



## Communication and Collaboration in Green Chemistry at Augsburg University

by Cynthia Mwenja, PhD

Michael Wentzel, Associate Professor and Chair of the Department of Chemistry at Augsburg University, develops green synthetic methods within the field of sustainable chemistry, focusing both on developing new experiments with undergraduate researchers and on communicating about green chemistry methods and results to the general public. His varied interests and initiatives exemplify the importance of communication for the sciences and the power of collaborations across departments, institutions, and nations.

### Green Chemistry

As a pre-med student looking to boost his resume, Wentzel applied to be an undergraduate researcher working to synthesize DEET, a common mosquito repellent that particularly interested researchers at the time. The research involved using ionic liquids, which are liquid salts at room temperature. These unique liquids are also reusable, which is good, but the process of creating ionic liquids is not necessarily. As Wentzel points out, a systems-thinking approach—considering every aspect of creating, using, and disposing of lab materials and products—should be considered when doing green chemistry. In his graduate studies, Wentzel focused on work with metals as catalysts, such as copper and rhodium. At that time, Jane Wissinger—currently Distinguished University Teaching Professor and Organic Lab Director in the Department of Chemistry at the University of Minnesota—was starting to “take off as the leader of green chemistry worldwide,” Wentzel states. He became her teaching assistant and, later, served for two years as head TA for organic chemistry.

Wentzel explains green chemistry as “the

design, development, and implementation of chemical products and processes that are benign by design.” He goes on to explain that chemistry “doesn’t have to be the solution to the problems it created—it could just not create them.” This green approach to chemistry from a sustainable mindset is driven by certain considerations, such as these: Does the process cause pollution? Can the process meet current needs without causing other issues? Is the process sustainable? Wentzel says that these ideas, though seemingly mainstream, are more recent than many people may realize, and the ideas haven’t necessarily made it into chemistry curricula yet. Additionally, he notes, green chemistry must be cost-effective to be adopted more widely—“people will pay a small premium, but generally, better must be better AND cheaper.”

### Research and Collaborations

After Wentzel earned his doctorate, Wissinger and Wentzel have continued to formally collaborate—their campuses are mere minutes from one another—and much of their work lies in developing new experiments to conduct with their students. A new experiment is one that students can perform and get reliable data,

Wissinger states. Each new experiment needs four or five implementations before being published; as a result, collaboration between Augsburg and the University of Minnesota is fruitful, since Wissinger and Wentzel can implement the experiment in different classes simultaneously to generate data more quickly. Wentzel points out that this work represents new trends in chemistry curricula—the American Chemical Society now recommends that all chemistry students learn both polymer and green chemistry. Wentzel—who get into polymers and green chemistry just as they were taking off in 2015—says that these curricular changes matter.

The University of Minnesota partners with National Science Foundation’s Center for Sustainable Polymers, and one aspect of this work that Wissinger and Wentzel focus on is in curricular development, Wissinger reports. The new experiments they develop have learning objectives embedded in them, as well as tying in important social concepts, such as the problem of plastics. These experiments capture the interests of students, who have already understood the issues at play because they’ve seen the images of turtles



with plastic rings on their shells and whales who have died due to plastics ingestion. Wissinger says that their goal is to help students see that chemists can address these problems, and these experiments model ways of doing so. Wentzel has his students working with polymers, which is not only “cool chemistry,” as he puts it, but also a way to teach his students “how to engage” with chemistry.

Wentzel’s sabbatical year was spent in Wissinger’s lab, extending his own undergraduate research program. He also audited a polymer course and developed a new experiment with a graduate student. Drawing on their long collaboration, Wissinger and Wentzel secured a grant to fund a workshop for chemistry professors at small, local, primarily undergraduate institutions. Attendees learned about opportunities to collaborate with others at the

University of Minnesota, thereby extending their own available resources. Since many PUIs hire generalists, Wissinger says, such opportunities can allow these professors to delve more deeply into green polymer research that might not be feasible at their home institutions.

New research in Wentzel’s lab—in collaboration with Sarah Zingales—also includes developing a multi-component reaction for small molecules that have potential as Alzheimer’s treatment. It combines three different simple starting materials, allowing them to become more complex products that can be altered; this approach easily gives access to a library of derivatives from small starting materials changes. The method is atom economical, meaning that most of the atoms in the starting materials are present in the product, catalytic, and potentially can be done without a solvent.

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### Work with Undergraduate Researchers

Dixie Shafer, Director of Augsburg's Office of Undergraduate Research and Graduate Opportunities, became aware of Wentzel when he first began working on campus as an adjunct. Suddenly, she says, students were coming to her office, telling her "how much they loved organic chemistry and that they wanted to become chemists or switch from biology to chemistry for their pre-med studies." She says she had to meet the person who was inspiring these students, and she has found that students love him because he makes things not only understandable but fun. In his role as the summer undergraduate research (UR) coordinator, Wentzel organizes social activities, such as taking the group to a baseball game on Star Wars night.

Wentzel oversees nine or ten undergraduate researchers himself, and Shafer says that

"they're motivated because he's motivated." Two of his students have won national green chemistry awards for research they completed under Wentzel's direction. One of his students who was researching self-healing hydrogels in collaboration with Patrick Willoughby had their work featured on the cover of the *Journal of Chemical Education*. Wentzel also offers a summer workshop for all summer researchers and McNair Scholars on giving effective presentations—how to speak, make helpful analogies, and compose effective PowerPoint slides. Shafer says that the students' presentations have become more intelligible and engaging as a result of these workshops; they help students learn how to speak to a non-expert audience. Shafer says that she sees student confidence growing; they move from a stance of asking "Am I researcher?" to one of affirming "I am a researcher!"

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Drawing on his experiences as a Science Communication Fellow, Wentzel now has Darcey Engen from theater work with his students so that they also become better communicators of their own research. As he says, “Science communication is a big deal. Scientists have a responsibility to make their research accurate but also accessible.”

Wentzel also mentors his students in developing their collaboration skills. He co-authored a book chapter in *Communication in Chemistry* with Brett McCollum and Layne Morsch discussing how his students partnered with students in Canada collaborate on multiple assignments then do a number of reflections on the process. They also have a chapter in *Taking Stock 2.0: Transforming Teaching and Learning in Higher Education*, due out this month, outlining a framework on how the work can be applied to other disciplines. Finally, he worked with computer science researchers led by Amy Larson to develop a scheduling app so that his students could potentially manage their work with collaborators in Australia and Ireland. These collaborations facilitate cross-cultural collaboration, thereby helping students begin to understand those who come from different places.

### Passion for Instruction

As an undergraduate, Wentzel had thought he would attend medical school until his mother—a social worker—pointed out how that he “lit up” when he talked about his undergraduate chemistry research. While in graduate school at both the University of Pennsylvania and University of Minnesota, Wentzel tutored and worked as a graduate teaching assistant whenever he could. Wentzel attributes his “gift of gab” to having grown up working in his grandfather’s and father’s hardware store in a small Iowa town of about 4,000 residents, and he enjoys the challenge of finding a variety of ways to explain things to his students. Additionally, the research experiments they run are just that—experiments. Students are often shocked to learn that an experiment does not have a pre-determined outcome, saying some version of “You don’t KNOW?!” They are learning how to do real science, which sometimes doesn’t turn out as expected.

Vivian Feng, Professor of Chemistry at Augsburg, says that Wentzel “brought in new ideas” when he came to the department, and they shared a goal of building a student-centered department. With this vision, they grew numbers of majors from an average of six to an average of eighteen or more each year by promoting UR as part of the student experience in the department. They hook students on research in the classroom, then get them into UR, with one-on-one interactions and hands-on work. Additionally, Feng says that Wentzel won the Best Professor award, a student-nominated recognition, the first year it was established. This recognition is particularly notable for a professor in organic chemistry, which is often thought of as a notoriously challenging course.

### Science Communication Fellow

According to Matt Kahoe, a staff member with the Science Communication Fellows initiative, the program was conceived to support early career environmental scientists and—later—green chemists better communicate the importance of their work and findings to the general public. As a one of the first cohort of green chemists to be Science Communication Fellows, Wentzel learned how to talk to the broader public about the importance of his work. Rather than leading with their research, as they have learned to do

in academic settings, Science Communication Fellows learn instead to “start with the headline,” as Kahoe says: saying what they’ve done, why it matters, and what people should do as a result. Participants also learn to think in terms of having a professional brand. Along with his 2018-19 cohort, Wentzel learned how to speak with reporters about his research by working with theatre, marketing, and communications specialists. This fellowship helped him to expand his thinking beyond the campus and hyper-local concerns, preparing him to confidently appear on television. Kahoe says that Wentzel—as a “regular, fun-loving person” who “brings a lightness to serious things”—made a “massive contribution” to the success of his cohort because “this advances learning—when people relax.” Over the course of their time together in Washington, D. C., the group wrapped up the experience by communicating their “passionate purposes” clearly and effectively in TED-talk-like videos. Readers can view Wentzel’s final video at this link: [https://](https://www.youtube.com/watch?v=6siHH63utAA)

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Prior to the fellowship, Wentzel says that he had unconsciously absorbed the general attitude that many scientists hold: “It’s not my fault that you don’t understand my work.” By contrast, he’s now come to realize that it’s “actually terrifying” that scientists haven’t been able to communicate well with people outside of their fields. Drawing on his experiences as a Science Communication Fellow, Wentzel now has Darcey Engen from theater work with his students so that they also become better communicators of their own research. As he says, “Science communication is a big deal. Scientists have a responsibility to make their research accurate but also accessible.”

### Relationships

Wentzel says that his successes stem from working with others, and he notes that he has gotten many opportunities in his life simply because he is “not a jerk and [he’s] ok to hang out with.” He says that the skills of

being willing to strike up conversations and engage people are under-rated, particularly in the sciences. Contrary to this popular belief, however, Wentzel says that “smart people ask questions and surround themselves with smarter people.” Being at a small school can be isolating, but researchers need to talk about their ideas, thinking through them in conversation. He points out that students need these opportunities to talk through their work, as well, whether in person or via Zoom.

Wentzel’s leadership—in collaborating with others his field as well as with those in other disciplines, communicating the importance of his work to the general public, and in employing systems thinking as a tool for all of his work—offers an exceptional model for others to follow, within the sciences and beyond.



**ABOUT THE AUTHOR:** Dr. Cynthia Mwenja teaches Composition and Rhetoric at the University of Montevallo.



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