the elements didn’t look quite right (they were adjusted after the kids departed), the evening was a huge success.

“The room was so popular that we ran out of elements about halfway through the event,” Lewis says.

Today, the Lego Periodic Table, which is about 3.5 feet tall and 7 feet wide, hangs in the university’s chemistry building and is a highlight of on-campus tours.

“Seeing the way the kids got so excited about the elements and the chemistry behind them was very rewarding,” says Lewis, who is now a graduate student at Indiana University. “I would love to do something like this again.”

As for advice about producing a hands-on activity that is unusual, yet educational, she says, “Be willing to look silly, be as organized as possible beforehand, and let the kids have some freedom.” For more information: <http://sites.arbor.edu/legoelements>.


A funny thing happened on the way to the chemistry demo

Admittedly, the University of Kansas (Lawrence) student chapter production of “Frozen Flames” isn’t your typical musical. Instead of boy meets girl, boy loses girl, boy gets girl back, the plot is a face-off between Dr. Cool and Dr. Pyro. This hot versus cold showdown—an annual highlight of the chapter’s Carnival of Chemistry—features students dressed in lab coats performing science-based skits and singing songs about chemistry for hundreds of children, ranging in age from toddlers to high school students.

It all got started in 2003 when several members of the chapter, who also happened to be terrific vocalists and stage actors, conceived and choreographed the 55-minute show. It is a parody of the play “A Funny Thing Happened on the Way to the Forum”. The opening song from the play, “Comedy Tonight” was rewritten as “Chemistry Tonight”:

More about the ACS Ambassadors Program

As chemists, we help solve some of the world’s biggest challenges and improve people’s lives through the transforming power of chemistry. By becoming an ACS Chemistry Ambassador, you help educate people about the importance of chemists and chemistry while taking part in community activities that are engaging and fulfilling for you.

The Chemistry Ambassadors program provides new ideas for activities, resources to support and strengthen your current activities, and recognition of your outreach efforts. As a Chemistry Ambassador you will also receive tools and messages that will resonate with your audience and information about new opportunities to connect with your community. Learn more at www.acs.org/chemistryambassadors. 



Chemistry Tonight

*Something explosive,
Something corrosive,
Something for everyone:
It's Chemistry tonight!*

*Nothing to test, nothing to grade;
Most of our solutions are already
made!*

*Something aerobic,
Or hydrophobic,
Something for everyone:
Chemistry tonight!*

*Nothing to hide, nothing you've seen;
We've got more magic than Houdini
could dream!*

*Nothing that's formal,
Nothing that's normal,
No calculations to rewrite;
Open up the Dewar!
It's Chemistry toooooo — n i g h t!*

Over the years, the show hasn't always had vocalists capable of singing this song, but the production retains the feel of a musical, according to professor Roderick Black, the chapter's faculty advisor. Often, the show now features recordings of several popular 1980s tunes.

"My favorite from the show is 'As Cold as Ice' by Foreigner, which is used to introduce one of Dr. Cool's demonstrations that uses liquid nitrogen," Black says. "And 'Shake It Up,' by The Cars, provides a great opportunity for chapter members to dance around while they shake a 5-gallon plastic stoppered vessel containing air and methanol. If they've shaken the container

long enough most of the methanol has evaporated, and they are left with a "methanol rocket for Dr. Pyro to ignite."

In addition to Dr. Pyro and Dr. Cool, the show features HAL, a talking computer that arbitrates between the two lead characters as they duel on the Kelvin scale.

Afterward, audience members can visit behind-the-scenes exhibits that offer insights into the chemical reactions that occurred during the show.

"Our goal is to motivate kids to study science," Black once told the *Lawrence World-Journal* (Kansas). "We encourage people to recognize the fun side of science and remember it's not just about the textbooks and the computer." For more information: chemclub@ku.edu.

Make a big difference in one life

For those who simply want to work one-on-one to bring science to life for a child in need, Big Brothers Big Sisters of America offers plenty of opportunities to do just that.

This 110-year-old organization provides children facing adversity with strong and enduring professionally supported mentoring relationships that forever change their lives for the better. It holds itself accountable for children in its program to achieve measurable outcomes such as educational success, avoidance of risky behaviors, higher aspirations, greater confidence, and better relationships.

And yes, chemistry students just like you can and do make a difference.

"One-to-one mentoring relationships make a significant impact on the lives of young people," says Pam Iorio, president and CEO of Big Brothers Big Sisters of America. "When you can influence these lives in a positive way and help mentor young people considering careers in fields like science and chemistry, it can have a tremendous impact on their futures."

To get started, go to www.bbbs.org, click on volunteer, and enter your zip code.

Finally, we end where we began, at Spring Arbor University, where apparently the sky isn't the limit for its whimsical students. Working with chemistry professor Tom Kuntzleman, alumni Josh Kenney devised an out-of-this-world experiment for kids participating in the university summer science camp. Inspired by a YouTube video of a father and son who launched a toy that soared to the edge of space attached to a weather balloon, Kenney decided to demonstrate the low pressure on a potato chip bag and marshmallows as they, too, took off toward the outer limits. Want to learn more? Read more about the results of the experiment and obtain step-by-step directions on how to do the weather balloon demo on Reactions, the ACS Undergrad Blog, at www.acs.org/undergradblog. **IC**



Doug Dollemaire is a senior science writer in the ACS Office of Public Affairs.

Call for Applications

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Kaylee Docker presents research to ACS President, Dr. Diane G. Schmidt. (Photo credit: Peter Cutts.)

"Posters on the Hill was an exciting and unique experience. I got the opportunity to meet many important members of the scientific community- all of whom loved to hear about my chemistry research! Sharing my passion and emphasizing the importance of undergraduate research to members of Congress was so special to me."

-Kaylee Docker, Minot State University, 2015 Participant

In spring 2016, the Council on Undergraduate Research will host its annual undergraduate poster session on Capitol Hill.

This event helps members of Congress understand the importance of undergraduate research by connecting them directly with students involved in such studies.

Call is open September 2, 2015. Applications are due November 4, 2015.



www.cur.org/conferences_and_events/student_events/posters_on_the_hill/

Programming Your Own Career Path

ChemDoodle Creator Kevin Theisen's Inspiring Path to Entrepreneurship

BY ERIC STEWART

Kevin Theisen took an unlikely path to becoming a software entrepreneur. Although his parents were both professionals in the field, Theisen notes, "I myself was never terribly interested in computer programming growing up. My father had urged me to pursue computer science in high school, and I kind of did it on the side. I remember thinking that it was cool to be able to create a program on a calculator that solved equations for me, but that was as far as it went."

Actually, Theisen was more interested in the field of organic chemistry, and specifically in the study of renewable energy. In college as an undergraduate chemistry major at Rutgers University (New Brunswick, NJ), he also started working with NMR spectroscopy, and grew to love the technology. "I saw it as a puzzle where I could view molecules in ways that I couldn't with a microscope, and it provided me with an interesting way to work with chemical structures."

And then, Theisen had his epiphany: what if he could create software that could predict the spectra he observed with NMR? "Because the spectra are so specific for molecules," he recalls thinking, "we should be able to generate rules to create them from the structure." So he did, and that is when he was able to embrace his interests in chemistry and fell in love with programming. He began to explore other areas of interest, including graphics and informatics.

A good time to innovate

As is often the case, timing played a very critical role in Theisen's story. In 2007, during his junior year of college, he released his first commercial product for chemical graphics and publishing, ChemDoodle, on the Internet. It was an immediate success, as he could instantly reach users around the world on a low budget. News spread by word of mouth, and soon Theisen was receiving 'fan mail' from users around the world. The feedback was an important validation of his ideas, and Theisen began keeping a record of some of the letters he received as a way of keeping in mind the real impact of his work.

That fall, Theisen showed the work he had done on the project to some colleagues and faculty members in the Chemistry



Kevin Theisen presents the newly released chemistry software package, ChemDoodle 3D from iChemLabs, a company he started as an undergraduate at Rutgers University,

Department — and in particular, to the then-Department Chair Roger A. Jones. Jones was impressed by the demonstration, Theisen explains, and recommended that the department award Theisen with a grant made possible by an alumnus to help him explore ways to turn his project into a commercial product, and launch a business to support it.

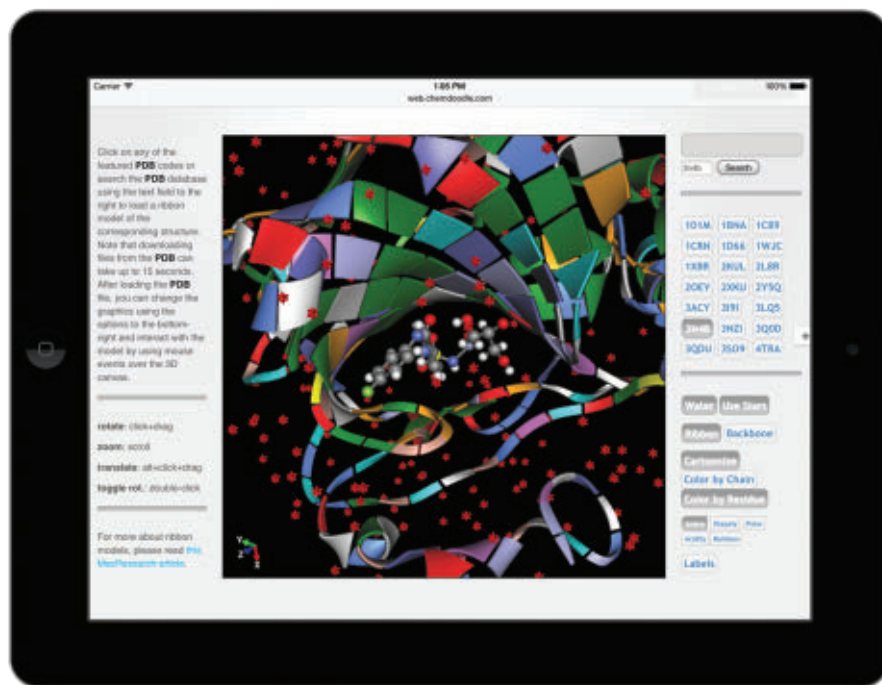
As Jones recalls in an article on the Rutgers website, "Kevin was in the right place at the right time, and received several thousand dollars of 'lab-to-marketplace' seed funding, a program initiated and supported by Rutgers alumnus Ybet Villacorta. Clearly, those have been dollars well spent." Theisen adds, "I am grateful to so many from Rutgers, and I hope to return the favor. The Rutgers chemistry faculty have proven that they support their students, and that is one of the main reasons I keep returning to collaborate with them."

Theisen was able to take advantage of evolving technologies again in 2009 when he began to experiment with the HTML5 Canvas application programming interface (API) Firefox implemented that year — which also happened to be the time the iPhone was opening up to developers and embraced HTML5.

Lost? Take Kevin's Advice

If you're excited about chemistry, but are not exactly sure what angle to take with it, here's my recommendation. Sit down and list all of your interests — not just the academic ones, but recreational as well. Then start 'connecting the dots' — connect any two interests together, and see if you can think of something you could do to combine them into a career. For me, it was connecting programming and chemistry.

More often than not, you will find a way to create your own niche, one that very few others (if any) have found. Start pursuing it and, if you're even moderately successful and find happiness in it, keep at it. Before long, you will find you're the expert in that unique area. Your unique approach to studying chemistry can truly create a difference in the scientific world! — *Kevin Theisen*



A view of ChemDoodle and its interactive components from an iPad.

Using this technology, Theisen created the ChemDoodle Web Components for creating HTML5-powered scientific applications across web and mobile devices. The ChemDoodle Web Components are used by companies and academic institutions around the world to create leading educational and industrial tools.

Meet iChemLabs

Fast-forward eight years, and Theisen's brainchild has blossomed into something he couldn't have imagined. His ChemDoodle software is now in its seventh release, and his company, iChem-Labs (www.ichemlabs.com), has formed partnerships with such organizations as Microsoft, ThermoFisher, Cengage Learning, and others, as well as distribution arrangements with a variety of corporate and academic organizations.

In addition to its flagship ChemDoodle brand products for chemical graphics and informatics, early this year the company released an enterprise solution for building intelligent chemical systems called ChemStack. More recently, iChemLabs has developed two additional new end user products — a bioinformatics data system called BioTuple, and ChemDoodle 3D for working with and creating advanced 3D scientific graphics (both launched in August 2015). “We have a wonderful system for creating and distributing scientific applications,” Theisen notes, “which allows us to efficiently produce high quality products and instantly deploy across Mac, Windows, and Linux platforms.”

The company has grown in revenue each year since its founding, and Theisen is pleased to see his company thriving. iChemLabs currently operates as a distributed workforce, with employees in New Jersey, where Theisen lives and works, as well as sites across

the country, in Canada and the U.K., and even in Indonesia. “We have a very diverse team, and I think that really helps us.”

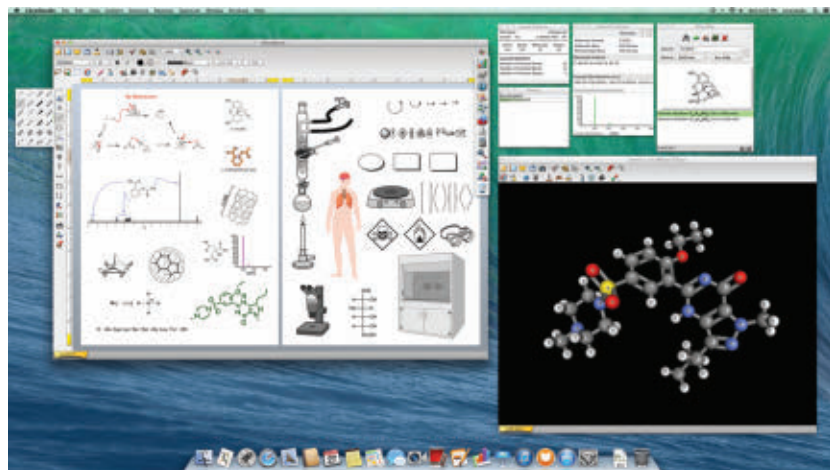
"When I was a student," says Theisen, "there were some programs that did similar things to what ours does. But they were all very expensive, and there was no way I could afford to use them other than using a copy owned by the university. In contrast, we're selling our student edition for \$19, so I think we've solved what I saw as a real need. Providing sustainable access to these tools to talented young chemists so they can explore their interests in chemistry is one of my biggest accomplishments!"

Every day is different — but it's all chemistry

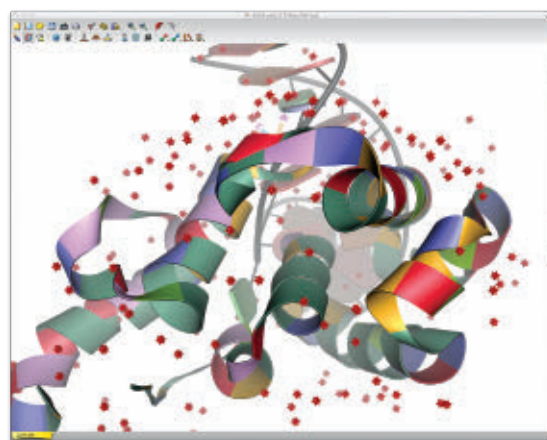
"There really is no such thing as a typical day on the job as a tech entrepreneur," Theisen says. "My day usually starts out with the decision of whether to eat breakfast first or dive right into my e-mail. I often end up doing the latter," he notes wryly, "which is probably not always the best idea."

During the course of the day, Theisen may get pulled in a variety of directions. For example, a customer may require service so he will focus on providing a solution. Or Theisen may get into discussions with his VP or CBO regarding sales trends, work with a developer on a project, teach interns, or participate in interviews as the public face of his company. “I wear a lot of hats, and have to be able to move from one activity to the next, usually repeatedly throughout the day.”

However, his true passion is programming. Theisen stresses that even though he's not at the bench doing chemistry, he's heavily involved in chemistry on a daily basis. "Some people look at what I do and believe it's just technology and not science. The



ChemDoodle is now used by thousands of countries in more than 80 countries.



Theisen developed ChemDoodle 3D to help students visualize complex chemical and biological structures.

truth is, I work with chemistry everyday — whether it's visualizing and communicating chemistry, analyzing and characterizing structures, or providing solutions to make laboratory procedures easier; it's all around understanding chemistry concepts and theory so chemists can better do their work and research."

"I'm also constantly working with students," Theisen adds. "It's very important to me to continue finding and cultivating talent. What we do is very, very specific, and not a lot of people in chemistry are doing it. So it's very important to encourage interest in what I do — not just for altruistic reasons, but also to enable our industry and the chemistry community to continue to innovate."

The ACS connection

Theisen was heavily involved in the Rutgers Chemistry Society, an ACS student chapter, as an undergraduate. He served two years as the club's secretary and was elected to serve as its president in his senior year. "The most important part of that experience for me," he says of his involvement with the chapter, "was learning how to work with people, not only when everything was going well, but especially when they weren't. Those are skills that come up again and again in my day-to-day roles running the company."

Theisen continues to be involved with the ACS in a number of ways; for example, he recently spoke at the ACS national meeting in August. His company is also working "to see how we can get the format of our software accepted by various ACS publications, so that the ACS can enable our large user community to publish advanced chemical documents to the ACS with an affordable and sustainable option."

Lessons learned

Theisen is philosophical about his career. For example, he notes that his success is due, at least in part, to simply not being afraid to fail. "I often find myself recommending to undergraduates that there is no time like the present to take chances — and if you fail, you're probably still learning things about your field and yourself that will pay off later. The point is when you're young, that's the best time to take calculated risks on your career. Later

in life, when you have career and family responsibilities, you will not be able to take such risks."

Theisen also credits his success to maintaining a healthy balance between work and life. "I think it's really important to feel like you have other things going on in your life that you enjoy. For example, I myself find a lot of satisfaction in participating in competitive archery, collecting federal US antique coins, and snowboarding when I can." The key, he observes, is to understand that doing other activities unrelated to your job not only helps you enjoy life, but will *complement* your professional abilities. "Being stressed out all the time," he says, "can make you feel like you're sinking in quicksand — it is important to remain balanced and happy!"

Where does he go from here?

Theisen tells his story modestly, and is definitely not one to over-inflate his accomplishments. "People sometimes tell me I must have made some great decisions to get here. But in some ways," he recalls with a laugh, "decisions were kind of made for me."

Looking forward, Theisen says he wants to continue reaching out to chemistry students and working chemists, and let them know his company's tools are available and affordable. "When I was a student, I wasn't able to get access to these kinds of tools, so one of my goals was to provide the tools people need to pursue their studies or careers in chemistry. We're doing that, and it's a great feeling." And he hopes more students choose this path. Theisen funds an annual undergraduate award at Rutgers University for excellence in chemical programming. "If you have interests in this type of work, please reach out to me. I look forward to reading about the successes of others in this field!" **IC**



Eric Stewart is a freelance writer in Arlington, Virginia.

Using Time Management Techniques to Study Smarter

How to Get the Grades You Want and Still Have a Life

BY DAVID MASTERS

College students are well-known for late-night cramming and pulling all-nighters. However, research has shown that squeezing your study time into intense sessions over a short space of time is the least effective way to learn. Plus, it creates unnecessary stress. You'll feel more relaxed in your studies and improve your chances of earning better grades if you manage your time well and pace out your study time.

Spacing out your work isn't easy, especially if this is the first time in your life you're responsible for managing your own schedule. And the temptations to avoid studying are plentiful: social media, friends, parties, and Hulu, to name a few.

Putting off hard work isn't just a student thing. It's human nature. Human beings are natural procrastinators. We put things off until they absolutely have to be done. Research shows that people find it much easier to motivate themselves when a deadline looms (see "Studies in Procrastination", page 17).

By reading this article, you'll learn three scientifically proven time management strategies to help you stop procrastinating and start studying smarter. Using these strategies, you'll improve your chances of securing good grades, and still have plenty of time to relax and hang out with friends. Let's get started!



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STRATEGY 1: The Pomodoro Technique

The Pomodoro Technique is a simple strategy you can use to avoid distractions during your study time. It was invented by Italian student Francesco Cirillo after he spent his first year at college struggling to complete his studies.

"Every day I went to school, attended classes, studied, and went back home with the disheartened feeling that I'd been wasting my time," Cirillo writes in his book, *The Pomodoro Technique*. He realized his main struggle was to stay motivated and concentrate on his work. So he set the following challenge for himself: study nonstop for 10 minutes straight.

He took the tomato-shaped timer from his kitchen, set it for 10 minutes, and sat down to work. Concentrating for just 10 minutes proved a difficult challenge. He failed again and again, but he kept trying. Eventually he reached his target: he stayed focused for a full 10 minutes. Once he'd succeeded, he reset the timer and went back to work. Using the timer, he discovered that he was far more productive and motivated than he'd ever been before.

He named his discovery the Pomodoro Technique after his novelty kitchen timer, as pomodoro is Italian for "tomato". He began adapting the technique to maximize his focus, and found that he worked best when he set his timer for 25 minutes.

You can use the Pomodoro Technique with any timer, including the timer on your phone.

First, choose the task you want to work on. Set your timer for 25 minutes and completely focus on the task at hand during that time. Whatever you do, don't allow yourself to be distracted by anything: e-mail, social media, your cell phone, friends saying hi, or other tasks.



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If you think of other tasks during the 25 minutes, jot them down on a notepad and then go back to your work. When the 25 minutes is up, take a 5-minute break, for example check e-mail, go to the bathroom, or have a snack. Set your timer for another 25 minutes, and repeat the process.

Each 25-minute chunk is known as a "Pomodoro". Cirillo recommends that you take a longer break of up to 30 minutes after a set of four consecutive Pomodori. After you've used this technique a few times, you'll get good at estimating how many Pomodori a task is likely to take.

How does the Pomodoro Technique help you get more done? According to Cirillo, it's because the technique "enhances focus and concentration by cutting down on interruptions." This claim is backed up by Gloria Mark, a professor at the University of Cali-

fornia, Irvine, whose research has found that when people are interrupted in their work, it takes them an average of 23 minutes to recover from the interruption and return to the original task. This applies to even small interruptions such as checking e-mail.

To put it another way, the human brain is really bad at multitasking. This is counter-intuitive to what many of us believe about productivity. Working on lots of tasks at the same time may feel productive, but it's actually the opposite. When Professor Clifford Nass of Stanford University saw the results of his study on multitasking, he was "absolutely shocked." He explained the results in an interview on the PBS show *Frontline*: "It turned out multitaskers are terrible at every aspect of multitasking. They're terrible at ignoring irrelevant information, they're terrible at keeping information in their head nicely and neatly organized., and they're terrible at switching from one task to another."

If you want to get things done, quit multitasking and focus on one task at a time. The Pomodoro Technique is ideal for helping you develop this focus. Try it and see how you do. You'll likely be amazed at how much you can accomplish in 25 minutes of focused work.

STRATEGY 2: Eat Frogs!

There's an old saying that goes: "If the first thing you do each morning is to eat a live frog, you can go through the day with the satisfaction of knowing that that is probably the worst thing that is going to happen to you all day long."

Business consultant Brian Tracy has used this old saying to develop a productivity technique that he calls "Eat that Frog!" Here's how it works: At the beginning of the day, write a list of all the tasks you need to get done. Look for the task you least feel like doing. That's your frog! It could be cleaning the dishes in the kitchen, reading a chapter from a chemistry textbook, or calling the doctor to make an appointment. The point is that until it's done, the task weighs on your mind — and as a result, you end up doing nothing. Finally, eat the frog. That is, complete the task you least want to do first.

Once you eat the frog, you'll feel motivated to whiz through the rest of your task list. What if there are two or three frogs staring you down at the beginning of the day? In Tracy's words, "eat the ugliest one first."

The efficacy of starting your day with eating frogs — at least metaphorical ones — has been proven by psychological research. Maria Gardiner and Hugh Kearns of Adelaide University, Australia, explored this in an article in *Nature* magazine. They write: "Some psychology research shows that action leads to motivation, which in turn leads to more action. You have to start before you feel ready; then you'll feel more motivated, and then you'll take more action."

In other words, when you're struggling to feel motivated, make yourself do something. And if you're really up for a challenge, eat a frog!

STRATEGY 3: Set Your Own Deadlines

Research by Professor Dan Ariely of the Massachusetts Institute of Technology has discovered something most students know all too well: when a deadline is looming, students are more likely to study.

Ariely's research also looked into how deadlines can help students get better grades. He found that the students who took part in his study performed worst when all their assignments were due on the last day of class. With this late deadline, students left their work until the last minute, then rushed their assignments. On the flip side, students got the best results when assignment deadlines were evenly spaced over the duration of the course. Not only did these students get better grades, but they also invested more time in their assignments. In other words, evenly spaced deadlines resulted in better time management.

What can you do if all your assignments are due on the last day of class? Fortunately, Ariely found a middle ground. Students who created their own evenly spaced deadlines performed almost as well as those who had evenly spaced deadlines imposed upon them. Why not set your own evenly spaced deadlines? If you meet them, reward yourself. The reward could be a meal out, a day off from studying, or organizing a party for your friends.



Tools You Can Use to Study Smarter

Block Distracting Websites

Do you get distracted from your studies by checking e-mail and social media? Free apps, such as StayFocusd (an add-on for Chrome browsers), LeechBlock (for Firefox), and SelfControl (for Mac OS), allow you to limit your use of timewasting websites.


Listen to Music to Improve Your Focus

Research shows that listening to music can help you complete tasks more quickly because it gives your mood a boost. The app Focus@Will features music that's specifically designed to increase your attention span and focus.

Use a Smartphone Timer for Your Pomodoro

The Flat Tomato app for iOS and ClearFocus for Android both provide Pomodoro timers for smartphones. Want to avoid the distraction of your phone while you study? The website www.tomato-timer.com is a free online Pomodoro timer.

Keep a To-Do List

With a to-do list, you'll always know what to focus on next. Google Keep for Android and Notes for iOS are ideal for writing simple task lists. To prevent yourself from getting overwhelmed, it's a good idea to limit your to-do list to five items a day. When they're done, you can relax! 

Studies in Procrastination

Have time to read more? Check out these resources!

D. Ariely and K. Wertenbroch (2002), "Procrastination, Deadlines, and Performance: Self-Control by Precommitment," *Psychological Science*, 13:3, 219–224

H. Kearns and M. Gardiner (2011), "Waiting for the Motivation Fairy," *Nature*, 472, 127


A. Padnani (2012), The Power of Music, Tapped in a Cubicle, *New York Times*, Aug. 11, 2012

PBS Frontline (2010), Interview with Clifford Nass, PBS

R. E. Silverman (2012), Workplace Distractions: Here's Why You Won't Finish This Article, *Wall Street Journal*, Dec. 11, 2012

CONCLUSION: Create Your Own Strategies

The strategies we've shared in this article aren't set in stone. You can try the ones that best fit your needs, and leave the others. You can even tweak them so they're a better match for your situation. It's also worth asking your friends how they manage their time. You'll likely be surprised at how many different strategies are available to help you keep on top of your workload.

Ultimately, it's up to you to develop a system for managing your time that fits your lifestyle and personality. Invest your effort in discovering the right strategies now, and they'll stay with you for the rest of your life. 



David Masters is a freelance writer based in Swansea, UK.

Internships Provide the First Step Toward Career Success

Through Internships, Companies Offer Chemistry and Chemical Engineering Students Work Experience That Can Lead to Postgraduation Jobs

BY SUSAN J. AINSWORTH

Excerpted from *C&EN*, May 11, 2015, Volume 93, Issue 19, pp. 41–43.

In today's competitive employment market, savvy chemistry and chemical engineering students know that having industrial internship experience on their résumé is a real plus. Internships provide students with the opportunity to take the skills obtained through college coursework and apply them to real-life work situations. Being able to demonstrate success in the workplace will undoubtedly give them an edge over a sea of competitors when it comes time to seek a postgraduation job.

But in some cases, finding a coveted internship isn't easy, notes Jamie Stacey, vice president for science at Kelly Services, which offers outsourcing, staffing, and workforce consulting services. In the United States, many companies are cutting or holding steady the number of students they hire. That's because companies view these programs as a pipeline into their entry-level jobs. And, in today's weak job market, some companies are favoring more experienced candidates as they selectively hire permanent staff to fill those starting positions, Stacey says.

Nevertheless, some companies are still welcoming a healthy number of chemistry and chemical engineering students into their ranks. Students can move into either internship programs, which typically offer summer-long work experience, or cooperative (co-op) education programs, which usually involve two- to three-semester jobs that provide college credit.

Through these internship and co-op programs, companies hope to find and begin to build relationships with the best STEM (science, technology, engineering, and math) talent, Stacey says. "Companies understand that employees who started out working for them as interns have a longer tenure and demonstrate greater loyalty in the future."

Winning a chemistry-focused internship: a student playbook

To help eager students gain an edge, *C&EN* contacted a sampling of experts to gather tips and advice for snagging one of these precious, résumé-bolstering positions.

Know when to apply. For most internships, fall is the prime recruiting season, according to Patricia Simpson, director of academic advising and career counseling and placement at the University of Illinois, Urbana-Champaign. Most big companies

visit campus in September and October to attend career fairs and conduct interviews as they often need to hire large numbers of interns, she says. Smaller companies also typically make campus recruiting visits in the fall to secure the best candidates.

However, students who don't land something in the fall should not give up. BASF, for example, recruits summer interns in the late winter and early spring, according to Lydia Everitt, manager of university recruitment. And other companies will still be finishing their summer intern selections in late spring, Simpson points out.

In addition, companies may develop hiring needs throughout the year as a result of a lower-than-expected acceptance rate from their first round of offers to prospective interns or because of unanticipated new projects, Simpson adds.

Merck & Co. echoes this point. Although the company posts most of its internships as early as the fall and typically makes its selections by February, the window of opportunity doesn't close at that time, says Scott B. Hoyt, a principal scientist in the chemistry group at Merck Research Laboratories (MRL), who manages MRL's chemistry intern program. "The large, dynamic environment of Merck means that new postings can happen nearly any time."

For co-op positions, which usually require a two- to three-semester commitment and result in college credit, application periods vary and are often dictated by the student's college or university, says Sylvia Court, graduate program manager for R&D at GSK. Some schools' co-op application window may be in the spring for the following fall semester or in the fall for the following spring semester, she notes.

Connect and reconnect. Simpson advises students to find multiple ways to interface with potential employers. "Talk to them at a career fair, luncheon, information session, or student-organization-sponsored event; apply online; and find and connect with alumni or other contacts who work for the organizations," Simpson says. LinkedIn, Twitter, and other social media sites can provide useful avenues for making connections to people students might not know or have no other way to meet or contact, she adds.

In addition, students should start connecting with companies as early as possible in their college career to demonstrate their enthusiasm. "Some of the companies will send the same recruiters

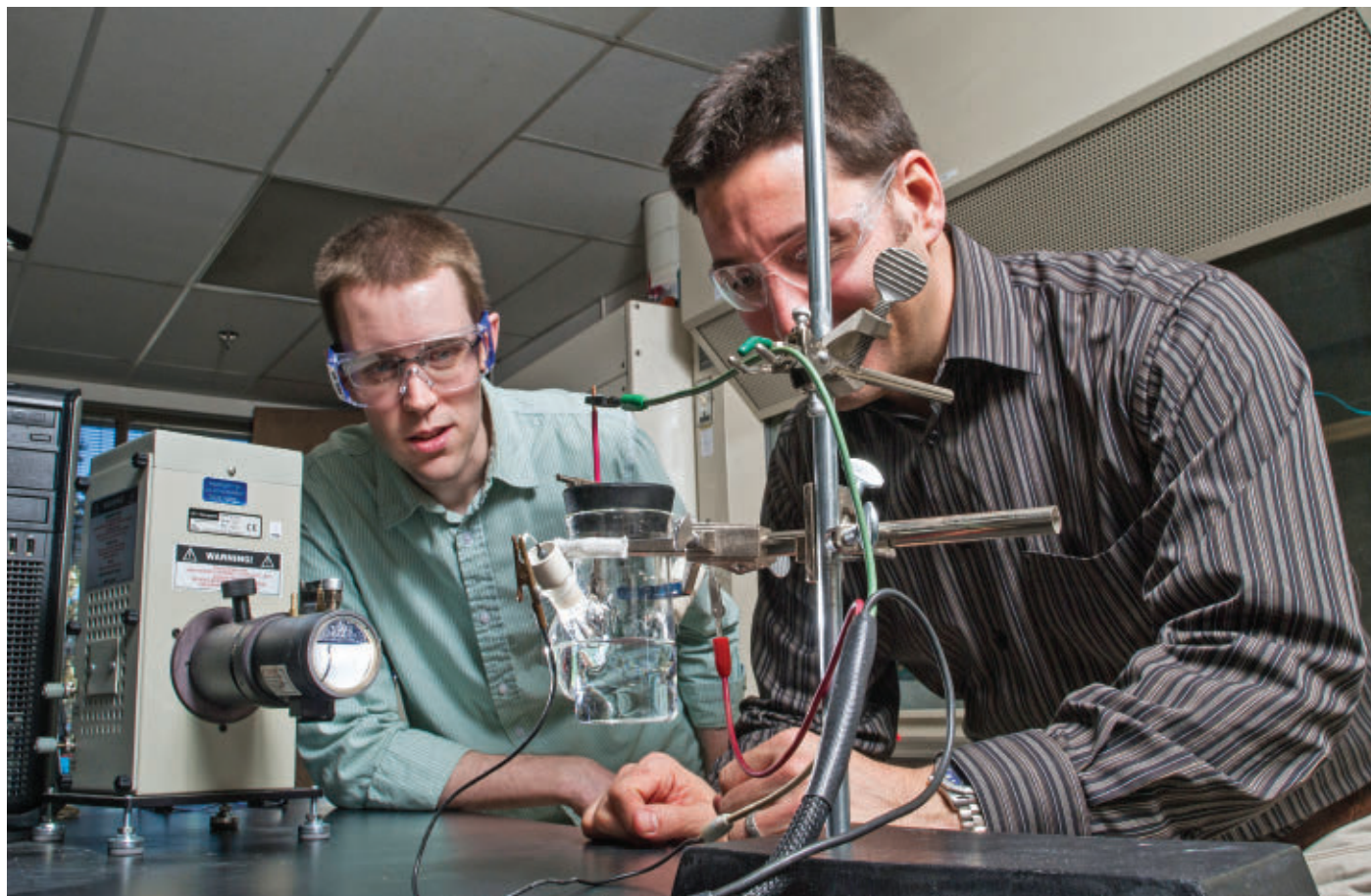


PHOTO: NATIONAL RENEWABLE ENERGY LABORATORY

to campus year after year, and if you are memorable—in a positive way—then they will be more interested,” Simpson says.

Stay focused. “Know what you want to do, and apply only for those jobs that interest you most and that mesh well with your skills,” says GSK’s Court. “Read job descriptions carefully, and don’t apply for too many different internships/co-ops at the same company as this could suggest that you lack focus,” which is a turnoff to prospective employers.

Hone and promote your skills. “The strongest candidates often will have earned good grades, taken appropriate courses, and have prior research or lab experience either at the college or in a prior internship,” says Merck’s Hoyt. And in his firm’s case, those candidates will also “have a desire to apply what they have learned to a health care environment.”

GSK’s Court advises students to promote not only their technical skills but also their soft skills, which she says are equally

important. GSK looks for evidence of teamwork, leadership, customer service, communication, and presentation skills, she adds. “Remember to highlight your life experiences as these are great ways to show how you’ve developed and applied these softer skills.”

Differentiate yourself. “Figure out what makes you stand out from everyone else, and ensure that your résumé reflects that,” advises Teresa Billingsley, student programs coordinator at Dow Corning. “In other words, make it clear to us that we should hire you over all the many other applicants.” **IC**



Susan J. Ainsworth is a Dallas-based science and employment writer and a former senior editor at C&EN.

Additional Resources

- To get tips for landing an internship, visit <http://cenm.ag/intern>
- To access ACS’s Get Experience database that lists internships and research opportunities, visit www.acs.org/getexperience
- To access additional career information, go to ACS’s College to Career website: www.acs.org/collegetocareer
- To read the full article online, go to the C&EN website: <http://cen.acs.org/articles/93/i19/Internships-Provide-First-Step-Toward.html>

Public Outreach and Communication Careers

BY NANCY MCGUIRE

Scientists keep up with the latest research developments by reading scholarly journals and attending science conferences, but how does the general public receive this information? When a freak storm hits or a new species of fish is discovered, how do news reporters find experts to help them explain the science?

Public communication professionals work in all job sectors, including industry, academia, government, and nonprofit organizations.

Communications professionals who work in industry focus on presenting their company's message to the public and ensuring that the company's positive contributions are communicated to such groups as stockholders, reporters, employees, and people who live in the community where the company operates.

Colleges and universities have public information officers (PIOs) who keep the public informed about research taking place at the university. Public institutions and nonprofit organizations have public outreach programs that educate people about science in general, especially scientific issues at the forefront of current

events. Communications offices organize community events, science fairs, science cafés, or exhibits where nonscientists can converse with scientists in an informal setting.

Public affairs officers (PAOs) in government agencies handle similar responsibilities, and they oversee their agency's official communications to ensure accuracy, security, and adherence to policy. They help keep the taxpaying public informed about their agency's work, and they act as the agency's spokespeople to ensure that various sources within the agency are not issuing conflicting or confusing information. Some government agencies sponsor public outreach programs. Government agencies also have legislative affairs offices that provide information about their agency's activities to legislators and other policymakers. Legislative affairs officers keep their own agencies informed on legal and policy issues that affect them.

Museums, including science museums, organize tours and classes, school visits, citizen-scientist programs, and other efforts to educate the general public. Professional societies often organize outreach activities for the public at their national meetings, issue press releases to notify media outlets of significant research that has just been presented or published, and provide access to experts who can make public presentations or give interviews to the media. ACS, for example, sponsors Reactions, a series of short, entertaining videos about chemistry topics at www.acs.org/reactions.

On occasion, science communications specialists are called on for "crisis communications," providing information to the media and the general public after a natural disaster, fire, or other emergency. Some organizations require a communications officer to be on call any time of the day or night in the event of such emergencies. They may provide lines of communications between upper management and first responders on the scene, or they may keep the press informed during situations where access to the scene is limited.

Is this career a good fit for you?

Science communications requires a broad general knowledge of a range of scientific fields and research areas, as well as the ability to see how these fields relate to the organization's overall mission. Communications specialists must tailor their message to the intended audience (management, government officials, junior high science students, etc.). This requires an ability to talk to nonscientists in understandable terms without "dumbing down" the information.

Communications skills are vital, including writing, speaking, presenting visual information, and interacting with journalists,

Typical work duties include the following:

- Communicate with funding agencies, regulatory agencies, and the general public
- Translate scientific content into understandable language for a variety of non-technical audiences, pointing out why the science matters
- Act as official spokespeople for their organizations
- Gather and provide scientific background information for publications and presentations
- Answer questions for visitors to science facilities and museums
- Develop clear, consistent responses to current events, including crisis communications
- Write press releases, newsletters, website content, speeches, opinion pieces, and articles
- Produce videos, podcasts, and social media content
- Help media representatives locate and speak with experts in their organizations
- Provide media training to scientists
- Organize and conduct tours, exhibits, and community events

policy-makers, and the public on a formal or informal basis. Because science communications specialists cover many different programs within their organizations, they must be able to come up to speed quickly on a variety of topics, which is a skill that is sometimes referred to as being an “instant expert”. They must also have an understanding of how their agency, institution, or organization works and be able to articulate its mission and activities.

Depending on the organization, the job may involve a simple reporting of factual information, integrating information from various sources into a coherent theme, offering interpretations of events and policy decisions, advocating for a specific position on an issue, presenting an organization in the best possible light, or presenting information that advances a specific program or agenda. Science communications specialists must understand which of these functions they serve, and adhere to ethical guidelines that delineate facts from opinions and reporting from advocacy work.

Communications specialists read a wide variety of science journal articles, patents, grant awards, and other background sources to stay current on the activities of their organization and the wider environment in which it operates. A solid science background is very helpful in understanding research publications and technical presentations.

Career path

Entry-level positions include working in university, government, nonprofit organization, or industrial public affairs or press offices. Such positions usually involve writing press releases and research news items, writing content for blogs and websites, arranging media interviews for scientists, preparing and staffing exhibits and tours, or producing podcasts and videos.

Experienced communications specialists may take positions as public communications directors, which entails manag-

ing other communications specialists, coordinating with upper management on outreach efforts and communications strategies, and preparing responses to emergencies and sensitive issues.

They may act as official spokespeople for their organizations. Larger organizations may have positions for vice presidents of public relations or corporate communications. Alternatively, experienced communications professionals may go into independent consulting after they have established their reputations and professional networks. They may advise clients on communications strategies, help them with special projects, offer media training to their clients' employees, or help them prepare crisis communications responses. Some communication professionals also move over to journalism at some point in their careers — working for magazines, newspapers, broadcast outlets, wire services, or web publications. **IC**



Quick Facts

OPPORTUNITIES

- The job outlook remains strong, especially as organizations place more emphasis on communicating their research programs and accomplishments to outside audiences.

EDUCATION NEEDED

- Public information and outreach specialists may enter the field with degrees in science, journalism, communications, or related topics. Scientists can learn communications by taking courses, workshops, and learning on the job, or they may pursue a master's degree in science writing or communication. It is not uncommon for scientists to go into communications after working in a research or laboratory environment.

SALARIES

- Salaries for communications and public information specialists vary widely, depending on the job sector, size of the organization, and level of experience required. Indeed.com lists 2015 annual salaries for “science public information officer” ranging from \$40,000 to more than \$120,000, with a median salary of \$66,000.
- In 2012, the National Association of Science Writers conducted a survey of its membership. Members who described themselves as full-time staff writers for their organizations reported average and median annual salaries between \$50,000 and \$75,000. A small percentage reported salaries less than \$10,000 a year, and an equal number reported salaries greater than \$200,000 a year. **IC**

Resources

Emily Calandrelli is a recent MIT graduate in Aeronautics & Astronautics and Technology & Policy, who hosts a TV show that explains science-related topics in an easily understood and entertaining way. www.emilycalandrelli.com/about

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, 2014–15 Edition, Public Relations Specialists (includes public affairs). www.bls.gov/ooh/media-and-communication/public-relations-specialists.htm

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook*, 2014–15 Edition, Public Relations and Fundraising Managers. www.bls.gov/ooh/management/public-relations-managers.htm

Science Writers Compensation Survey Report. Compiled by Cell Associates Marketing Consultants for the National Association of Science Writers. March 2014. (Available to NASW members.)

Public Relations. For Your Information, Chris Woolston. *Nature* 2014, 509, 123–125. DOI: 10.1038/nj7498-123a. www.nature.com/naturejobs/science/articles/10.1038/nj7498-123a

Explaining Scientific Discoveries to the Masses

The Career of Alisa Machalek, Science Writer

BY DARYL RAMAI

Explaining science and the impact of important discoveries in lay terms to the public at large requires the work of skilled, professional science writers. Among them is Alisa Machalek, a science writer at the National Institute of General Medical Sciences, National Institutes of Health (NIH) in Bethesda, Maryland.

Machalek is the editor of *Findings* magazine. This NIH publication showcases the cutting-edge work of young researchers, as well as their interesting lives away from the bench. Its primary function is to educate the public about the mechanics of research discoveries at NIH and the benefits resulting from them.

The typical day of an NIH science writer

On any given workday, Machalek might wear many hats, such as writer, editor, photo researcher, public information expert, or media trainer. “Every day is different,” Machalek explains. “Typically, I’m working on a mix of short-term, medium-term, and long-term assignments.” Her primary writing focus is within the biomedical sciences, where she enjoys communicating with many scientists and writing on topics such as cell biology, chemistry, genetics, and pharmacology. Her job responsibilities include:

- Writing online articles, news releases, feature stories, and scientist profiles.
- Collaborating with graphic artists to produce science education booklets, classroom posters, and programmatic materials.
- Answering questions from the public, the news media, and, occasionally, Congress about the research her institute supports.
- Keeping up-to-date on the latest scientific literature.

Forging a career path

In college, Machalek initially aspired to become a medical researcher, but after many lab experiences and internships, it became apparent that a career in research didn’t interest her. Though still very interested in pursuing a career relating to science, she began exploring science-related careers that were outside the lab. She conducted informational interviews with pharmaceutical consultants and medical illustrators and also had extended conversations with her mother, who is a physician. However, the chemistry involved in these fields just wasn’t enough for Machalek!

At last, things came together when she realized she could incorporate her love for science into her other life-long passion: writing. After earning a bachelor’s degree in biochemistry, Machalek began plotting her pathway. Needing more science, but not more lab work, she designed her own master’s-level graduate program in biochemistry at the University of Wisconsin–Madison.

With fewer lab reports due, Alisa began writing articles about campus research for the school’s student newspaper and also worked with two professors who were writing a biochemistry textbook. “I served as the editorial assistant, photo researcher, and, for a time, central point of contact for everyone involved in the project.” In the process, she also learned a Unix-based molecular-modeling program that allowed her to create detailed images of molecules. While these experiences expanded her understanding of science, they also affirmed her original goal of becoming a science writer. Machalek completed her education by entering the University of California, Santa Cruz science writing certificate program.

Machalek’s advice for budding science writers

First and foremost, if you’re interested in becoming a science writer, Machalek advises, “learn science and practice writing. It is going to be an asset, no matter what field you go into.” It is not the amount of education you have that makes you a good writer. “Don’t think that a Ph.D. in biochemistry makes you a writer. You have to practice. Successful writers write almost every day.”

If you are a graduate student in a master’s or Ph.D. program and are thinking of moving from a research career to science writing, Machalek notes, “education is never a waste.” By earning a higher degree, you demonstrate an ability to work hard and overcome many obstacles. “These qualities are highly valued by prospective employers.”

She further explains that the way to get any sort of science writing job is to show that you can write about a complex topic in a clear, interesting, and accurate way. At the outset of their future careers, aspiring writers must be able to prove themselves to the broader community and employers.



Gaining real-world experience

One low-cost approach to gaining real-world writing experience that's also worthy of adding to your résumé is to start a blog. One benefit of having a blog is that it reflects personal and unedited work; thus, employers can visit your blog to get a better understanding of the "true you". You can also gain writing experience by writing for Reactions, the ACS Undergraduate Blog at www.acs.org/undergradblog. (Contact undergrad@acs.org for more information.)

Another way to gain experience is by becoming a volunteer science writer. Nonprofit organizations dedicated to science and medicine sometimes recruit writers for a trial period before hiring them permanently. Because you will not be earning a paycheck as a volunteer writer, you must keep in mind that this experience is an investment in your future that will enable you to build a portfolio of "clips", or writing samples, that any employer will want to see before hiring you as a science writer.

Another way to gain experience is by writing for your college's newspaper. While most colleges have a newspaper, not many highlight the exciting research of their scientists and students. This is a great opportunity for you to demonstrate leadership in joining a journalistic team and proposing to write a scientific section or column.

Sample Science Writing and Communication Internships

Many institutions and media outlets offer science writing internships, which can be paid or unpaid. Some last for just a few months, while others can extend for a year or more. Here are just a few of the many options.

- Brookhaven National Laboratory Science Communication Internship — www.bnl.gov/education/program.asp?q=118
- National Cancer Institute Health Communications Internship Program — <https://hcup.nci.nih.gov/hcup>
- *Science* magazine Minority Science Writers Internship — www.aaas.org/page/aaas-minority-science-writers-internship
- Society for Science and the Public, Science News Internship — www.societyforscience.org/science-news-internship
- *Journal of Young Investigators* (the undergraduate journal) — www.jyi.org/participate/student
- Rhode Island Sea Grant — <http://seagrant.gso.uri.edu/students>
- Argonne National Laboratory — Summer Science Writing Internship for Undergraduates. www.anl.gov/news-room/summer-science-writing-internship-undergraduates
- National Public Radio — Offers a list of internships throughout different semesters. www.npr.org
- American Society of Animal Science — Communications internship. <https://asas.org>

Graduate Certificate Programs

The number of science writing certificate programs in the United States has increased in the past decade. Here are a few examples.

- University of California, Santa Cruz science communication program
- Vanderbilt University communication of science and technology program
- Massachusetts Institute of Technology graduate program in science writing
- John Hopkins University Master of Arts in Science Writing and Graduate Certificate in Science Writing
- University of Wisconsin–Madison science writing program
- Boston University graduate program in science journalism
- New York University Science, Health and Environmental Reporting Program
- Texas A&M University graduate program in science and technology journalism


Writing internships are also very valuable. These positions will demonstrate to future employers that you received structured training and mentoring within the field. For more information on various internships, students can visit the ACS Get Experience website at www.acs.org/getexperience or search Naturejobs for a broader list of writing and editorial opportunities at www.nature.com/naturejobs/science.

Graduate certificate programs

Graduate certificate programs will help to nurture your skills and demonstrate to future employers a bit more specialization within the field of writing. Although these programs are not a prerequisite to becoming a professional science writer, Machalek notes that they may still help. What she believes is more important is proving that you've got a mind for science and the skills to write for the public.

A future in writing

The future appears bright for science and for science writers! As scientists continue to make important discoveries, there will continue to be a demand for adept science writers who can communicate these advances and educate the public. Journals and magazines need editors to screen manuscripts for publication. And the emergence of any new biotech or pharmaceutical company will require skilled technical writers.

If you are looking for a dynamic and highly creative outlet that also harnesses your love for sciences, consider science writing. Start by getting some form of experience to determine if this is really your destined path. Who knows? You may have a knack for it! If you decide that this is where you want to be, then, as Machalek advises, "just keep on writing." 



Daryl Ramai is a science writer who lives in New York.

SPOTLIGHT

University of Central Florida

Orlando, FL

COMPILED BY ROBIN LINDSEY

**Chapter president:** Morgan E. Beebe**Website:** <http://acsucf.weebly.com>**Chapter members:** 65**ACS student members:** 30**Institution description:** Large, public, urban, 4-year**Q:** How do you ensure a smooth officer transition from year to year?

A: Our Continuity Book contains all of the forms, documents, contacts, and responsibilities of each officer. Whenever new executive board members are elected, they are trained for two weeks using the documents in the Continuity Book. In addition, we scan important information onto a Google Drive that the officers share and access.

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

A: We recruit members through in-class outreach and through outreach events the university hosts for all the registered student organizations. One of our most successful recruitment events is the Ice Cream Social that we hold at each orientation during the summer semester.

Q: What methods do you use to retain members from year to year?

A: Active members in our organization tend to stay because of the family atmosphere we create for them. UCF has more than 60,000 students, so it can be daunting at first for new students to find a community. All of the members of the executive board strive to be as accessible as possible, making our members feel comfortable and that they belong. The most successful events are sometimes

just meeting up for bowling once a month and “bonding” to encourage these relationships that make the members feel that they have a family on campus.

Q: What is your most popular or unique chapter activity?

A: Clean the World’s “Soapy Saturdays” tend to be a real hit for our members. Clean the World is an organization that recycles soaps and distributes them to areas all over the world with poor sanitation. It is a fun way to spend the morning giving back to the community, and it also allows us to incorporate green chemistry into our event!

Q: How do you collaborate with other student chapters in your area?

A: Ten of our student chapter members attended the 249th ACS National Meeting in Denver, and we reached out to representatives of other Florida student chapters who were also at the meeting. We hope to see growth and unity between the Florida chapters from this initial meeting.

Q: What career-related events does your chapter offer?

A: Speakers from the Career Services Department on campus give workshops on résumé building, constructing a curriculum vitae, strategies for interviewing, what to expect for the GRE, and other related

topics. We also provide members with information regarding career fairs and invite speakers who are employees or employers of companies in Orlando looking for undergraduate chemistry majors to intern.

Q: What innovative methods of communication are used to inform chapter members of chapter activities?

A: Our chapter holds weekly meetings for members as well as make-up meetings at an alternative time for members who are unable to attend at the regularly scheduled meeting time. We also communicate through our Facebook page and send meeting minutes to our members. **IC**

Faculty advisor:

Stephen M. Kuebler, 8 years

Q: Why did you become a faculty advisor?

Kuebler: When I was a new assistant professor, the chapter’s previous faculty advisor, Cherie Yestrebtsky, encouraged me to take over for her as advisor so that I could become more involved in the department and grow professionally. The chapter was very well established, so the transition was quite easy. My involvement with the chapter helped me to develop my own teaching and mentoring skills and to share my ideas for professional development.

Q: What challenges have you faced in your position?

Kuebler: The university and our surrounding community have experienced phenomenal growth over the past 10 years. This has opened outstanding new opportunities for the chapter to make new professional connections and to bring our excitement for chemistry to the community. We have greatly expanded the chapter’s outreach efforts and integrated our activities with the ACS Orlando Section and other ACS student chapters. **IC**



PHOTO COURTESY OF UNIVERSITY OF CENTRAL FLORIDA

UCF student chapter members volunteer to clean and recycle soap on “Soapy Saturdays” sponsored by Clean the World, an organization that recycles hotel soap and sends it to areas with high death rates due to hygiene-related illnesses.

SPOTLIGHT

Truman State University

Kirksville, MO

COMPILED BY ROBIN LINDSEY



Chapter president: Leela Chapman **Chapter members:** 36 **ACS student members:** 15

Website: <http://acs.truman.edu> **Institution description:** Small, public, rural, 4-year

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

A: We have a master binder with information about the responsibilities of each executive position and a historical record about events we have held. In addition, the chapter president serves a three-semester term. In the first semester, the president-elect assists the president with duties, runs some weekly meetings, and prepares the chemistry department's weekly seminar series. The following semester, the new president oversees all the organization's meetings and activities and presides over the executive board. In the third semester, the post-president advises the new president.

Q: Do you have any unique positions?

A: We have positions dedicated to planning National Chemistry Week (NCW) events, designing green chemistry events, putting together the Musical Demo Show, and setting up Kids and Chemistry events at elementary schools.

Q: What are your most popular or unique chapter activities?

A: The fall and spring picnics. The fall picnic is for chemistry majors and chemistry faculty members. In the spring we sponsor the All-Science Picnic and invite students and faculty from the biology, agricultural science,

physics, mathematics, computer science, and chemistry departments. These two picnics kick off and end our school year and feature food, games, and volleyball.

Q: Do you collaborate with other clubs on campus on activities?

A: We have a close relationship with the Gamma Theta chapter of Alpha Chi Sigma, and a majority of our members belong to both organizations. Occasionally we co-host events or fundraise together. Our green chemistry chairs also work with other environmental clubs on campus.

Q: What is your most successful fundraiser to date?

A: Our most profitable fundraiser by far is the sale of lab glasses to the chemistry lab classes. On average, we sell 180 pairs per semester, making about \$3 per pair.

Q: What career-related events does your chapter offer?

A: Our chapter plans and runs the Truman Chemistry Department's Friday Seminar Series, bringing in professors, researchers, and other chemistry professionals to speak about their work and advise students on how to prepare for the future. Afterward, students network with the speakers.

Q: Describe a challenge your chapter recently faced and how members overcame the challenge.

A: Last year, as the date for our Musical Demo Show approached, we were relying heavily on the chair in charge of the event. However, without warning, he suddenly had to leave town the day before the event — and with him went our demo and script binder. Members came together and brainstormed an entirely new production, and carried out a very successful show. **IC**

Faculty advisors:

Tim Humphry and Amy Fuller,
3 years

Q: Why/how did you become faculty advisors?

Humphry & Fuller: The previous advisor took a year-long sabbatical. That was three years ago, and we have been advising the chapter ever since.

Q: What challenges have you faced in your positions?

Humphry & Fuller: The initial challenge we faced was transitioning the chapter to a new set of advisors. Since the previous advisor had a style similar to our own, it wound up being a painless process. However, it took the students a semester to really feel at ease around us!

The most challenging continuing aspect of advising the chapter is allowing the students to be responsible for their own activities, and not micromanaging. Students plan, organize, and execute events on their own. It is hard when an event does not turn out as well as the students wanted, but far more often the events are great successes! We are present for advice, but we do not plan club events. **IC**

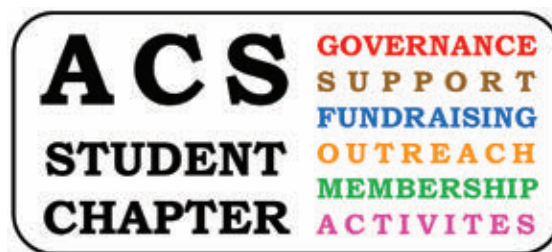


To help ensure that its community outreach program is well organized and successful, the Truman State University chapter developed leadership positions dedicated to planning and developing its Musical Demo Show and NCW, green chemistry, and Kids and Chemistry events.

PHOTO COURTESY OF TRUMAN STATE UNIVERSITY

Fostering an Active ACS Student Chapter

BY KAYODE D. OSHIN, ANNIE CAVALIER, MEGAN DOHERTY, MEGAN UEKERT, MORGAN MATTHEWS, AND COURTNEY WESTON



The Saint Mary's Affiliate of the American Chemical Society (SMAACS) has been active at Saint Mary's College (located in Notre Dame, IN) for more than 50 years, serving as a friendly haunt for faculty and students who have a passion for science and a desire to share it with others. When our faculty advisor began working with the group in 2012, we had a shared interest in revitalizing the chapter and becoming more engaged with our campus and community.

We have made strides toward achieving this goal while providing a fulfilling experience for members; two examples include appearing in a Chapter Spotlight in *inChemistry* and an honorable mention award presented to the chapter by ACS in 2014. We believe that these and other accomplishments have resulted from our focus on six key areas: governance, support, chapter membership, fundraising, activities, and outreach. We hope our experiences can serve as a resource and inspiration for others looking to develop, rejuvenate, or nurture their own ACS student chapters.

Governance

Effective and sustained governance contributes to prosperity and longevity for the student chapter. We particularly focused on:

- Updating our student chapter constitution to reflect current and effective practices.
- Electing competent and passionate students to occupy officer positions.
- Resourcefully distributing chapter duties among our elected officers, including president, vice-president, secretary, treasurer, and historian.
- Developing a plan to sustain good governance for an extended period of time. To address the high turnover rate common among officer positions, we adopted a model where officer positions can be held consecutively for two- or three-year periods. We also try to include younger students, typically sophomores, in the officer pool to ensure continued and experienced governance after senior officers graduate.

Chapter membership

To encourage student membership and participation, we do not collect any fees/dues. Our funding comes solely from donations and fundraising activities carried out by students. This has been an effective strategy, resulting in a membership average of 21 students over the past three years. We also maintain a strong chapter presence on Facebook, providing interested parties with access to our activities. Membership is open to all students and alumnae who have an interest in science and a desire to share their knowledge with the greater community. The exception is for officer posi-

tions, which can only be filled by current chemistry majors. As the year progresses, elected officers mentor other student members who express interest in serving in chapter positions in the future.

Support

Increased faculty, administrative, and departmental support have allowed our chapter to become more engaged and effective. Faculty support has come primarily in the form of time and guidance provided to officers/members, assistance with planning/implementation of chapter events, and applying for chapter grants or student funding. Administrative support has been provided in the form of financial support for the chapter (travel grants) and assistance with club events (e.g., supplies for activities, help with advertising chapter events). Departmental support has also included funding and supplies for chemistry shows.

Fundraising

Over the past three years, we organized several fundraising events, including the sale of SMAACS apparel (shirts, jackets, and embroidered laboratory coats), chemistry demonstration shows, and a pie-your-professor event. Through these activities and the hard work of members and officers, we raised more than \$1,800 last year; we also received travel grants from ACS, our local section, and our student government totaling nearly \$2,700.

Activities

In addition to its outreach mission, our chapter helps student members have fun and network with their colleagues/faculty, which in the process increases membership and retention. During summer break, chapter officers and members research and compile activity ideas for the coming academic year. All ideas are presented during the first officers' meeting in the fall, and a preliminary schedule is assembled.

Over the past three years, SMAACS member activities have included a craft and pizza night, end-of-the-semester bowling parties, and chemistry demonstration shows. We also started a new tradition of fun, competitive on-campus games against the biology club at the beginning of each semester. The inaugural game in fall 2013 was an indoor volleyball game, followed by kickball the next spring and field-day games last fall.

We arranged to have a trophy engraved with the winning organization's name after each game, which the winning department displays for the remainder of the semester. Both groups have a chance to either defend the trophy or win it back at the beginning



SMAACS student members at a chapter event in 2013



SMAACS events have included an end-of-the-semester bowling party and a spring kickball game against the biology club



2014 Demonstration Show



SMAACS members awarding a prize at the science fair



2013 Halloween Show



Hypatia Day demonstration

of the next semester. Needless to say, this has become an event that students really look forward to! More importantly, it provides SMAACS students with an opportunity to interact with other student organizations on campus, developing new relationships across disciplines.

Another activity that has been very beneficial for the chapter has been student attendance at ACS national meetings. A total of seven SMAACS members have attended three ACS national conferences. Student members who express interest in attending a national meeting are asked to submit an essay outlining the value of attendance to themselves, the chapter, and the college. SMAACS officers review all applications and make selections on behalf of the chapter (preference is given to students who also want to present at the conference). Conference attendance gives us a great opportunity to interact with other student chapters and share ideas for growth and success. The ACS national meeting undergraduate programs also provide valuable resources for attending students and chapters, such as networking with graduate school representatives, chemistry demonstration exchange sessions, workshops, seminars, and social events.

Outreach

SMAACS has organized several outreach activities that have brought a tremendous sense of fulfillment and validation to our members. Student members continuously present new outreach ideas to officers for consideration. Activities have included chemis-

try show demonstrations, judging at local science fairs, and Hypatia Day. This last activity is a collaborative on-campus event with the biology, mathematics, and engineering clubs, where middle school students from the local community visit for a day to participate in hands-on demonstrations with each group.

Our biggest outreach event is the SMAACS Chemistry Halloween Magic Show. This popular event began in 2013 and has become an annual activity. The past two years have produced an average turnout of more than 200 people, which includes an average of 120 children. The show provides thought-provoking demonstrations and an interactive experience for the entire audience; in addition, it led to an article being published in the *Journal of Chemical Education Xchange*, with current officers as primary authors.

Conclusion

The six areas of focus highlighted here have contributed to the success of our chapter. We have become more engaged and are also fortunate to have reliable, responsible, and motivated student members who are passionate about our mission. We aspire to continued growth and success by increasing our student membership organizing more outreach activities, chapter events, and fundraising prospects. **IC**

Kayode D. Oshin is the faculty advisor of the student chapter at Saint Mary's College, in Notre Dame, IN. Annie Cavalier, Megan Doherty, Megan Uekert, Morgan Matthews, and Courtney Weston are undergraduate students and SMAACS officers.

Plan an Outreach Event for



at the Zoo



Many zoos have a Halloween “Boo at the Zoo,” at which local organizations host a variety of activities.

This is a great way to share chemistry with the community and have some fun.

Here are some tips and ideas for your ACS student chapter to participate in an awesome Boo at the Zoo event.

P.S. Be sure to send *inChemistry* some high-resolution photos with captions for an upcoming issue.

1.

6 Months Before

- Contact the Boo at the Zoo organizers
- Get details: how to join, event goals, size, restrictions

2.

3 Months Before

- Plan your chemistry activities
Make them:
 1. safe for general audiences
 2. easy to explain quickly
 3. something that can be done at night (think dry ice bubbles, oozing pumpkins, luminol, etc.)
 4. fit the theme and venue
- Identify the main concept you want the audience to learn
- Decide on a takeaway item (trinket, information, activity product, etc.)

3.

2 Months Before

- Order supplies
- Recruit volunteers
- Develop activities (script, waste management, etc.)
- Prepare takeaway items

4.

1 Month Before

- Scope out performance area: check for electrical service, lighting, crowd control (caution tape, rope separator, etc.)
- Practice and refine activities
- Confirm volunteers
- Prepare contingency plans

5.

Day of Event

- Arrive about an hour early for set-up and last-minute changes
- Wow your audience with cool Halloween chemistry!

6.

1 Week After

- Debrief with Boo at the Zoo organizers and volunteers; identify what went well, what could be improved
- Thank volunteers
- Enter activity in chapter report at www.studentchapteronline.acs.org



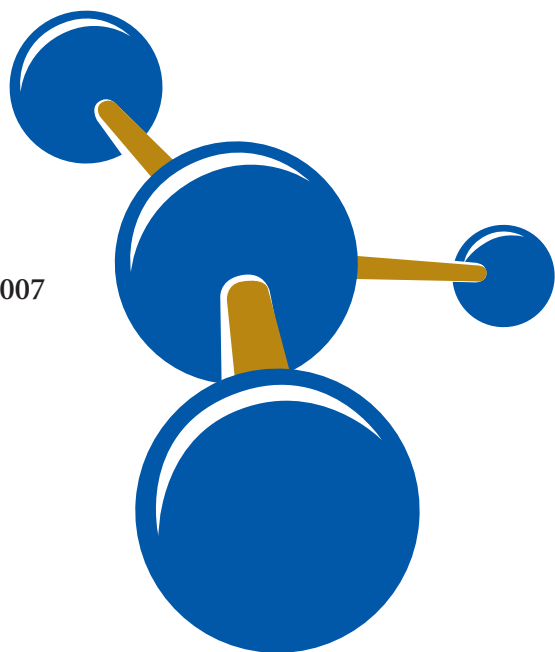
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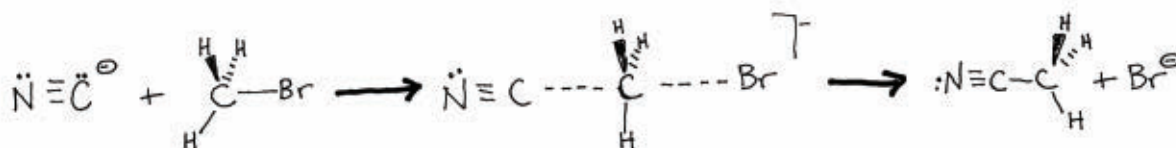


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MIND OVER MATTER BY VERONICA BERNIS



ORGANIC CHEMISTRY IS OFTEN ABOUT PUSHING ELECTRONS AROUND, AND WATCHING THE NUCLEI TODDLE ALONGSIDE. THIS RESULTS IN SOME CLASSIC MECHANISMS THAT MANY ORGANIC REACTIONS FOLLOW.

ONE COMMON REACTION MECHANISM IS THE $\text{S}_{\text{N}}2$; A NUCLEOPHILIC SUBSTITUTION WITH 2 MOLECULES LOCKED IN THE CHARACTERISTIC TRIGONAL BIPYRAMIDAL GEOMETRY OF THE TRANSITION STATE. ONE BOND IS BROKEN AND ONE BOND IS FORMED SIMULTANEOUSLY AS THE ELECTRONS INVOLVED PULL THE NUCLEI TO THE MOST STABLE STATE, RESULTING IN THE SWAP OF TWO SUBSTITUENTS ON THE CENTRAL ATOM.



THE MOTION OF THE $\text{S}_{\text{N}}2$ MECHANISM
IS BASICALLY AN UMBRELLA TURNING INSIDE OUT