



Washington College

What do students really want to know? — Washington College has developed a unique and fluid curriculum that changes and adapts to students' interests. Professors Anne Marteel-Parrish and Aaron Amick seek to train chemistry students in ways that are important and impactful to them. From *"Art in the Anthropocene"* to *"Science Policy"*, green chemistry is taught in interdisciplinary courses within the Department of Chemistry at Washington College so that upon graduation, students will enter the work force with diverse knowledge and practice in green chemistry and aware of fulfilling career paths in this field.

Anne Marteel-Parrish has been teaching the Green Chemistry course at Washington College for 15 years. At its inception in 2005, it was one of only 12 Green Chemistry courses taught in the US. Since then, it has been continuously revised and improved with feedback from the student body. Partnering with Aaron Amick, Green Chemistry principles were shared with students in General and Organic Chemistry laboratories. Now, the Green Chemistry principles are the driving force in the laboratory component of the "Chemistry of the Elements" course which has replaced the foundational and traditional Inorganic Chemistry course. Today, all chemistry labs at Washington College are 100% paperless. Looking to provide students with unique educational experiences outside of the natural sciences, Anne co-teaches a cross-disciplinary course "Art in the Anthropocene: Greener Art through Greener Chemistry" with Heather Harvey in the Art and Art History Department at Washington College. Anne is also a founding member of the Green Chemistry Commitment Advisory Board at Beyond Benign.

Washington College is devoted to community outreach. All interested chemistry students regularly teach and help children K-12 with experiments, using the Beyond Benign website for content and ideas. Participation in outreach events is an essential component of the implementation of green chemistry in the curriculum. Experiments that feature green chemistry principles, such as making art with paints derived from fruits, vegetables, and spices are especially interesting to young students. Building and nurturing relationships with teachers in the community is important for the success of outreach programs.

To departments looking to sign the GCC and improve their green chemistry education and outreach efforts, Anne says "Start small. Perform slow and incremental changes to the curriculum and get constant feedback and input from students." Aaron adds "Go for it. You don't know what is going to happen, but just start."

Why does the Washington College participate in the Green Chemistry Commitment?

Community engagement is an essential skill for chemistry students

Both faculty and students believe that the promotion of green chemistry principles is important and should be an integral component of a chemistry education. Students teach younger students about green chemistry and in so doing, they solidify their own understanding of and passion for the subject. Beyond Benign provides essential content for success in this area and signing onto the GCC is another step towards promoting incorporation of green chemistry into the general community.

A resource for other institutions looking to teach green chemistry

Many faculty and departments are interested in implementing greener practices in their teaching, service and research. The Commitment provides a resource for faculty and departments who are looking to adopt green chemistry principles and practice. The Commitment helps to connect them with likeminded institutions that are currently implementing green chemistry. This can be an invaluable resource for institutions who are new to the field and who are beginning to engage faculty and administrators.



What is Green Chemistry?

Green chemistry is the design of chemical products and processes that reduce and/or eliminate the use or generation of hazardous substances. This approach requires an open and interdisciplinary view of material and product design, applying the principle that it is better to consider waste and hazard prevention options during the design and development phase, rather than disposing, treating and handling waste and hazardous chemicals after a process or material has been developed.

The **Green Chemistry Commitment (GCC)** is helping to *transform chemistry education* in college and university chemistry departments that strive to:

- prepare world class chemists whose skills are well aligned with the needs of the planet and its inhabitants in the 21st century, and
- design and develop innovative, efficient, and environmentally sound solutions to the safety and effectiveness of chemical products and processes.

The Green Chemistry Commitment offers access to a broad and supportive community of chemistry experts and a flexible framework for green chemistry curriculum and training. With multiple pathways to the implementation of green chemistry education, the Green Chemistry Commitment sets a benchmark to track progress on specific learning and research objectives.

With the GCC, college and university faculty can band together to share resources and experience to shift how and what the next generation of chemists learn. Students will enter the workforce armed with the necessary skills, knowledge, and confidence to be leaders in making the principles of green chemistry standard practice in all fields and sub-disciplines of chemistry.

Why introduce the Green Chemistry Commitment?

During the last 15 years, individual teachers, professors, and chemistry departments have introduced green chemistry concepts into lectures and lab activities, outreach initiatives, and some have even used green chemistry as the basis for academic research projects. The Green Chemistry Commitment seeks to build on the efforts of leaders in the field and systematically change chemistry education. The Green Chemistry Commitment aims to facilitate and support the development of a consortium program that unites the green chemistry community around shared goals and a common vision to:

- expand the community of green chemists
- grow departmental resources
- improve connections to industry and job opportunities in green chemistry
- affect systematic and lasting change in chemistry education

“Exposing K-12 students to green chemistry principles is the key to a sustainable future. Practicing green chemistry then becomes an inherent way of living for all generations.”

Quote from Anne Marteel-Parrish

“Integration of green chemistry concepts into the chemistry curriculum challenges our students to make these practices common place in the chemical laboratory. Additionally, the implementation of green chemistry practices saves both the environment and departmental resources.”

Quote from Aaron Amick

“The goal of Green Chemistry is for the term to disappear and it simply becomes how we practice chemistry.”

John C. Warner Co-author of “Green Chemistry: Theory and Practice” and Founder of the Warner Babcock Institute for Green Chemistry

Who is part of the Green Chemistry Commitment?

Colleges, universities, and industry leaders from around the world have signed the Green Chemistry Commitment for access to shared up-to-date resources, collaborative discussions and projects, improved curriculum, and accountability to track progress on specific learning and research goals.

The Green Chemistry Commitment is shaped and led by a Faculty Advisory Board comprised of faculty members of chemistry departments from across the United States, representing large and small academic institutions.

The supporting organization for the Green Chemistry Commitment is Beyond Benign (www.beyondbenign.org), a non-profit organization dedicated to providing future and current scientists, educators and citizens with the tools to teach and learn about green chemistry in order to create a sustainable future.

Beyond Benign’s vision is to revolutionize the way chemistry is taught to better prepare students to engage with their world while connecting chemistry, human health, and the environment. Beyond Benign is led by Dr. John Warner, a founder of the field of green chemistry and co-author of *Green Chemistry: Theory and Practice*, and Dr. Amy Cannon, the world’s first PhD in green chemistry.