

2022 STATUS REPORT

GREEN CHEMISTRY COMMITMENT



GREEN
CHEMISTRY
COMMITMENT
beyondbenign.org



2022 STATUS REPORT



The [Green Chemistry Commitment \(GCC\)](#) is a framework to unite the green chemistry higher education community around a common vision to:

- Expand the community of green chemists
- Grow departmental resources
- Improve connections to job opportunities
- Affect systemic and lasting change in chemistry education

Institutions at the postsecondary level sign on to the GCC program, which is free to join, in order to pledge to bring these changes and achieve these goals within their institutions, all through the support of Beyond Benign and other GCC signers.

108 GCC Signers

as of 2022

in North America (84, 78%),
and International (24, 22%)

21 MSIs (19%)

10%

of graduating chemists
in USA come from GCC
signing institutions yearly

Why Sign the GCC?



access to a broad and supportive community of chemistry experts



a network dedicated to shifting how & what the next generation of chemists learn



a flexible framework for green chemistry curriculum and training



access to funding opportunities and projects



a benchmark to track progress on learning and research objectives

GREEN CHEMISTRY COMMITMENT STUDENT LEARNING OBJECTIVES

GCC signers agree that upon graduation, all chemistry majors should be proficient in the following:



THEORY

Have a working knowledge of the Twelve Principles of Green Chemistry.



TOXICOLOGY

Have an understanding of the principles of toxicology, the molecular mechanisms of how chemicals affect human health and the environment, and the resources to identify and assess molecular hazards.



LABRATORY SKILLS

Possess the ability to assess chemical products and processes and design greener alternatives when appropriate.



APPLICATION

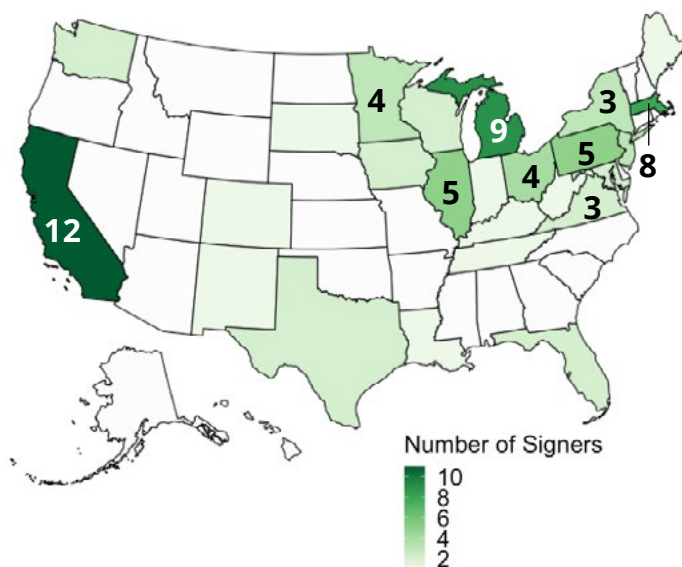
Be prepared to serve society in their professional capacity as scientists and professionals through the articulation, evaluation, and employment of methods and chemicals that are benign for human health and the environment.

Learn more about the GCC, including information about the 100+ signing institutions, [here](#).

2022 GREEN CHEMISTRY COMMITMENT SURVEY DATA

We asked our GCC signers a range of questions. The available response sample for the GCC Signer survey is 61 unique USA signer responses (62% of total GCC signers). The following data shows how they responded.

GCC Signers by State



81 GCC USA Signers | January 2023

California:

- University of California Berkeley
- College of the Canyons
- University of California Davis
- Las Positas College
- Loyola Marymount University
- University of California, San Diego
- Harvey Mudd College
- University of California, Santa Barbara
- Claremont McKenna College
- Pitzer College
- Scripps College
- California State University San Marcos

Colorado:

- University of Colorado, Colorado Springs

Florida:

- Florida Gulf Coast University
- Florida Southern College

Indiana:

- Rose-Hulman Institute of Technology

Iowa:

- Iowa Lakes Community College
- Buena Vista University

Illinois:

- Elmhurst College
- Millikin University
- North Park University
- Bradley University
- Monmouth College

Kentucky:

- Berea College

Louisiana:

- Dillard University
- Southern University & A&M

Massachusetts:

- Bridgewater State University
- Gordon College
- Northeastern University
- Simmons University
- Northern Essex Community College
- Salem State University
- Stonehill College
- Worcester State University

Maryland:

- Loyola University Maryland
- Washington College

2022 GREEN CHEMISTRY COMMITMENT SURVEY DATA

Maine:

- University of New England

Michigan:

- Grand Valley State University
- Michigan Technological University
- Lawrence Technological University
- Michigan State University
- Siena Heights University
- University of Detroit Mercy
- University of Michigan-Flint
- Wayne State University
- University of Michigan-Ann Arbor

Minnesota:

- Augsburg University
- Saint Catherine University
- University of Minnesota
- University of Minnesota Morris

New Jersey:

- Ramapo College of New Jersey
- Montclair State University
- Seton Hall University

New Mexico:

- Central New Mexico Community College

New York:

- Kingsborough Community College
- SUNY Fredonia
- Siena College
- Utica University

Ohio:

- Bluffton University
- University of Toledo
- Wittenberg University
- Wright State University

Pennsylvania:

- Drexel University
- Saint Francis University
- Penn State Shenango
- Widener University

- Wilkes University

South Dakota:

- South Dakota State University

Tennessee:

- Tennessee Tech University

Texas:

- Prairie View A&M University
- Texas A&M
- Texas Woman's University

Virginia:

- Eastern Mennonite University
- Randolph College
- Hampton University

Washington:

- Green River College
- Pacific Lutheran University

West Virginia:

- West Virginia State University

Wisconsin:

- Edgewood College
- University of Wisconsin-Whitewater

27 GCC International Signers | January 2023

Africa:

- First Technical University (Nigeria)
- Bingham University (Nigeria)
- Kabete National Polytechnic (Kenya)
- Rhodes University (South Africa)

Australia:

- Monash University
- Canada (North America)
- Ambrose University (Alberta)
- University of Toronto (Ontario)
- Vancouver Island University (Vancouver)

2022 GREEN CHEMISTRY COMMITMENT SURVEY DATA

Germany

- Technische Universität Berlin (TU Berlin)
- University of Wuppertal
- Universität Duisburg-Essen

India

- Dnyanprassarak Mandal's College and Research Centre
- R.V. College of Engineering (RVCE)

South America

- IFRJ – Campus Duque de Caxias (Brazil)
- São Paulo State University, UNESP (Brazil)
- Universidade de Brasília (Brazil)
- Universidad de la Costa (Columbia)
- Universidad Federal de Pelotas (Brazil)

- Univeridad EAN (Colombia)
- Universidade Federal de Goiás – UFG (Brazil)
- Universidade Federal do Mato Grosso do Sul – UFMS (Brazil)

Sweden

- Stockholm University

Thailand

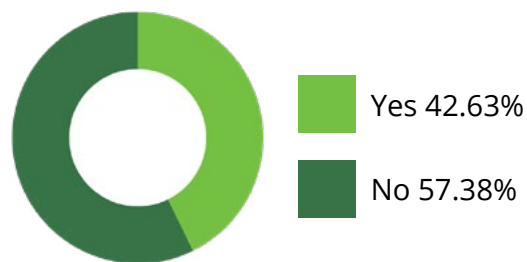
- Chulalongkorn University

United Kingdom

- Queen's University Belfast
- University of Bath
- University of Birmingham
- University of York

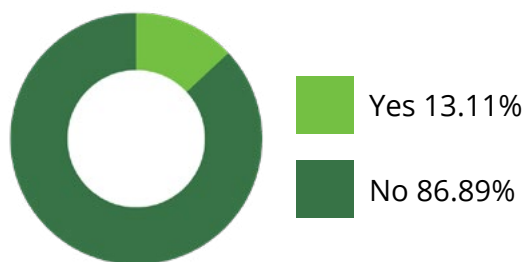
Standalone Course

Question: Do you have a standalone Green Chemistry course?



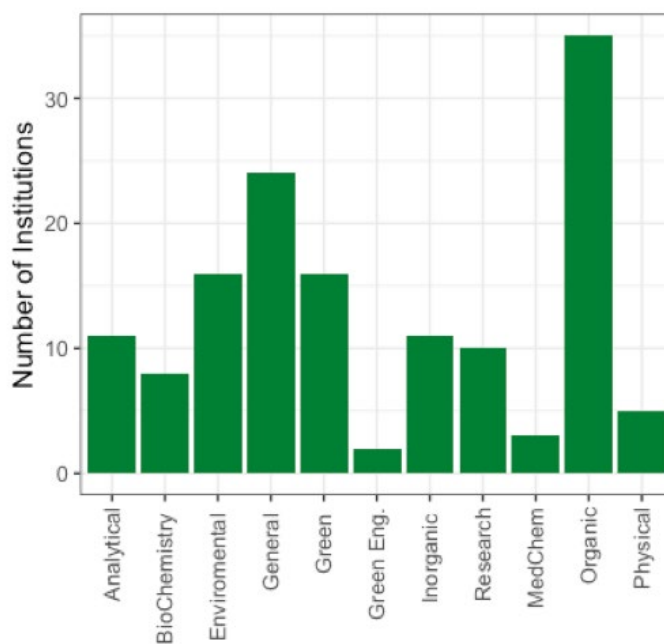
Standalone Program

Question: Do you have a standalone Green Chemistry program?



Courses Introducing Green Chemistry

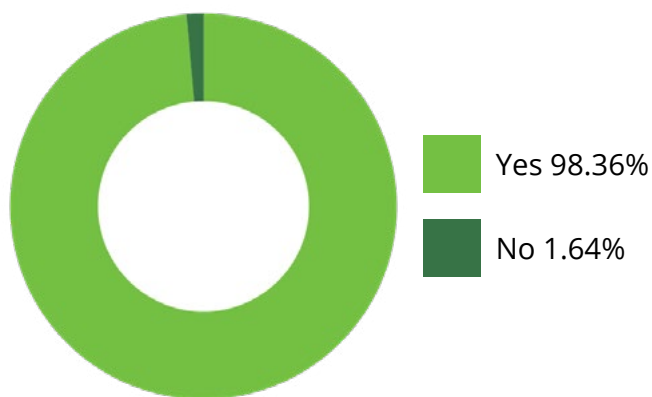
Question: What courses introduce Green Chemistry as a discussion point at your institution?



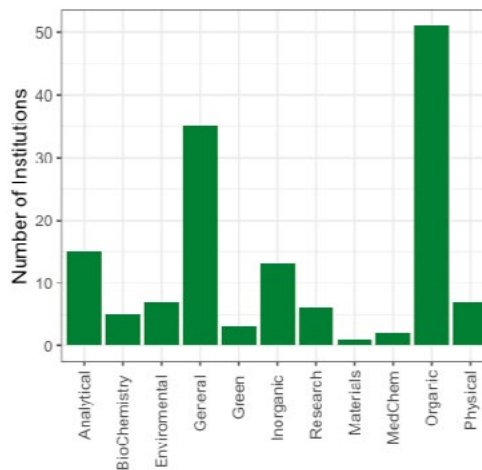
2022 GREEN CHEMISTRY COMMITMENT SURVEY DATA

Green Chemistry in the Teaching Laboratory

Question: Have Green Chemistry principles and practices been implemented in the teaching laboratory?

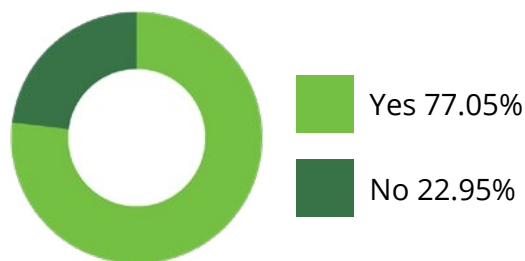


Question: What courses where Green Chemistry principles and practices have been implemented in the teaching laboratory?



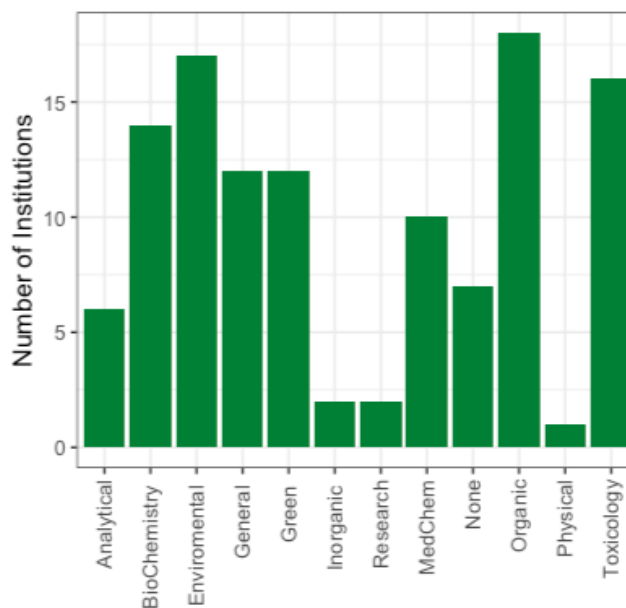
Green Chemistry in the Research Laboratory

Question: Are there any active research groups performing Green Chemistry in the lab?



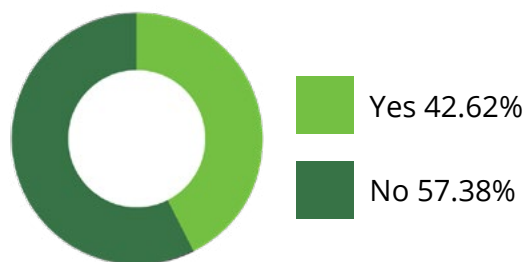
Courses Including Toxicology

Question: What courses where Toxicology has been used as a discussion point?



Standalone Toxicology Course

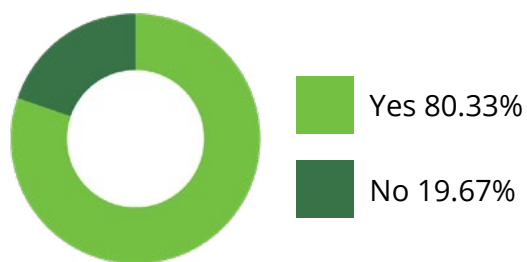
Question: Do you have a standalone toxicology course at your institution?



2022 GREEN CHEMISTRY COMMITMENT SURVEY DATA

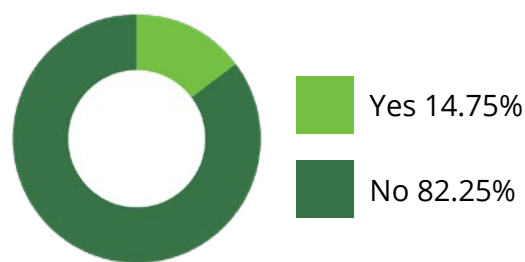
Related Courses

Question: Do you offer additional courses, seminars, or content within existing courses in Environmental Science, Sustainability, or other related subjects?



Green Chemistry Club

Question: Does your department have a Green Chemistry Student Club?



Community and K-12 Outreach

Question: Does your department organize or participate in community and/or K-12 outreach?



2022 GREEN CHEMISTRY COMMITMENT STORIES

Growing Community, Connections and Inspiration: A Q&A with Green Chemistry Commitment advocate Dr. Andrea Oseolorun

Dr. Andrea Oseolorun has seen the difference being part of a like-minded community can have for her career and her students. An Assistant Professor of Chemistry at Prairie View A&M University (PVAMU) in Prairie View, Texas, Dr. Oseolorun helped drive her department's signing of the Beyond Benign Green Chemistry Commitment (GCC).



The GCC provides a framework to unite the green chemistry higher education community around a common vision to expand the community of green chemists, grow departmental resources, improve connections to job opportunities, and affect systemic and lasting change in chemistry education. With support from Dow, Beyond Benign launched a GCC 25x25 initiative with a goal of ensuring that 25% of graduating U.S. chemists have a background in green chemistry by 2025. PVAMU recently signed onto the GCC, becoming the first HBCU (historically Black college and university) to do so.

Holding degrees in Chemistry and Environmental Toxicology, Dr. Oseolorun is the co-advisor to the PVAMU Chemistry Club and a Co-Chair for the Diversity, Equity, Belonging and Respect Subcommittee on Beyond Benign's Green Chemistry Teaching and Learning Community (GCTLC) Leadership Committee. In this Q&A, Dr. Oseolorun shares what being a member of the Green Chemistry Commitment community has



I've always envisioned creating an environmental chemistry course in my department, and the encouragement I've received from the GCC community has built my confidence to move forward with the project. I have found my feet and my voice.

- Dr. Andrea Ashley-Oyewole

meant for her professionally, as well as what it has offered her students, her department and the University.

HOW DID YOU FIRST LEARN ABOUT THE GREEN CHEMISTRY COMMITMENT?

PVAMU Chemistry heard about the GCC through an invitation to attend a meeting with Beyond Benign, Dow and the College of Engineering, which was held on our campus in the spring of 2020.

WHAT WAS THE PROCESS OF BECOMING PART OF THE GCC COMMUNITY LIKE FOR YOU?

Signing on to the GCC was easy for us. We had permission from our department head to complete the necessary documents and then it was forwarded to the Dean for final signatures. It all happened in a day.

WHAT HAS BEING PART OF THE GCC COMMUNITY DONE FOR YOU AS A FACULTY MEMBER?

As a scientist from an interdisciplinary background in a department filled with Ph.D. chemists, it has given me a voice and a way to show what I can offer to the academy. It has also allowed me to introduce my students to a subject that is of particular interest to me coming from an environmental science background.

ANY SPECIFIC OUTCOMES YOU CAN SHARE?

I've always envisioned creating an environmental chemistry course in my department, and the encouragement I've received from the GCC community has built my confidence to move forward with the project. I have found my feet and my voice, literally, and I am looking forward to bigger things because of the assistance from my colleagues in the GCC. I have experienced a genuine sense of belonging as a scientist that was not there before.

It's also helped me connect with new colleagues and students across the globe. I've met students in Berlin who are doing great work to advance green chemistry in the University. I have talked with colleagues in Canada and multiple states across the U.S., and I hope to work on research projects in the future.

HOW HAS BEING PART OF THE GCC COMMUNITY IMPACTED YOUR STUDENTS AND THEIR ABILITY TO PREPARE FOR CAREER COMPETITIVENESS?

My students have been very receptive to our green chemistry infusion topics, and my first-year courses also received B-Global designation to help students become more active and informed global citizens.

Students are excited to see how chemistry is applied to solving everyday problems, to explore tangible examples of environmental issues and how chemistry can solve these problems. One example is the overproduction of fast

fashion and the environmental problem with the disposal of that waste. That was obscure to students but after learning about it, they wanted to commit to recycling and reusing more products. Many were amazed by the carbon footprint of their daily lives and began thinking more about energy efficiency. Others began to understand sea level rise and greenhouse emissions as urgent problems to be solved. The end result is they are talking more about the issues and making connections to their chemistry coursework, as well. This will serve them in their future careers as they learn applications of science solving real global issues.

HOW HAS BEING PART OF THE GCC HELPED YOUR INSTITUTION?

Our Department has benefited a great deal. This work has given us avenues to expand in research and supported our efforts toward effective and relevant teaching. Recruitment efforts for new majors and graduate student research enquiries are increasing.

The University has the distinction of being the first HBCU to sign on to the GCC and I am very proud of that. The [Texas Defender regional newspaper published a story](#) on that achievement.

WHY DO YOU THINK OTHER INSTITUTIONS SHOULD JOIN THE GCC?

They would be giving their students access to priceless knowledge. They're also joining a community of like-minded individuals with a passion for teaching, and preparing global citizens and future scientists with the necessary skills to understand and solve globally relevant issues that affect all people.

WHAT ADVICE WOULD YOU GIVE ANOTHER FACULTY MEMBER ABOUT ADVOCATING FOR GREEN CHEMISTRY ON THEIR CAMPUS?

Start small with what is already available. Every effort, no matter how small, is relevant. Don't be afraid if you are the only one in the beginning. Also stay connected with the community by attending the monthly connections when possible, and reach out if you need help. The online community has a wealth of information and support is always just an email away.

Dr. Veronica Mengqi Zhang: Gaining Resources, Support & Opportunities Through the GCC Community



In the long run, being part of the GCC sends a signal to researchers and students who are interested in green chemistry that MSU values green chemistry. I was drawn to this position because of that.

- Dr. Veronica Mengqi Zhang



Dr. Veronica Mengqi Zhang joined Michigan State University (MSU) as the Organic Chemistry Laboratory Coordinator and has been working on implementing and refining the reformed laboratory curriculum towards cooperative learning and green chemistry. As a [Green Chemistry Commitment \(GCC\) signer](#), MSU has prioritized green chemistry education and knowledge sharing for several years.

In this Q&A, Dr. Zhang shares her story about being part of the GCC community.

HOW DID YOU FIRST LEARN ABOUT THE GREEN CHEMISTRY COMMITMENT?

My first encounter with green chemistry and the GCC was during my Biennial Conference on Chemical Education (BCCE) trip at Notre Dame in Indiana (2018). I attended a symposium held by Beyond Benign. I have been drawn to the concept and this community ever since.

WHAT WAS THE PROCESS OF BECOMING PART OF THE GCC COMMUNITY LIKE FOR YOU?

The MSU Chemistry Department signed the GCC in 2018, which was before I joined MSU.

The Chemistry Department is committed to implementing green chemistry in its courses, including lectures, seminars and labs. During my interview to become the organic lab coordinator at MSU, they welcomed me as a green chemist after describing prior green chemistry projects I had been involved in as a doctoral student. The transition to including green chemistry as the organic lab coordinator was natural, especially as the cooperative chemistry team at MSU had already laid a foundation of green chemistry in the organic labs.

WHAT HAS BEING PART OF THE GCC COMMUNITY DONE FOR YOU AS A FACULTY MEMBER?

Being a part of the GCC community allows me to keep up with the most up-to-date developments and breakthroughs in green chemistry in both academia and industries and share this information with approximately 1600 students every year.

Green chemistry is a relatively new but fast-growing field. I am very lucky to be in an institution where there is a vibrant cohort of chemists and researchers in green chemistry and especially Green Synthesis. Being part of the

GCC community, we were able to collaborate on multiple projects and make progress as a team.

ANY SPECIFIC OUTCOMES YOU CAN SHARE?

MSU has some great green chemistry programs for both graduate students and undergraduate students. The REU summer program focused on Cross-Disciplinary Training in Sustainable Chemistry and Chemical Processes. The Green Cooperative Organic Chemistry Laboratory and Green Chemistry Freshman Seminar aimed to provide students with in-person experience in green chemistry and even field trips to industries on related topics!

Being part of the IUSE team, we successfully implemented a reformed Green Cooperative Organic Chemistry Laboratory curriculum in the 2021 Fall semester and have been making great progress since then. In the 2022 Fall semester, we are incorporating a new Amide Synthesis project into the undergraduate instructional laboratory. The beta testing of this work was sponsored by Beyond Benign and DOW. I am very excited for this new project!

HOW HAS BEING PART OF THE GCC COMMUNITY IMPACTED YOUR STUDENTS AND THEIR ABILITY TO PREPARE FOR CAREER COMPETITIVENESS?

My students come from various backgrounds in STEM: Biology, Physiology, Zoology, Kinesiology, Physics, Chemistry, etc. Our curriculum features cooperative learning and green chemistry. We want students to work as a team and tackle real-life problems using crosscutting concepts and scientific practices. Being provided with a project scenario, students will need to conduct experiments like researchers, analyze experimental data, make decisions, and communicate their findings in various scientific formats, all of which will make them more competitive in future career opportunities.

Taking the Green Cooperative Laboratory course will hopefully plant a seed in their minds and help guide the direction for their professional development.

HOW HAS BEING PART OF THE GCC HELPED YOUR INSTITUTION?

Personally, I was very excited to share our curriculum reform (towards project-based lab and green chemistry) results from MSU with the Green Chemistry Community at Beyond Benign Symposiums in the past year! It's a great opportunity for connections as well.

In the long run, being part of the GCC sends a signal to researchers and students who are interested in green chemistry that MSU values green chemistry. I was drawn to this position because of that.

WHY DO YOU THINK OTHER INSTITUTIONS SHOULD JOIN THE GCC?

Resources. Being a part of GCC allows you to gain access to the systematic training in green chemistry, most recent development in curriculum reform towards green chemistry, and numerous connections/symposiums held every month.

Support. GCC is a great community for researchers and chemists who share common academic goals in green chemistry. Knowing that you are not alone on this path is important in the long run.

Opportunities. Interested in future collaborations? Join GCC!

WHAT ADVICE WOULD YOU GIVE ANOTHER FACULTY MEMBER ABOUT ADVOCATING FOR GREEN CHEMISTRY ON THEIR CAMPUS?

JUST DO IT! You are not alone. Never underestimate how many people you can impact.

WHAT DID YOU SHARE AT THE BCCE? WHAT WAS YOUR FAVORITE PART?

The topic of my presentation at BCCE 2022 was “Integrating Green Chemistry into the Organic Laboratory using Project-Based Experiments and Case Studies.” It was about the incorporation of the new amide project into the laboratory curriculum and how that echoes with the case study on the same topic.

BCCE conferences have always been my favorite national conferences. I absolutely appreciated the conversations with and feedback from the audience and green chemistry community.

WHAT HAS THE DOW GRANT ALLOWED YOU TO DO THAT YOU WOULD HAVE OTHERWISE NOT BEEN ABLE TO DO? WHAT IMPACT HAS IT HAD ON YOU AND YOUR STUDENTS?

The beta testing of the new Green Cooperative Organic Laboratory projects was sponsored by the DOW grant and Beyond Benign. There would not be a new lab project without the DOW grant!

I also want to give credit to the three brilliant MSU undergraduate students I was fortunate to work with on the beta-testing process: Brennan Baldwin, Lillian Centlivre and Morgan Maclean. It is their hard work that led to the success of the test.

Seeding Inspiration and Action for a Sustainable Future through Green Chemistry Higher Education with Cintia Milagre

Education is central to creating lasting change in any movement. Through green chemistry education, we can catalyze technological innovations that result in less hazardous materials, products and processes in support of a sustainable, healthy society.



By offering access to a broad and supportive community of chemistry experts and a flexible framework for green chemistry curriculum and training, Beyond Benign’s Green Chemistry Commitment (GCC) is helping transform chemistry education in college and university chemistry departments.

Cintia Milagre is Assistant Professor at the [Institute of Chemistry at University Estadual Paulista in Brazil](#), a GCC signer. Cintia believes finding sustainable solutions should be a commitment we all make to the planet we call home, and she advocates for sustainability both within the university and in her community.

In this Q&A, Cintia speaks with Beyond Benign about the importance of green chemistry in education and the GCC, and shares some of the impacts she’s seen this critical work have on students.

WHY DOES THE INSTITUTE OF CHEMISTRY AT UNESP BELIEVE TEACHING STUDENTS GREEN CHEMISTRY PRINCIPLES IS IMPORTANT?

Training the new generation of chemists to be aware of their socio-environmental role with the planet is paramount. When we teach the principles of green chemistry to students in the

“Education is the most efficient way to build a sustainable planet. By signing the GCC, we can move faster because more people (professors, staff, technicians, employees, students) are involved and committed to making the chemistry developed and carried out in our institute greener.

- Cintia Milagre

early years and this knowledge is consolidated over the following years, we provide them the means and tools necessary to reinvent chemistry to meet sustainable development demands.

CAN YOU SHARE SOME OF THE WAYS YOU'VE SEEN GREEN CHEMISTRY IMPACT STUDENTS' EDUCATIONAL EXPERIENCES AND CONNECTION TO CHEMISTRY?

In 2021, Professor Humberto Milagre and I taught the course "Sustainable Chemistry," where we addressed the principles of green chemistry, and the relationship between chemistry and the United Nations Sustainable Development Goals (SDGs).

At the end of the course, the students were divided into small groups to present a project in which one or more principles of green chemistry could be used in the chemist routine. This experience was fantastic. We had projects that addressed greener chemical processes and reactions, projects involving experiments for undergraduate chemistry labs, and projects centered on outreach activities. Some projects focused on important incremental innovations, while others were more audacious.

During the project presentations, the discussions were vibrant. The class came up with suggestions on implementing green chemistry practices in their routine, ways to circumvent the challenges, and strategies to convince the most resistant people that green chemistry is viable.

HOW DID YOU SEE THIS EXPERIENCE TRANSLATE BEYOND THE CLASSROOM?

Some students reported that they were already putting the teachings into practice in their work environments. One of the students, an intern at a chemical company, said that she presented the principles of green chemistry and proposals to implement some specific changes in the project she was working on in one of her team meetings,

and that the team started to discuss how to make such changes feasible. Another student is considering organizing a new student chapter at the Institute of Chemistry, whose pillar will be Sustainable Chemistry.

HOW DO THOSE STUDENT EXPERIENCES GO ON TO IMPACT THEIR FUTURE CAREERS AND THE WORLD?

In addition to the excitement of all students with the green chemistry topic, we had students from the previous year planning to execute their course projects in "real life" at the beginning of 2022.

These students develop critical thinking skills on the topic of green chemistry, and the feedback from the students is very positive. I'm sure all of them are now committed to spreading and adopting the precepts of green chemistry in their daily choices.

WHY DID THE INSTITUTE OF CHEMISTRY – UNESP SIGN THE GCC? HOW DO YOU SEE COLLABORATION WITH OTHER GCC SIGNERS IMPACTING YOUR WORK?

The [Institute of Chemistry – UNESP](#) has always been at the forefront of this area, and therefore it was natural for us to be a GCC signer. We believe it is not enough to train competent professionals with the necessary technical skills for this profession. It is also essential to train professionals aware of their socio-environmental responsibilities and provide the required means to act in their field of activity.

Education is the most efficient way to build a sustainable planet. By signing the GCC, we can move faster because more people (professors, staff, technicians, employees, students) are involved and committed to making the chemistry developed and carried out in our institute greener. For example, we included a discipline that deals with green chemistry in

the mandatory curriculum for the first-year students—exchanges of experience with other GCC signers helped in this process.

The Green Chemistry Commitment is currently accepting new signers. The GCC is voluntary, flexible and progressive — in other words, departments do not have to be perfect in green chemistry implementation to sign up, they only need to commit to continual improvement.

[Learn more about the program and how to become a signer here.](#)

