ACS Green Student Chapter Activity: Inviting a Speaker

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This guide is produced by the ACS Green Chemistry Institute®

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Sustainable and green chemistry in ~~very~~ simple terms is just a different way of thinking about how chemistry and chemical engineering can be done. Over the years different principles have been proposed that can be used when thinking about the design, development and implementation of chemical products and processes. These principles enable scientists and engineers to protect and benefit the economy, people, and the planet by finding creative and innovative ways to reduce waste, conserve energy, and discover replacements for hazardous substances.

It's important to note that the scope of these green chemistry and engineering principles go beyond concerns over hazards from chemical toxicity and include energy conservation and waste reduction, as well as life cycle considerations such as the use of more sustainable or renewable feedstocks and designing for end of life or the final disposition of the product.

By incorporating sustainable and green chemistry into your student chapter's activities you can:

- Become a spokesperson on your campus for sustainability and the solutions chemistry can bring through green chemistry
- Start a movement of sustainability across your campus and in the community
- Make a difference through chemistry
- Have a positive impact on human health, the environment & the future
- Improve the "image" of chemistry

Chapters who engage in at least three green chemistry outreach and educational activities during the school year are eligible to win a Green Chemistry Student Chapter Award.

Green Chemistry Themes to Consider[1]

It is better to:

Prevent waste than to treat or clean up waste after it is formed
Minimize the amount of materials used in the production of a product
Use and generate substances that are not toxic
Use less energy
Use renewable materials when it makes technical and economic sense
Design materials that degrade to innocuous products at the end of their usable life

[1] Middlecamp, Catherine, ed. *Chemistry in Context: Applying Chemistry to Society*. 8th ed. New York: McGraw Hill, 2014. Print

Convincing someone to come to your college or university to give a talk might seem like a daunting task full of logistical hurdles, but a little planning and organization go a long way toward hosting a successful event. Speakers have a unique potential to attract an interdisciplinary group of students, faculty, and members of the community while providing a structured forum for discussion. ACS Student Chapters all over the country have hosted speakers from government, industry, and academia to raise awareness about green chemistry. The table provides examples of speakers and topics that ACS Student Chapters have hosted in the past.

Chapter	Speaker	Topic
University of Tennessee Martin	Dr. Scott Brown, Murray State University	Examples of green chemistry applications beyond the lab, inspiration for faculty to incorporate greener lab practices and lessons
University of Tennessee Martin	Dr. Robin Rogers, University of Alabama research professor and director of the Center for Green Manufacturing	Ionic liquids
University of Texas Tyler	Dr. Roy Crawford, Research and Technology Director at The Texas Allergy, Indoor Environment, and Energy Institute (TxAIRE)	Green chemistry principles in construction of LEED certified houses
Alvernia University	Dr. Amanda Grannas, Villanova University	Environmental chemistry in the atmosphere and arctic tundra, photochemical effects
University of Toledo	Nathan Gaubert, Spartan Chemical Company	Greening the production process of household goods through reduction of hazardous chemical use during manufacturing
University of Toledo	Becky Kaufold, Spartan Chemical Company	12 Principles of Green Chemistry and the chemistry of consumer products
University of Massachusetts Boston	Dr. Berkeley Cue, adjunct professor at the UMass Boston Center for Green Chemistry	Green chemistry development in pharmaceuticals
South Texas College	Dr. Dave Brown, Southwestern College, professor of chemistry and a program director National Science Foundation	Project iLaser (2011) and engaging the public in sustainable energy and nanotechnology with emphasis on engaging youth
University of Connecticut	Dr. Nicholas Leadbeater, professor of chemistry and director of the New Synthetic Methods Group	Green chemistry techniques in industry

Logistics: The Who, What, Where and When

A guest speaker won't show up uninvited and an audience won't come to an event they don't know about. There are a few key components of planning to keep in mind when considering hosting an event.

It is essential to determine a **time, date, and place** well in advance. Consider whether or not the selected date is convenient for members of your ACS student chapter to dedicate time. Then think about scheduling the event around midterms, exams, holidays, major campus events, etc. for potential attendees.

The guest must be invited well in advance for their convenience and planning. The sooner they are contacted the greater the likelihood that they will be available. Establishing **communication** with the guest is critical to the planning process. Depending on who is invited, you may have to speak with his or her agent or representative. Don't be afraid to pick up the phone! Write down what you're looking for and any questions you have beforehand.

Universities often budget for guest speakers far ahead of time – as early as in the spring term for the upcoming academic year. However, if you've missed the official budgeting window inquire about available **funds** anyway from the university and the chemistry department. The budget may have been drafted in general terms rather than with specific allocations (i.e. guest speakers may not have been chosen yet). Universities often provide the invitee with a dinner (with a select group of faculty and students), accommodation, and travel reimbursement. Depending on the guest, he or she will likely require a speaking fee. Do internet searches for external grants that could help you bring a speaker to campus. Again, remember to apply well in advance.

Do some research on green chemistry and the speaker you wish to invite before proposing the event. This way you can confidently **explain why it will be important** for students, faculty and the community. There will probably be an application for inviting a guest speaker. Inquire about or search for it on your university website then promptly return the form.

If the **location** needs to be reserved be sure to ask about its availability at least a few weeks in advance (i.e. before the event is advertised). Think about how many people might attend and what kind of technology the speaker(s) need (i.e. a projector for PowerPoints, smart board, microphone, etc.). Will you need a classroom, lecture hall or auditorium?

A **time** estimate will be needed for advertising, making reservations, and keeping the event on track. Tell the speaker how long they will have to talk so they can plan appropriately. Assign deadlines to members of your student chapter if they have associated responsibilities.

And of course, be sure to **thank everyone - especially the guest -** for participating, donating time, or supplying resources.

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What's the Talk About?

Remember that this talk is focused on green *chemistry*, not sustainability or environmental friendliness. What's the difference? Initiatives such as recycling, using less paper, and cleaning up litter are examples of general sustainability projects which are focused on the need to slow global warming, reduce carbon dioxide emissions, etc. many of which have been popularized and there's a good level of awareness surrounding them. It's easy to get these kinds of activities confused with green chemistry because in certain respects they overlap significantly. It is essential, however, to make a distinction between the two.

The manufacture of goods – everything from cars to paint to pesticides – involves chemical processes. "Green Chemistry" was developed as a way to re-thinking past and current processes, many of which posed significant risk to human health and safety or the environment. Green Chemistry takes into consideration the effects of a chemical through its entire "life" from the time it is extracted from the earth to what happens after it is disposed of as waste. This includes the risks involved in its transportation, effects when it enters wastewater, and potential harm caused to those who are working with it. Green chemistry is also a way in which businesses can reduce their expenses by spending less money on waste treatment and using fewer chemicals in general. Some green chemists consider there to be twelve guiding principles for greener chemistry while others feel the scope is much broader. A few key ideas in green chemistry are to prevent waste instead of treating or cleaning it, use as few materials as possible, make and use non-toxic substances, reduce energy use, take advantage of renewable materials, and design things to be harmless even when they reach the end of their useful life.

Although a goal of green chemistry is to create more sustainable practices it's a specific area of the sustainability movement. For example, recycling plastic is a great sustainability practice. However, a green chemist might consider designing plastic that is more biodegradable, doesn't require non-renewable petroleum or contain potentially harmful chemicals like BPA, or how to improve the efficiency of the recycling process itself. Another example of a sustainability project would be "going electronic" for a newsletter to reduce paper. A green chemist might consider how to reduce the environmental impact of the paper production process such as eliminating the use of bleach as a whitener or how to re-use chemicals that become waste during the paper production process.

Where on Earth Can I Find Someone to Talk About That?

When designing this event first consider what is nearby. Most student chapters have invited guests from no more than an hour's drive away. The GEMs database map of the green chemistry community may be helpful as it includes industry, government, non-government, and educational locations of green chemistry activities. Ask chemistry professors and graduate students if they can think of anyone who might be interested or if they are themselves. You never know who has a connection to someone who would be qualified, especially as more businesses and organizations are investing in green chemical research and development. Regional ACS meetings may also be useful in locating chemists in your vicinity.

There's also the potential for inviting non-chemists. Keep in mind other departments like biology, economy, or political science. Chemistry affects everyone and making the event interdisciplinary will be more attractive to many potential attendees.

Again, stress that the talk needs to be focused on greener chemistry, how it affects us, how industry is approaching it, innovations in the field of chemistry, its effects on the economy or the environment, green chemistry in policy-making, programs or new projects in green chemistry or something along these lines. Let the guest know what you're looking for and don't be afraid to reject a proposed topic if it's not appropriate. Don't try to tell someone what to talk about but gently request that he or she alter the focus of the talk or presentation to be more aligned with what you have in mind. This way, the talk will be relevant and the speaker has room to be creative and enthusiastic about his or her subject.

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How Do I Get People to Attend?

Who will come to the talk if no one knows about it? One of the most important parts of hosting an event is advertising. Here are a few tips for getting better attendance when designing posters or spreading the word online.

1. Remember, you will know who you're inviting and why better than anyone looking at your flyers, posters, or probably even in attendance. Sometimes it's best to take a step back when you're very familiar with the project. Think of how undergraduates, professors, high school teachers, etc. who have never heard of green chemistry would perceive advertisements and tailor your message around the perceptions of the intended audience. Do some research to find out what they are most likely to care about and adjust the program to fit their needs.
2. Always approach advertising in a way that is SIMPLE, DIRECT, and RELEVANT. You don't need a sassy/witty marketing push. Stick true to your message and the purpose of the lecture. People can instantly sense authenticity so try and be as clear as possible.
3. Make sure you have information access points for your program. Establish a simple Facebook page, Tumblr, or WordPress, etc. with information and to give a more behind-the-scenelook, and the main webpage. Also try to get your own URL and make it as short as possible for advertisements.
4. If you have an online presence, make sure all the facts are straightforward and easy to find. A simple page with about (time, date, place, description) and contact information should suffice. Find a tech-savvy friend to help you set up a website if you want to but aren't sure how. There are a number of fairly simple drag and drop webpage builders.
5. If you are inviting a "high-profile" speaker you may want to consider making it a ticketed event. Tickets can be free and work as seat reservations or you can charge for them which might help cover the costs associated with the speaker. Be sure to include any information about purchasing or obtaining tickets clearly on advertisements and webpages.

Bonus Tip: **Lecture Series**

Is there an upcoming lecture series hosted by your college or university? Inviting or nominating a speaker to participate in a larger event can ease the pressure off the ACS student chapter as much of the organization, planning, funding, advertising, etc. will likely be provided by the school. In addition, this can be a great way to ensure that the talk is part of something interdisciplinary. The theme may be something like sustainability or Earth Day, but be creative and try to work with what the event planners have in mind and think about where green chemistry might have a place. Annual lecture series' in particular are likely to attract more attendees because students, faculty and members of the community will already have some awareness about them.

Working with the Speaker, Making it Work

1. **Get his or her attention**

   a. Once you have the green light from the department, student chapter, or institution for the necessary finances, officially invite the guest to visit the campus and deliver a lecture by writing an email or making a phone call on behalf of the student chapter and whichever group is providing financial support, particularly if they require a speaking fee (but it doesn't hurt to try to get them to come for free in the name of science!).
   b. If you send an email or make a phone call and neither is returned, try again. Have a second and third choice in mind. Include a "please reply by" date; you'll know a candidate isn't interested if they don't get back to you by then.
2. **If the invitee accepts it's time to work out the details**.
   a. How will they travel? What proportion of the expenses will be covered including food, accommodation, transport, etc.? Make it clear what the budget is.
   b. Are you organizing a reception dinner? You will need to…
      i. Contact catering services (consider dietary restrictions)
      ii. Invite faculty
      iii. Choose a dining room on campus or make reservations at a nearby restaurant
      iv. No, the guest should not pay for his or her own meal.
   c. Make sure the purpose of the talk is understood. Discuss this over the phone if you feel uncertain. Ask if the speaker will need any particular equipment.
   d. If the speaker requires payment there will be associated paperwork. Be sure to have this ready before the guest arrives so they can be compensated promptly.
   e. Be sure someone is available to greet him or her when they arrive to campus or that they have a point of contact (phone number) from the accommodation. This can be someone from the student chapter or a faculty member that has helped organize the event.
   f. Discuss a schedule for the day of the event with the speaker well in advance so he or she is comfortable, guests can be invited to dinner (if necessary), and the talk can be advertised appropriately. Include things like a Q&A session, book-signing, demonstration, etc. in advertisements if the speaker wants to include them.
3. **Remember to write a thank you note**
   a. an actual card is better than an email
   b. if have the budget for it, a small thank-you gift such as a gift card is a nice token of appreciation

Practical Checklist

- ☐ Contact the guest or his or her agent

- ☐ Apply for funds
- ☐ Create a budget
- ☐ Continue communicating with the guest or agent
- ☐ Select a time and date
- ☐ Reserve a location
- ☐ Make travel arrangements
- ☐ Choose a point of contact
- ☐ Advertise, advertise, advertise
- ☐ Organize a dinner; invite guests (no more than 12)
- ☐ Acquire any needed tech
- ☐ Send a thank-you note

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Want to Know More about Green Chemistry?

If you're feeling unsure about what green chemistry is, how it applies to you, or why it's worth getting a speaker, below are some examples of green chemistry in everyday life and resources where you can become familiar with the basic concepts.

Websites:

The ACS Green Chemistry Institute
Beyond Benign
The Berkeley Center for Green Chemistry
Green Chemistry Initiative at the University of Toronto
Green Chemistry Centre of Excellence

A list of textbooks and lab manuals with a green chemistry focus can be found here.

Everyday Examples of Green Chemistry [2]

Below are some interesting examples of how green chemistry affects everyone.

- *Have you ever had you clothes dry-cleaned?* [3]
    - Dry Cleaning: dry-cleaning processes have conventionally used the chemical perchloroethylene (perc). Several organizations have stated that perc is a hazardous substance to human health. The International Agency for Research on Cancer (IARC) concluded that perc is a "probable human carcinogen" meaning it is likely to cause cancer in addition to its short term effects like dermatitis. Workers in a dry-cleaning facility can be exposed to perc in a number of ways from cleaning the machine to simply loading clothing.[4] In addition, perc is categorized as a hazardous air pollutant by the U.S. EPA's Clean Air Act and it may contaminate groundwater when it is disposed.[5]
    - *Applying green chemistry to this situation has resulted in a markedly improved process using liquid carbon dioxide – a substance that is essentially non-toxic and is equally effective at removing grease and dirt from fabric. This simple innovation of replacing a hazardous chemical for a benign one is a perfect example of green chemistry at work in everyday life.*
- *Do you own something involving a computer chip?*
    - Have you ever considered what goes into making a smartphone, computer, or television work? As technology progresses so does our consumption of endangered elements: the 44 critical materials which will soon face supply limitations. These limitations can stem from factors such as geographic concentration, political motivations, regulatory laws, or consumer demand. Some green chemists are researching more abundant alternatives, more efficient syntheses where alternatives are not found, diversifying the supply and better recycling and recovery programs for these scarce materials. A smartphone, for example, usually contains over 80 elements, many of which are considered "endangered," for everything from the touch screen (dysprosium, europium, etc.) to the color display (yttrium, terbium, and more). To manufacture computer chips, many chemicals, large amounts of water, and energy are required. In a study conducted in 2003, the industrial estimate of chemicals and fossil fuels required to make a computer chip was a 630:1 ratio! That means it takes 630 times the weight of the chip in source

[2] http://www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry/examples.html
[3] Ryan, M. (ed.), Tinnesand, M. (ed.) (2002*) Introduction to Green Chemistry*, American Chemical Society: U.S.A. pp.23-29
[4] https://www.osha.gov/dsg/guidance/perc.html
[5] http://yosemite.epa.gov/opa/admpress.nsf/0/e99fd55271ce029f852579a000624956

materials just to make one chip! Compare that to the 2:1 ratio for the manufacture of an automobile. This is an example of very poor atom economy. Scientists at the Los Alamos National Laboratory have developed a process that uses supercritical carbon dioxide in one of the steps of chip preparation, and it significantly reduces the quantities of chemicals, energy, and water needed to produce chips. Richard Wool, director of the Affordable Composites from Renewable Sources (ACRES) program at the University of Delaware, found a way to use chicken feathers to make computer chips! The protein, keratin, in the feathers was used to make a fiber form that is both light and tough enough to withstand mechanical and thermal stresses. The result is feather-based printed circuit board that actually works at twice the speed of traditional circuit boards. Although this technology is still in the works for commercial purposes, the research has led to other uses of feathers as source material, including for biofuel.

- *Who owns clothes? By the looks of it, all of you!*
    - Micro-organisms are everywhere, even in our clothes. They cause odors, wearing, and color changes to fabrics in textiles. To reduce the number and effects of micro-organisms on our clothes, antimicrobial textiles have been developed. Unfortunately, some of these synthetic agents have toxic effects on humans. For example, silver antimicrobial agents have caused dermatitis, some synthetic dyes have been found to cause cancer, and still others like zinc pyrithione are mildly neurotoxic. Not only are these compounds harmful to humans, they are often not biodegradable and the waste created by their manufacture is difficult to treat and sometimes become ineffective over time. *Green chemistry approaches have created benign antimicrobial textile solutions. These include materials called biopolymers that are made from a huge variety of renewable materials found in nature such as chitosan from crustaceans and fungi, cyclodextrin from starch, and alginate from brown sea weeds. Antimicrobial agents made from these ingredients are less harmful to the environment, have lower toxicity, are renewable, and still highly functional.* [6]
        - *Have you ever eaten food?*
    - Many people are surprised to learn that even what they eat is a product of chemical design. Decaffeination and the production of flavors are just two examples of food-industry processes that green chemistry principles have been applied to with success. Decaffeination of coffee beans using dichloromethane, a suspected carcinogen, was the accepted process for about 70 years. However, greener methods have been developed and applied on an industrial scale. The Swiss water process and the use of supercritical CO_2 are both the result of green chemical innovation. The Swiss water process uses water, green bean extract and a difference of caffeine concentrations. No harmful solvents are used and very little waste is produced as the water is easily recycled. Decaffeination by supercritical CO_2 is also a safer and more environmentally friendly method because it is a very low-waste process using a relatively non-toxic substance; the

[6] Shahid-ul-Islam, Shahid, M., Mohammad, F. Green chemistry approaches to develop antimicrobial textiles based on sustainable biopolymers – a review. *Ind. Eng. Chem. Res.* 2013, 52, 5245-5260.

carbon dioxide is recycled throughout the process and the caffeine solution produced is sold to other manufacturers.[7]

- Consider everything vanilla-flavored you've ever eaten or vanilla-scented candles, soaps, and more that you've used. The production of synthetic vanillin, the main flavor component of natural vanilla extract, has undergone several changes through industry attempts to improve efficiency, reduce waste, and increase the quality as demand grows at a faster rate than vanilla bean production. In the 1930's, use ligninsulfonates (organic material from wood pulp production) became the conventional starting material for vanillin production but were eventually replaced by a petrochemical starting material due to the large amounts of waste created through the wood-production by-product process[8]. New research has found that vanillin molecules can be collected and purified using ionic solvents which are often greener than the solvents they replace (less volatile) and can be derived from renewable resources unlike petrochemicals[9]. Although this synthesis is still in development the pathway towards greener production is being paved.

- *Have you ever used plastic?*
  - Several companies have been working to develop plastics that are made from renewable, biodegradable sources.
  - NatureWorks of Minnetonka, Minnesota, makes food containers from a polymer called polylactic acid branded as Ingeo. The scientists at NatureWorks discovered a method where microorganisms convert cornstarch into a resin that is just as strong as the rigid petroleum-based plastic currently used for containers such as water bottles and yogurt pots. The company is working toward sourcing the raw material from agricultural waste.
  - BASF developed a compostable polyester film that called "Ecoflex®." They are making and marketing fully biodegradable bags, "Ecovio®,"made of this film along with cassava starch and calcium carbonate. Certified by the Biodegradable Products Institute, the bags completely disintegrate into water, CO_2, and biomass in industrial composting systems. The bags are tear-resistant, puncture-resistant, waterproof, printable and elastic. Using these bags in the place of conventional plastic bags, kitchen and yard waste will quickly degrade in municipal composting systems.
- *Have you ever taken a medication?*
  - Merck and Codexis developed a second-generation green synthesis of sitagliptin, the active ingredient in Januvia™, a treatment for type 2 diabetes. This collaboration lead to an enzymatic process that reduces waste, improves yield and safety, and eliminates the need for a metal catalyst. Early research suggests that the new biocatalysts will be useful in manufacturing other drugs as well.
  - Originally sold under the brand name Zocor®, the drug, Simvastatin, is a leading prescription for treating high cholesterol. The traditional multistep method to

[7] Jimenez-Gonzalez, C., Constable, D. J. C. (2011) *Green Chemistry and Engineering: A Practical Design Approach.* Hoboken, New Jersey: John Wiley & Sons, Inc.
[8] Calvo-Flores, F.G., Dobado, J.A. Lignin as a renewable raw material, *Chem Sus Chem.,* 2010, 3, 1227-1235. http://onlinelibrary.wiley.com/enhanced/doi/10.1002/cssc.201000157/
[9] http://www.sciencedirect.com/science/article/pii/S1383586610002789

make this medication used large amounts of hazardous reagents and produced a large amount of toxic waste in the process. Professor Yi Tang, of the University of California, created a synthesis using an engineered enzyme and a low-cost feedstock. Codexis, a biocatalysis company, optimized both the enzyme and the chemical process. The result greatly reduces hazard and waste, is cost-effective, and meets the needs of customers.

- *Have you ever painted something?*
  - Oil-based "alkyd" paints give off large amounts of volatile organic compounds (VOCs). These volatile compounds evaporate from the paint as it dries and cures and many have one or more environmental impacts.
  - Procter & Gamble and Cook Composites and Polymers created a mixture of soya oil and sugar that replaces fossil-fuel-derived paint resins and solvents, cutting hazardous volatiles by 50 percent. Chempol® MPS paint formulations use these biobased Sefose® oils to replace petroleum-based solvents and create paint that is safer to use and produces less toxic waste.
  - Sherwin-Williams developed water-based acrylic alkyd paints with low VOCs that can be made from recycled soda bottle plastic (PET), acrylics, and soybean oil. These paints combine the performance benefits of alkyds and low VOC content of acrylics. In 2010, Sherwin-Williams manufactured enough of these new paints to eliminate over 800,000 pounds, or 362,874 kilograms of VOCs.

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Submitting Your Green Student Chapter Activity

Once your ACS student chapter has completed a green activity it's time to fill out the student report with details about what's been done. Feel free to send along photographs or a mention of your work in the university or college news.

See this webpage for information on deadlines, submission requirements, and the report form.

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