

2021 ANNUAL IMPACT REPORT



Green Chemistry
Teaching and Learning
Community

A joint initiative by



beyondbenign
green chemistry education



ACS Green Chemistry Institute
Chemistry for Life®

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A MESSAGE FROM THE PROJECT TEAM

Over the many years that we have collectively been working in the green chemistry education space, one of the things that never ceases to amaze us is the whole-hearted dedication, love and commitment that this community puts into the work they do, day in and day out. Every meeting is bursting with excitement and energy, with ideas and dreams about how we can make teaching, learning and the world better. No small positive change goes unnoticed and participation is always encouraged, whether you're new to the community or a seasoned green chemistry expert. It goes without saying that people who do green chemistry in education want to make the world a better place, to build a more sustainable world through chemistry, and they constantly push the envelope to make it happen. They care deeply and passionately about their students, and about the people impacted by the chemical industry (whether positively or negatively). This has been, and continues to be, our constant source of inspiration, and we couldn't imagine a more exciting, supportive or thriving community to be a part of than this one.

We believe that greater widespread change in education is coming. To address global issues like climate change and a large-scale vision like the United Nations Sustainable Development Goals, the world needs chemistry, and in particular green chemistry. And there is no better way to get there than through education. To all of the teachers, students, and sustainability leaders out there, our simple message is this: This platform will be for you, for all the reasons above and more.

On behalf of Beyond Benign, the American Chemical Society (ACS) Green Chemistry Institute, our Leadership Committee, our founding and ongoing sponsors, and all of the partners and stakeholders who work day in and day out to help support this program, we look forward to welcoming each and every one of you to the new Green Chemistry Teaching and Learning Community (GCTLC).

We are excited to explore with you all the possibilities of what this online community can do, and we can't wait to get started.

- Amy, Jenny and Jonathon



2021 OVERVIEW + LOOKING AHEAD

In 2021, the GCTLC project team and Leadership Committee built the strong foundation needed to achieve critical development goals in the coming year and be ready to launch the platform in 2023.

Here is a brief overview of our most important achievements last year:

- **Created a diverse project team:** Developing a platform such as the GCTLC requires a cross-disciplinary administrative team, being led by Beyond Benign and the American Chemical Society Green Chemistry Institute. Program Manager Dr. Jonathon Moir joined the team early in 2021 and helped spearhead the work of our Leadership Committee—a diverse group of advisors at the heart of our work, composed of 20 members representing a variety of educational sectors, backgrounds and geographies. [Read more about the team.](#)
- **Identified the program’s mission, vision, and core values:** Together the development team workshopped the GCTLC’s vision, mission, and core values. The platform will aim to develop and nurture a diverse and accessible online community of practice that fosters a strong sense of belonging and supports open collaboration, mentorship, and resource-sharing. Through this work, the team aims to center values such as equity, diversity, integrity, excellence, and more. [Learn more about these fundamental statements and values.](#)
- **Created a timeline for execution to launch:** The development team worked to create a timeline for launch, spanning research and strategic planning in 2021, through platform launch in 2023, and on to expansion of the community and ongoing support and interaction through 2025 and beyond. [See the full timeline.](#)

- **Selected a platform developer:** Critical to the success of the GCTLC is an easy-to-use, interactive platform to house a library of educational resources; enable open conversations, collaborations, and feedback; facilitate networking and peer-to-peer mentoring; and more. In 2021, the project team interviewed more than 20 external stakeholders to help identify the needs and desires that would make this platform indispensable to the green chemistry community. Then they scoped potential technology solutions and identified a partner to lead the platform development throughout the coming year. [Learn more about our platform development.](#)

To learn more about the GCTLC and receive regular updates about the program's activities and progress, sign up for our newsletter [here](#).

The GCTLC program is looking for partners and sponsors to help build and grow the community and platform. If you are interested in sponsorship or partnership opportunities, please reach out to:

- Dr. Amy Cannon (amy_cannon@beyondbenign.org),
- Dr. Jonathon Moir (jonathon_moir@beyondbenign.org), or
- Nicki Wiggins (nicki_wiggins@beyondbenign.org)

for more information.

EXECUTIVE SUMMARY

The Green Chemistry Teaching and Learning Community (GCTLC) is a virtual online community space set to launch in 2023 that will help transform chemistry education programs across the U.S. and the world. A joint initiative by Beyond Benign and the American Chemical Society (ACS) Green Chemistry Institute, the GCTLC will host a clearinghouse of peer-reviewed, open-source green chemistry education materials (including greener lab experiments, lecture slides, in-class activities, and more) that will be available through a searchable online digital library. The GCTLC will also host online spaces for collaboration, networking, mentorship, and peer-to-peer learning for educators (including K-12 teachers and university and college faculty instructors), students, and industry stakeholders. Additional features will include discussion forums, groups dedicated to relevant contemporary topics in green chemistry education, event listings of upcoming conferences and webinars, job boards and opportunities for students with an interest in green and sustainable chemistry careers, and more.

Since first receiving a generous round of seed funding from The Argosy Foundation in December 2020 as well as additional support from BASF and the Washington State Department of Ecology, the GCTLC program has been ramping up for IT development in 2022 and eventual launch in 2023. Through engagement with a Leadership Committee composed of green chemistry education experts across sectors, the team has been hard at work building the foundations for what will be a critical piece of infrastructure for chemistry educators looking to impart green and sustainable chemistry knowledge and skills on to their students. Ultimately those students will be able to take those skills with them into the workforce and create positive change as future global leaders and innovators.

This report provides a summary of the program's activities in 2021 that have been crucial for setting up the program for a successful technical build-out. The program is off to a phenomenal start thanks to a bold, creative and dedicated team, an engaged community of leaders, a strong mission and vision, and dedicated funders. We are excited to share the results so far and we look forward to an exciting year ahead building out the platform and connecting with the community at (in-person) conferences and virtual events in 2022.

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WHAT IS GREEN CHEMISTRY?

Green chemistry is defined as “the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products.” It is framed by the **Twelve Principles of Green Chemistry**, which serve as a guiding framework under which chemists can design more sustainable and less hazardous chemicals and chemical products. Through the application of green chemistry, scientists and innovators can prevent the generation of pollutants and toxic compounds, rather than mitigating hazards and pollution after-the-fact. In that way, green chemistry is an upstream, preventative and solutions-oriented approach to creating a more sustainable and healthy future. However, in order for that future to manifest, green chemistry must be taught holistically in schools and science programs to help students gain effective skills for tackling sustainability challenges throughout their lives and careers.

THE GCTLC'S ORIGIN STORY

Since its founding in 2007, Beyond Benign has worked closely with the chemistry education community, gathering a tremendous amount of detailed feedback concerning the barriers that continue to exist in adopting green chemistry in classes and instructional labs across the U.S. and globally. Examples include overcrowded or full curricula, lack of textbooks and lecture materials, issues identifying relevant topics, and difficulty staying current on technical knowledge. These challenges consistently come up in a variety of settings (from K-12 through to Higher Education), and were highlighted in a 2015 survey of chemistry educators in the U.S.¹ These challenges must be addressed in order for students to build the skills needed to effect systemic societal change.

In 2019, Beyond Benign facilitated focus groups to understand important drivers in green chemistry education, and to see how Beyond Benign's

¹ MacKellar, J.J. et al. Toward a Green and Sustainable Chemistry Education Road Map. *J. Chem. Educ.* 2020, 97, 2104-2113. <https://pubs.acs.org/doi/abs/10.1021/acs.jchemed.0c00288>.

programs could help address these barriers. Some of the critical feedback included the following needs:

- To convene academia/educators and industry.
- A scaffolded curriculum that connects across levels.
- A centralized, open education resource (OER) system developed by faculty and students.
- Facilitation of connections and collaboration (such as with environmental health and safety (EH&S) groups).
- Peer support, mentorship, and opportunities to bring together monthly working groups.
- Enhanced promotion of green chemistry work and activities.
- Greater access to employment opportunities for graduates (such as paid internships and learning certificates).

Beyond Benign and the ACS Green Chemistry Institute joined forces to address these challenges and to catalyze the adoption of green chemistry in teaching and practice with the aim of creating systemic change in chemistry education. The two organizations explored one of the most effective methods for creating change in education across a geographically distributed population: a Community of Transformation (CoT)². CoTs consist of groups of individuals that share a common philosophy and who embody that philosophy in their day-to-day work. They form a delocalized network of peers who can support each other in making change, allowing member-to-member mentorship and guidance through a community that is dedicated to transforming the way they think about and practice education.

Features that will be included on the GCTLC platform



Forums &
Discussion Tools



Collaboration &
Mentoring



Open-Access
Resource Hub



Connections to Green
Chemistry Professionals



Job Board & Industry
Connections

2 Kezar, A.; Gehrke, S.; Bernstein-Sierra, S. Communities of Transformation: Creating Changes to Deeply Entrenched Issues. *J. High. Educ.* 2018, 89 (6), 832–864. <https://doi.org/10.1080/00221546.2018.1441108>.

The GCTLC will provide a central online space for the green chemistry education CoT to thrive, where educators and teachers can share best practices and resources, connect and collaborate, receive mentorship and feedback, and participate in peer-to-peer learning. For more on this, please see Beyond Benign's Executive Director and Co-Founder [Amy Cannon's talk on the GCTLC and Communities of Transformation](#), available on YouTube.

BUILDING A PROGRAM TEAM

Internal Project Staff

Developing an online platform such as the GCTLC requires a dedicated and cross-disciplinary team on the administrative side, which is being led by Beyond Benign and the ACS Green Chemistry Institute.

With that in mind, Beyond Benign brought on a new Program Manager—Dr. Jonathon Moir—in March 2021 to lead the GCTLC's planning, development, launch and growth. Dr. Moir began quickly working to understand the needs of the program and the community, connecting with stakeholders across education and industry, and scoping potential technology vendors and solutions for the platform.

With the addition of Dr. Moir as the project lead, the GCTLC is being spearheaded by the following team of individuals:

Beyond Benign

- Dr. Jonathon Moir, Program Manager
- Dr. Amy Cannon, Executive Director
- Nicki Wiggins, Director of Development and Strategic Partnerships

ACS Green Chemistry Institute

- Christiana Briddell, Senior Communications Manager

The project team is responsible for planning and strategizing GCTLC activities, working out timelines and deliverables, reflecting on connections with and feedback from other stakeholders, consulting with experts, and providing general administrative oversight of the program.

The team would like to especially acknowledge the immense work and dedication of Jennifer (Jenny) MacKellar, who was previously the Senior Portfolio Manager of Education Programs at the ACS Green Chemistry Institute but has since moved on to a new role with the Green Chemistry & Commerce Council (GC3). The program would not be where it is now without her dedication, hard work, insight and support. The team is thrilled that she will be continuing with the GCTLC program as an advisor through her membership on the GCTLC Leadership Committee.

The GCTLC Leadership Committee:

The Heart and Soul of the Program

The Leadership Committee for the GCTLC was founded in early January 2021 and has been a cornerstone for supporting the planning and groundwork of the GCTLC. The committee includes 20 members from various areas in education (postsecondary learning, K-12, industry, and information management) and from diverse backgrounds and geographies (15 U.S., 2 Canada, 1 UK, 1 Brazil/Germany).



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The Leadership Committee works as a full group to discuss big-picture ideas and technical/functional needs. They also work through subcommittees focused on specific strategic actions for the platform, namely:

1. Developing, distributing, and sharing accessible, high-quality green chemistry education resources.

- Understanding and developing submission and review criteria for open education resources (OER).
- Recommending best practices in management of an online, searchable digital library.
- Exploring trends in green chemistry education, opportunities for new resource development, and curated content.

2. Creating opportunities for open collaboration, networking, and mentorship.

- Building a recommended framework for user profiles, group structures, and collaborative spaces on the platform.
- Understanding the needs of chemistry educators in online spaces and how to best engage and connect them through the platform.
- Exploring ways to facilitate mentorship and peer-to-peer learning.

3. Driving awareness and adoption of green chemistry.

- Exploring professional development opportunities for educators to advance their knowledge and practice of (and leadership in) green chemistry education.
- Understanding how to optimize group learning to drive awareness.
- Connecting with other communities, sectors, and disciplines to broaden the reach and impact of green chemistry through education.

Diversity, Equity, Belonging and Respect (DEBR) Subcommittee

A fourth subcommittee with members spanning all three of the other groups was created to help better understand **Diversity, Equity, Belonging and Respect (DEBR)** within the community and on the GCTLC platform. The DEBR subcommittee is a critical part of the foundation of the platform, which all team members agree must be at the core of the platform's build out.

MOVING FORWARD: STRATEGIC PLANNING AND SCOPING

Mission, Vision and Core Values

In 2021, the leadership committee workshopped the GCTLC mission and vision statements as well as the core values that would help define the platform and guide its programming and functionality. They identified the following guiding principles:

Mission

To create, develop, and nurture a diverse and accessible online community of practice that fosters a strong sense of belonging and supports open collaboration, networking, mentorship, and resource sharing between members of the scientific community to advance the integration of green and sustainable chemistry principles and practices across the education continuum.

Vision

A teaching and learning community that empowers responsible global citizens with green chemistry knowledge, skills, and tools to transform science education, address grand challenges, and ensure a sustainable future for all.

Core Values

Creating a **respectful online community** that fosters a strong sense of **belonging and inclusivity**.

Ensuring **transparency** and **integrity** across GCTLC development and operation.

Maintaining high standards of **excellence** and **quality**.



Delivering **equitable access** to resources that help **create positive change** in education.

Fostering **innovation, discovery,** and **creativity** through **collaboration**.

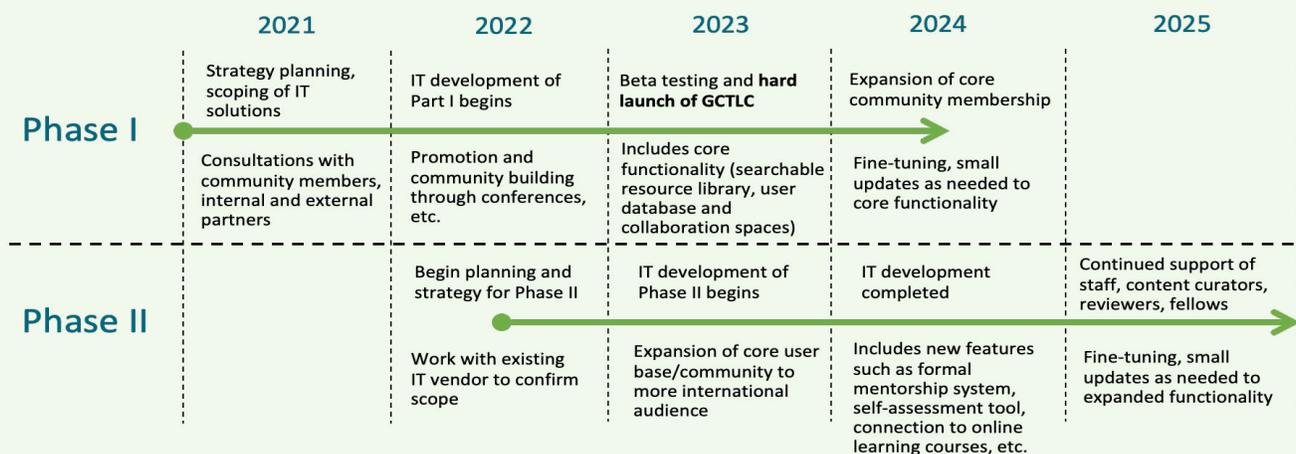
Based on this work and on a preliminary theory of change developed by GCTLC project team members in 2020, a draft strategic plan was developed in June 2021. This draft is now being updated based on additional consultations with the Leadership Committee and shifting priorities to align with a more international and engaged community.

In addition to the above, the project team is aware of the need to develop a unifying philosophy for the community, which is a critical part of Communities of Transformation (CoTs) and their ability to create reform in Science, Technology, Engineering and Mathematics (STEM) education.³ This philosophy will be refined in the coming months by the GCTLC Leadership Committee and external experts.

Timeline for Development

After extensive scoping work and consultations, it was determined that the GCTLC will benefit from a phased development approach, as shown in the timeline below. The first phase—built out by the site developer—will culminate in the launch of the platform with a foundational structure and functionality (including a searchable library of resources, collaboration and networking tools, job boards, discussion forums, and content moderators). The second phase of the development is anticipated to begin in mid to late 2023 or later and will bring online additional functionality and upgrades (examples could include mentorship tools, self-assessment tools, connections to learning management systems, etc.).

3 Kezar, A.; Gehrke, S.; Bernstein-Sierra, S. Communities of Transformation: Creating Changes to Deeply Entrenched Issues. *J. High. Educ.* 2018, 89 (6), 832–864. <https://doi.org/10.1080/00221546.2018.1441108>.



Developing the Platform and Consulting with Experts

To better understand how to approach the strategy, development, launch, and long-term maintenance and growth of the platform, the project team met with **21 external organizations and stakeholder groups** over the course of 2021, including collaborators, other not-for-profits, existing online Communities of Practice, individual experts, technology vendors, and more. The goal was to gather information about best practices related to online community building and resource sharing/distribution. A few of these collaborators include:

- North American Association for Environmental Education (NAAEE)
- Virtual Inorganic Pedagogical Electronic Resource (VIPeR)
- Organic Chemistry Educational Resources (OrganicERs)
- Association for the Advancement of Sustainability in Higher Education (AASHE)
- CourseSource (open access journal of peer-reviewed teaching resources)
- PlantingScience
- BioQUEST Curriculum Consortium

Based on recommendations from the organizations above, along with extensive interviews with prospective technology partners, the project team identified [Skvare](#) (pronounced “square”) as the platform development technology partner.

Based in the U.S., Skvare will be able to scale with the development of the GCTLC as it grows to meet the needs of an international community of green chemistry educators and community members across the world. Development work began in March 2022, with an anticipated timeline of 12-16 months to the full launch in 2023.

Communication, Outreach and Branding

As part of the Strategic Planning process for the GCTLC in 2021, **a basic communications strategy was developed** and is currently being updated and expanded in collaboration with an external branding and marketing consultant (Bark Media). More details will be forthcoming, but the broad overarching focus for the first three years of the program is outlined below:

Year 1 (2021)

Plan and Build

- Primarily targeted communications and engagement with specific core stakeholder groups and partners
- Fostering community through virtual interactions
- Spreading the word about the GCTLC groundwork and ramp-up through internal and external channels

Year 2 (2022)

Develop

- Increasing external promotion and building momentum
- Continuing to engage with stakeholders, focus groups and partners
- Spreading the word about the upcoming launch through internal and external channels
- Expanding understanding of audiences types and needs to strengthen development

Year 3 (2023)

Launch

- Hard launch of site promoted heavily (including through press release)
- Engaging groups actively through the site and building an online community within the platform
- Focusing specific outreach towards targeted communities and sectors
- Expanding engagement to international and broader audience bases

Critical to these efforts is a need to reach out and engage with diverse communities of users, educators, students and industry stakeholders, including community members from institutions across the U.S. and globally who are traditionally underrepresented in STEM fields. This will be a central focus for the project team and Leadership Committee over the next few years.

In addition, both Beyond Benign and the ACS Green Chemistry Institute launched informational websites in 2021 to provide updates on the GCTLC as it continues to be developed and built out. They are available below:

- [Beyond Benign Online Community site](#)
- [ACS Green Chemistry Institute Teaching and Learning Community site](#)

Beyond Benign regularly sends out updates about the GCTLC through its regular monthly newsletters. For more information and to sign up, please click [here](#).

NEXT STEPS FOR 2022

As we begin the next phase in the GCTLC program, we are excited to focus on critical phases of program development, including the following:

Beginning IT Development in March 2022

Beyond Benign and the ACS Green Chemistry Institute are working closely with Skvare to initiate the discovery, design and development of the online platform. The Leadership Committee and select educators, industry leaders and consultants will play a pivotal role in helping to guide the design and functionality of the platform. Beta testing of the platform will take place throughout the process, but is anticipated to ramp up at the end of 2022 through early 2023.

Outreach and Building Further Momentum

Beyond Benign has partnered with Bark Media to design and execute a communications plan for the GCTLC. Key priorities include fostering strategic partnerships, virtual networking, and promotion through online and in-person presentations at conferences and events throughout the summer and fall. This will include the 2022 ACS Green Chemistry & Engineering Conference in June, the Biennial Conference on Chemical Education in early August, the ACS Fall Conference in late August, and more. More information will be communicated through Beyond Benign and the ACS Green Chemistry Institute's newsletters, social media posts, and websites.

Leadership Committee

The subcommittees of the Leadership Committee will also be hard at work over the next year laying the groundwork for the new GCTLC platform. This will include finalizing recommendations for resource submission and review criteria for the online digital library, assessing the needs of various audience types, recommending peer learning and mentorship as well as professional development opportunities and functionality for GCTLC users,

and advising on best practices related to DEBR in online communities of practice.

With the above work already underway, we anticipate an exciting and busy year continuing the development of this much needed and highly anticipated platform. We look forward to all the wonderful things to come and will continue to provide regular updates as the project progresses.

THANK YOU TO OUR FOUNDING SPONSORS



Beyond Benign and the ACS Green Chemistry Institute were thrilled to have received significant support in seed funding from [The Argosy Foundation](#) to help launch the GCTL platform. The Argosy Foundation is a private family foundation based in the U.S. that was founded in 1997 by John Abele (co-founder of Boston Scientific). The foundation's mission is to support people and programs that make society a better place. Support from The Argosy Foundation has been critical to helping the project team and the GCTL Leadership Committee ramp up program activities in the first year. The support will also fund a significant portion of the technical development of the platform in 2022 and has helped to leverage additional grant proposals and requests for funding from other organizations.

In addition, the project team is extremely grateful to the Washington State Department of Ecology and to BASF for their one-time sponsorships of the GCTL program. Their generous support will also go toward supporting staff and Leadership Committee work as well as the technical build-out of the platform in 2022.

CALL FOR PARTNERS AND FOUNDING SPONSORS

COMMUNITY AND EDUCATION PARTNERS

The GCTLC is intended to be a tool by the community, for the community. As such, the program welcomes collaborations with individuals and organizations from all areas of green chemistry, sustainability, and chemistry and STEM education who want to make the world a better place through science and in particular sustainable practices in chemistry. If you are interested in partnering with the GCTLC program, please get in touch with Dr. Jonathon Moir (jonathon_moir@beyondbenign.org).

SPONSORSHIPS

Your sponsorship of the GCTLC platform helps indicate your organization's commitment to sustainability. Our goal is to launch the GCTLC with 20 sponsors to showcase the entire industry's commitment to a healthy future. To learn more about sponsorship opportunities, including Founding Sponsor opportunities, please reach out to Nicki Wiggins (nicki_wiggins@beyondbenign.org), Director of Development and Strategic Partnerships at Beyond Benign.



**Green Chemistry
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