

2022

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 SENIOR PROGRAM MANAGER

After a second year of discovery, learning, development, consultations, discussions, building, iteration, rebuilding, networking, partnerships, testing, designing, retesting, and more, I am excited to present our second annual report on the progress of the new Green Chemistry Teaching and Learning Community (GCTLC) online platform. The 2022 calendar year was an exciting year for the development of our new online community space, as our project team worked diligently with our partners and educators, our experienced and dedicated developers, and our broader community to help shape the foundation for the GCTLC's structure and function. Discussions with our Leadership Committee throughout the year were extremely fruitful and helped our team better understand what functionality and workflow processes were needed to make the GCTLC an indispensable tool for educators, students and industry members. Working closely with our designers, we were also able to create a beautiful, elegant and user-friendly theme and design for the platform that will help make it accessible for everyone (some screenshots are included in this report to give you a sneak peek).

2022 was also a year for building connections and strengthening our partnerships, both in North America and abroad. With in-person conferences back in full swing, colleagues and friends were able to once again meet face-to-face to discuss progress and challenges from the past few years, and how our community plans to move forward. With so many wonderful things happening in so many different schoolrooms, labs, classrooms, and offices around the world, there is no better time for us to stay connected through a central online space to share, connect, learn and grow.

Even while writing this, we are only months away from the launch of the new GCTLC online platform going live in August 2023. The next few months will be critical for the testing and final preparations for "go-live" of the site. With that in mind, we take a brief moment in this report to reflect on and celebrate all the hard work that we've achieved so far, as we continue to build our collective anticipation for the year to come. Once again, we are excited to (very soon) welcome you to the new Green Chemistry Teaching and Learning Community, and with your help make this platform a welcome space for everyone in the green chemistry education community.



DR. JONATHON MOIR
Senior Program Manager,
GCTLC, Beyond Benign

EXECUTIVE SUMMARY

Year at a Glance

In 2022, the project team, GCTLG Leadership Committee, and developers:

- Built and developed functional site components for the GCTLG platform for beta testing, including user registration & user dashboards, forums, learning objects (resources), groups, events calendars, a job board, and more;
- Developed and documented critical processes such as resource submission and review guidelines, content for a platform-wide code of conduct, and more;
- Promoted the GCTLG during four virtual and three in-person conferences, workshops and meetings, reaching hundreds of educators, industry stakeholders and students globally;
- Created a new, elegant and user-friendly theme and design for the platform; and
- Secured new funding to complete the development of Phase 1 of the platform, launch the GCTLG, and hire additional GCTLG staff support.

In early 2022, we released [our first report](#) on initial activities undertaken in 2021 to lay the groundwork for the development and build-out of the new GCTLG platform. In brief, during that first year, working closely with our Leadership Committee—a nineteen-member advisory group comprised of educators across K-12 and higher education as well as industry stakeholders and information management experts—we identified key priorities, functional components, and important strategy considerations that were needed to build a strong and inclusive online community space that could create a sense of belonging for all. This included establishing

a mission, vision and set of core values for the platform, speaking with numerous other online education communities, and consulting and scoping with various technology vendors.

After many months of listening, learning and consultations, we secured a developer for our platform ([Skvare, LLC](#)) and began development of the platform in March 2022. This involved several scoping calls between the project team and the developers before beginning the build-out of the platform's foundational data structure, front-end website components, and eventual design, colour and theming. To support this process and ensure the platform was built to specification and to properly support the community, our Leadership Committee spent many months working in smaller groups to identify the important functional components and workflow considerations for each portion of the platform. The committee also provided critical feedback on the design and considerations for accessibility, diversity, equity, belonging and respect within the platform.

Throughout the summer, the project team presented and promoted the upcoming GCTLC at numerous conferences and events, including three in-person and four virtual events. Many of the in-person conferences this year provided a welcome opportunity to meet and greet colleagues face-to-face, including many of the Leadership Committee members who had never before met in-person. Important partnerships also began to blossom from these meetings and will help to solidify so much of the GCTLC's impact over the years to come.

Finally, Beyond Benign contracted [Bark Media](#) to undertake the design of the GCTLC platform, including its theming, colour styles and layout. The design is now being implemented on the existing site and some screenshots are included in this report ahead of the launch. For the first six months of 2023, the project team, Leadership Committee and Skvare will be hard at work preparing the platform for eventual launch in the summer.

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WHAT IS THE GREEN CHEMISTRY TEACHING AND LEARNING COMMUNITY (GCTLC)?

The GCTLC is an online platform “by the community, for the community” being co-developed by Beyond Benign and the American Chemical Society Green Chemistry Institute (ACS GCI). Set to launch in summer 2023, the GCTLC will provide a central online space where educators, teachers, students and industry stakeholders can share best practices and resources around green chemistry education, connect and collaborate, receive mentorship and feedback, and participate in peer-to-peer learning (see Figure 1 below).

The GCTLC will include a searchable online library of educational materials (including greener alternative lab experiments, in-class activities, lecture slides, case studies, and course syllabi), user profiles and forum discussion spaces, group pages, an events calendar, job postings, and so much more.

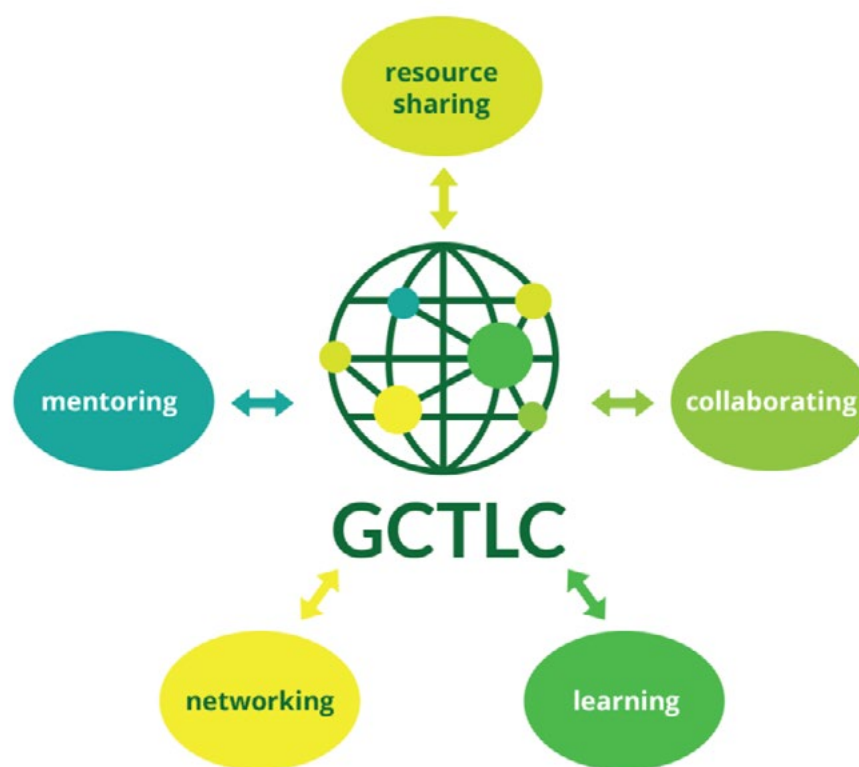


Figure 1. Features that will be included on the GCTLC platform.

A YEAR IN REVIEW

March 2022: Putting Shovels in the Ground (Starting Technical Development)

In March 2022, Skvare (pronounced “square”) began their contract to develop the new GCTL platform. As a 100% virtually distributed team with a wealth of experience building online tools and websites for educational and membership-driven non-profit organizations, Skvare was quick to establish a project plan in collaboration with the project team. Using an agile development methodology, each aspect of the platform was built through a multi-stage process:

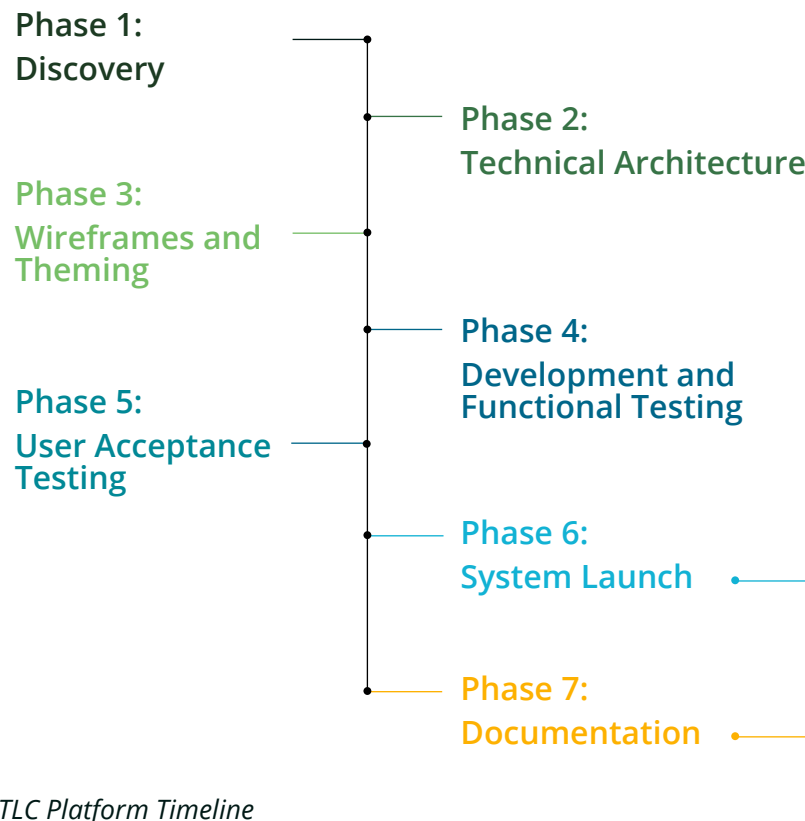


Figure 2. GCTL Platform Timeline

Phases 6 and 7 will take place in 2023, but the technical components of the platform have each gone through the first five phases at different paces and are now being prepared for wider testing with the GCTL Leadership Committee as well as members of Beyond Benign’s core programs and the community at large.

From March to December 2022, **Skvare and the project team put in a combined effort of over 600 hours of development, discovery, discussion and testing work.** The results are the following technical components, which will be present at launch of the GCTLG:

- **User Registration + User Dashboard:** Any online visitor to the GCTLG will be able to create a new user account to take part in the GCTLG community. All a user needs is an active email account and a passion for green chemistry education. Once registered, users can update their profiles (including adding profile images, biographic information, and more), search for other users, and access a list of all their submitted content (such as learning objects, job postings, events, and more) on their personal user dashboard.
- **Learning Objects:** These are the curriculum and educational resources which will be available in a searchable library on the platform, including greener lab experiments, in-class activities, lecture slides, course syllabi, and more. Registered users will be able to submit their own resources to the site, which will go through a peer review process before being published and assigned a Digital Object Identifier (DOI) to allow them to be citable. Importantly, every learning object will have the ability to be updated and have version control, as well as space for comments and discussion on each learning object page.
- **Forums:** The GCTLG will host a set of site-wide forums specifically for general topics in green chemistry education. Registered users will be able to post comments, start new threads, and reply to other users in an open and collaborative setting.
- **Groups:** For smaller dedicated discussion and collaboration spaces, registered users can request to join existing groups on the platform or can submit requests to create new groups to help fill a need, spark a new idea, or start a new project, collaboration or conversation with other like-minded users.
- **Events:** Registered users will be able to submit events to the GCTLG's site-wide event calendar, which will have a community-driven list of all upcoming events including conferences, webinars, symposia, online courses, and more.

- **Jobs:** A searchable list of green chemistry-related jobs will be available on the GCTLC. Industry partners and stakeholders will be able to submit job postings to include on the platform, where students can access them from anywhere in the world.

As of March 2023, the functionality for all the above has been finalized and built out and is undergoing rigorous testing by the project team, the GCTLC Leadership Committee, and members of Beyond Benign's core programs. Following that, the project team will be holding additional workshops in April in order to receive additional feedback prior to soft launch in May and hard launch in August.

May-August 2022: The GCTLC Leadership Committee – Working in Subcommittees

The Leadership Committee for the GCTLC was first formed in early January 2021 and continued to be a critical voice in the development and build-out of the GCTLC in 2022. Comprised of 19 members representing different sectors and levels of chemistry education (including postsecondary learning, K-12, industry, and information management) as well as representing diverse backgrounds and geographies (15 U.S., 2 Canada, 1 UK, 1 Germany), the committee continued to meet both as a full committee and in subcommittees throughout the year. During the summer months, the four subcommittees outlined below (based on the strategic actions for the platform) were hard at work discussing important functional and workflow considerations for the GCTLC.

SUBCOMMITTEE #1:

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

This subcommittee focused specifically on discussing the following:

- How the digital library of educational resources should be organized.
- What types of resources can be included in the online library.

- What the criteria are for submission of resources to the platform and how the peer review process should take place. In particular, the committee strongly felt it was important for the peer review process to be **open** as opposed to blind.
- Mechanisms to support authors in getting their materials published on the GCTLC, including mentorship, documentation, support groups (a “sandbox”), webinars, and/or virtual “lunch-and-learns” or office hours.

SUBCOMMITTEE #2:

Creating opportunities for open collaboration, networking, and mentorship.

This subcommittee focused specifically on discussing the following:

- Different mechanisms for collaboration and networking on the GCTLC, including groups, forums, and information objects (such as events, job postings, etc.).
- The structure and function of groups, including responsibilities of moderators, the submission and review of requests for group creation, the inclusion of discussion spaces and file sharing within groups, visibility and access of groups, actions and interactions within groups, and more.
- The structure and function of forums, including which forums should be present at launch, how forum posts are moderated and reviewed, how forums are maintained, and more.
- Types of information objects that should exist on the GCTLC, including events, job postings, “looking for” ads, professional or research opportunities, and more, as well as the review process for these types of objects.

SUBCOMMITTEE #3:

Driving awareness and adoption of green chemistry (professional development).

This subcommittee worked closely with the others to understand and lay out the functional components needed for networking and collaboration,

given the importance of this in helping to drive awareness and adoption of green chemistry. In addition, this group focused specifically on understanding the user journey and identifying the needs of users at each of stage of their engagement. Knowing what support mechanisms should be in place at each point was a critical part of helping to better structure the platform.

SUBCOMMITTEE ON DIVERSITY, EQUITY, BELONGING AND RESPECT (DEBR)

The DEBR subcommittee had a very special role to play in discussions throughout 2022. As a foundational aspect of the GCTLC, this group wove the lens of DEBR across all discussions around functionality and workflow related to the development of the platform. To that end, the DEBR subcommittee reviewed all documentation and notes from the other subcommittees prior to sharing them with the developer. This included aspects of submission and peer review of resources, group moderation and flow and much more. The Committee worked through questions such as:

- Is the peer review process equitable?
- What support mechanisms can be put in place for authors?
- How do we account for different backgrounds and levels of both authors and reviewers?
- How should moderators be trained to handle discussion spaces?
- What does a sense of belonging in a virtual space look like?

Towards the end of the year, the DEBR subcommittee began discussing and drafting what to include in a Code of Conduct for the platform. This document is now being finalized and will form an important part of the GCTLC at launch and moving forward. In addition, the work of the DEBR subcommittee will help support the development of groups on the GCTLC that can support dedicated spaces for Black, Indigenous, and People of Color (BIPOC) faculty and students as well as community members from minority serving institutions (MSIs) to engage with each other. This is part of Beyond Benign's ongoing MSI Initiative (you can read more about the initiative [here](#)).

May-October 2022: Promoting the Upcoming GCTLC at Virtual and In-Person Events

The Beyond Benign team was very busy throughout the summer and into the fall promoting activities and programs including the GCTLC. Below is a brief summary of some of the events attended by the team in 2022 in order to promote the upcoming GCTLC platform.

MY GREEN LAB (MGL) ANNUAL SUMMIT

MAY 26, 2022 – ONLINE

[My Green Lab \(MGL\)](#) is a non-profit dedicated to introducing sustainability to laboratory spaces across the world, including in industry, government and academia. In May, Beyond Benign Senior Program Manager Dr. Jonathon Moir participated in a virtual panel discussion on “Collaborations: Innovative ways the community is coming together to address lab sustainability” at the online MGL Annual Summit, highlighting how the GCTLC will be a virtual tool for collaboration to advance green chemistry in education.

ANNUAL GREEN CHEMISTRY AND ENGINEERING (GC&E) CONFERENCE

JUNE 6-8, 2022 – RESTON, VA, USA

At the quintessential GC&E conference in Reston, VA, many members of the Beyond Benign and ACS GCI teams met in person for the first time since the COVID-19 pandemic to interact, exchange ideas, and socialize with over 500 conference participants from across the world (see Figure 2). Countless presentations demonstrated some of the wonderful progress that has been made in integrating green chemistry into undergraduate chemistry education programs and laboratories. Senior Program Manager Dr. Jonathon Moir presented on the latest progress in building out the GCTLC, while DEBR subcommittee co-chairs Dr. Andrea Oseolorun (Prairie View A&M University) and Nimrat Obhi (Beyond Benign) presented on work done by the subcommittee to identify important considerations in creating a sense of belonging and inclusion on the platform.

GREEN CHEMISTRY WORKSHOP**JUNE 22, 2022 – UNIVERSITY OF MINNESOTA, MINNEAPOLIS AND SAINT PAUL, MN, USA (VIRTUAL PRESENTATION)**

The annual [Green and Sustainable Chemistry High School Teachers Workshop](#) is a phenomenal event hosted by the University of Minnesota. Developed through the University of Minnesota Materials Research Science and Engineering Center (MRSEC) Research Experiences for Teachers (RET) program, the workshop provides instruction to high school teachers located in the U.S. Midwest on the principles of green chemistry, industrial applications, and applications of shared lesson plans in secondary chemistry classrooms focused on green and sustainable chemical practices. Topics include bioplastics, design engineering biomimicry, and commercial products from renewables. During the 2022 workshop, Senior Program Manager Dr. Jonathon Moir presented remotely over Zoom to the workshop participants, providing an overview of the upcoming GCTL platform and the opportunities it can provide to secondary school teachers.

NEW YORK LEAD TEACHER SUMMIT**JULY 19, 2022 – SIENNA COLLEGE, LOUDONVILLE, NY, USA**

Beyond Benign's Annual Lead Teacher Summit took place at Sienna College from July 18-20, 2022. During the summit, former Director of K-12 programs Kate Anderson led teachers through a series of workshops, professional development sessions, and peer-to-peer learning opportunities, allowing participants to learn from one another by sharing best practices about their experiences bringing green chemistry and sustainable invention into the classroom. Senior Program Manager Dr. Jonathon Moir was invited to remotely give a brief Zoom presentation to the participants highlighting the upcoming GCTL platform and gathering feedback for the development.



Figure 3. Participants at the Lead Teacher Summit at Sienna College in Loudonville, NY (July 18-20, 2022).

BIENNIAL CONFERENCE ON CHEMICAL EDUCATION**JULY 31 - AUGUST 4, 2022 - PURDUE UNIVERSITY, WEST LAFAYETTE, IN, USA**

The [Biennial Conference on Chemical Education \(BCCE\)](#) is one of the premier conferences for high school chemistry teachers and higher education chemistry faculty in North America. This year's conference theme was "New Approaches to Modern Challenges". Beyond Benign staff and members of Beyond Benign's core programs were on site to network, share recent pedagogical advances and program updates, and establish new connections and partnerships. Senior Program Manager Dr. Jonathon Moir presented recent survey results from Beyond Benign and the ACS Green Chemistry Institute as well as updates on the progress of the GCTLC platform. Many of the GCTLC Leadership Committee members were also present and gave presentations on work at their home institutions, including Ken Hoffman (STEM Innovation Academy), Dr. Alexey Leontyev (North Dakota State University), and Dr. David Laviska (ACS Green Chemistry Institute). Beyond Benign also organized a "Birds of a Feather" lunch-time networking event, attracting over 35 conference attendees to discuss topics in green chemistry education.



Figure 4. Photos from the BCCE conference at Purdue University (July 31 – August 4, 2022), including the Beyond Benign booth in the exhibitors hall and the Birds-of-a-Feather event for green chemistry education.

UNIVERSITY OF YORK

AUGUST 17, 2022 – YORK, UNITED KINGDOM

In August, Senior Program Manager Dr. Jonathon Moir travelled to York, UK to visit with members of the Green Chemistry Centre of Excellence (GCCE) at the University of York. During the visit, discussions around points of collaboration in elementary, secondary and postsecondary education as well as connections to industry and engaging more postsecondary institutions in the United Kingdom were paramount for laying the groundwork for future connections across the pond. Dr. Moir then provided a departmental seminar highlighting the importance of Communities of Practice (CoPs) and Communities of Transformation (CoTs) in creating systemic change in education as an important context for the build-out and development of the new GCTLC platform.

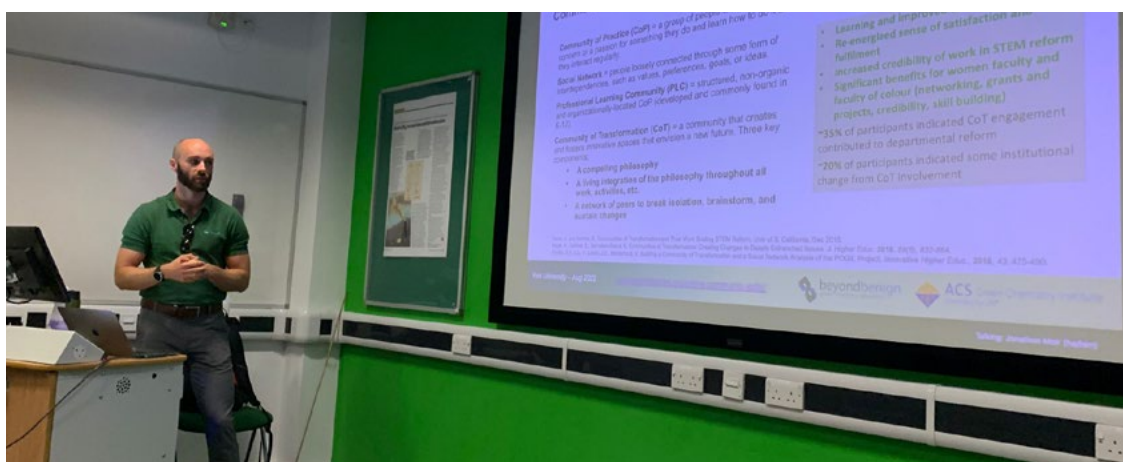


Figure 5. Senior Program Manager Dr. Moir presenting at the University of York on August 17, 2022.

MY GREEN LAB (MGL) AMBASSADORS MEETING

OCTOBER 27, 2022 – ONLINE

Finally, in October, Senior Program Manager Dr. Jonathon Moir was invited to present virtually at the My Green Lab (MGL) monthly Ambassadors Meeting. Hosted by Dr. Namrata Jain (Marketing Manager, MGL) and the MGL team, the webinar provides an opportunity for the over 700 global MGL ambassadors to learn about lab sustainability and how to bring this back to their home organizations or institutions. Dr. Moir presented on the upcoming GCTLC platform and fielded questions from representatives from industry, government and academia.

November-December 2022: Theming and Design for the Platform

As the GCTLC was in development throughout the second half of 2022, the team needed a strong design and theming for the platform in order to give it an approachable, accessible and user-friendly look and feel. Beyond Benign partnered with Bark Media, an experienced branding and marketing consulting agency, to create the design, colour scheme and overall look. Bark Media ensured the colour and theming was in line with accessibility requirements, and integrated the feedback received from the GCTLC Leadership Committee. The results of the design process are shared in the screenshots below.

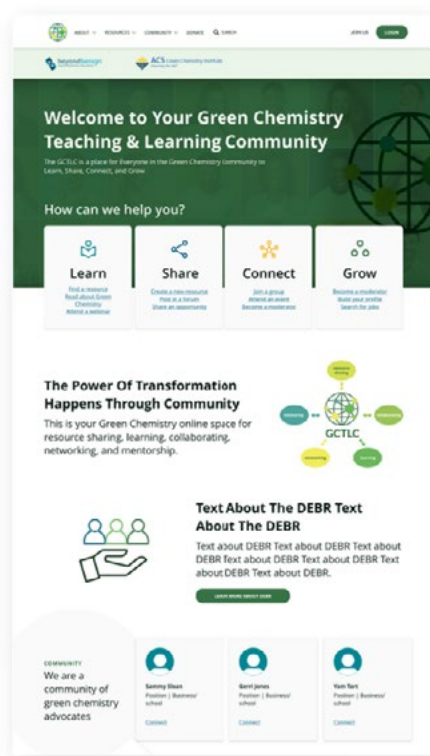
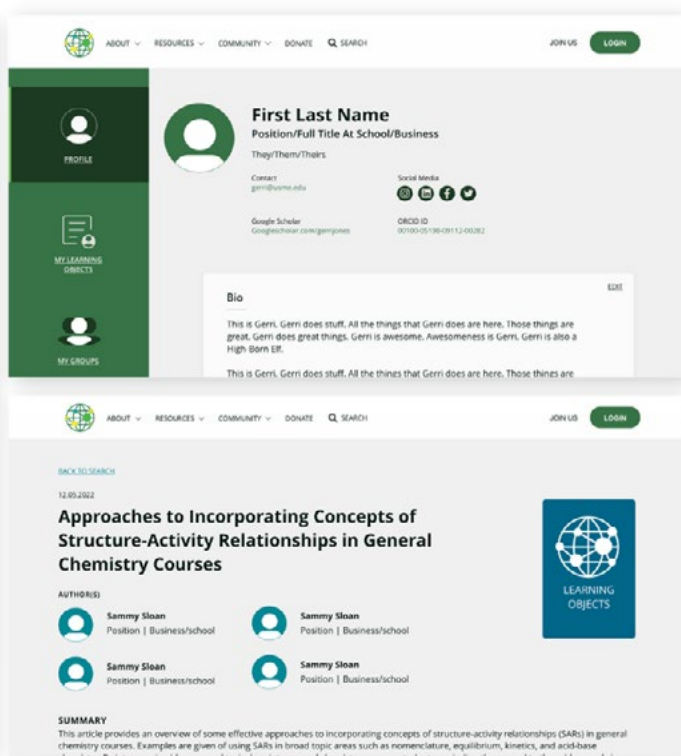


Figure 6. Proposed design for the GCTLC homepage.

Credit: Bark Media.



Top Right: Figure 7. Proposed design for a user profile page on the GCTLC. Credit: Bark Media.

Bottom Right: Figure 8. Proposed design for a learning object (curriculum resource) on the GCTLC. Credit: Bark Media.

Creating a Unifying Philosophy Statement

Communities of Practice (CoPs) are well known mechanisms for creating systemic change. Many examples exist in the literature, including in science education. Under the right conditions and with the right supports in place, these communities can evolve into Communities of Transformation (CoTs). A prominent case study by Kezar and Gehrke examined four such CoTs centred around science education reform.^{1,2} They found that these communities all shared common traits and characteristics that allowed them to be successful in changing teaching practices in education. One important characteristic is the need for a unifying philosophy, which is the underlying set of core beliefs and values that unite the members of each community to a common cause.

Understanding the importance of having a common unifying philosophy, the GCTLG Leadership Committee set to work drafting a first-of-its-kind philosophy statement for green chemistry education. The resulting statement is now being finalized and will be made available on the GCTLG platform when it launches.

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

2 Kezar, A.; Gehrke, S. COMMUNITIES OF TRANSFORMATION AND THEIR WORK SCALING STEM REFORM. 2015, 1–96.

FUTURE OUTLOOK

Build-up to Launch in 2023 and Beyond

Moving into 2023, Beyond Benign and Skvare are finalizing the development of the GCTLC and initiating testing both internally and externally before soft launch of the platform in May 2023 and hard launch in August 2023. From January to April 2023, the GCTLC Leadership Committee and members of Beyond Benign's core programs will be testing the functionality of the GCTLC to ensure it meets the needs of the chemistry education community. During this time, the GCTLC Leadership Committee in conjunction with Beyond Benign staff is continuing to develop important content for the platform, including a Code of Conduct, submission and review guidelines for resources submitted to the platform, guidelines and expectations for moderators and group leaders within online spaces, and more.

During launch over the summer, Beyond Benign staff will be soliciting additional feedback at conferences and events including:

- The Canadian Society for Chemistry (CSC) Annual Conference (June 4-8, 2023 – Vancouver, BC)
- Beyond Benign's Green Chemistry Commitment Summit (June 12, 2023 – Long Beach, CA & virtual)
- The Annual Green Chemistry & Engineering (GC&E) Conference (June 13-15, 2023 – Long Beach, CA)
- "Integrating Green Chemistry into Higher Education in the UK" (July 7, 2023 – University of York, York, UK)
- The Biennial ChemEd Conference (July 23-27, 2023 – Guelph, ON)
- ACS Fall Meeting (August 13-17, 2023 – San Francisco, CA)

At the ACS Fall Meeting, the Beyond Benign team will be undertaking a hard launch of the platform when users across the globe will be welcomed into the platform. This will involve significant promotion, a press release, and collaborations with funders and partners to help promote and share the platform widely.

Moving into post-launch, the project team and Leadership Committee will be looking towards next steps for the GCTLC. This will include the following:

- Moving the Leadership Committee to an advisory committee structure in 2024 and establishing set terms for membership moving forward.
- Refining technical aspects of the platform and improving user experience over time.
- Increasing user engagement by building awareness of the platform and supporting and encouraging users to upload content and contribute to online discussion spaces.
- Strengthening and expanding existing partnerships with the ACS Green Chemistry Institute and other critical partners.
- Expanding internationally, including connecting with chemical societies, networks, and other educational and green chemistry partners and professionals in the United Kingdom, Europe, South America, Oceania, and Asia.

New Sponsors and Building Partnerships

This work is not possible without the support of our partners. In addition to the generous funding provided by the **Argosy Foundation**, **BASF** and the **Washington State Department of Ecology**, Beyond Benign is pleased to announce new corporate partnerships to support the launch of the GCTLC platform. Funding from these companies is allowing us to launch the platform on our scheduled timeline, hire additional GCTLC staff to support the content development of the site, provide leadership positions for community members to encourage engagement and mentorship within the GCTLC, and promote the GCTLC platform to thousands of educators, students and industry practitioners across the globe.

**THRIVE LEVEL (\$100,000+):****MilliporeSigma**

A long-time partner and supporter of Beyond Benign, MilliporeSigma, the U.S. and Canada Life Science business of Merck KGaA, Darmstadt, Germany, is a leading provider to the global biopharmaceutical industry and the industrial sector. The company is dedicated to helping transform chemistry education to better prepare next generation scientists with skills to address sustainability through chemistry. Learn more about MilliporeSigma's commitment to the GCTLG through the [press release here](#).

**GROW LEVEL (\$50,000):****Cell Signaling Technology**

Cell Signaling Technology is a different kind of life science company—one founded, owned, and run by active research scientists, with the highest standards of product and service quality, technological innovation, and scientific rigor. As a company of caring people driven by a devotion to facilitating good science, we are committed to doing the right thing for our Customers, our communities, and our planet.

**SEED LEVEL (\$10,000):****Hexion, Inc.**

Hexion is a chemical production and manufacturing company that has been advancing performance materials and specialty chemicals for over 100 years. Hexion is dedicated to responsible chemistry, including safe manufacturing and community involvement. Read more about Hexion's dedication and commitment to the GCTLG program through the [press release here](#).

At present, a number of additional funding and sponsorship opportunities are currently being explored by Beyond Benign to build internal capacity to support educator engagement on the GCTLG as well as enhancing the technical development of the platform based on community needs. To learn more about sponsorship opportunities, please reach out to Nicki Wiggins (nicki_wiggins@beyondbenign.org), Chief Operating Officer at Beyond Benign, for more details.

THE PROJECT TEAM IS GRATEFUL TO ITS FOUNDING SPONSORS:



THRIVE



GROW



NURTURE



SEED





Green Chemistry Teaching and Learning Community

A joint initiative by



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