Title: Integrating Green Chemistry and Sustainability into Chemistry Education

Description: This symposium is co-organized with Andy Dicks and Lloyd Bastin and will highlight the incorporation of green chemistry and sustainability principles throughout the chemistry curriculum as well as through co-curricular activities such as clubs, organizations, and service-learning opportunities. The focus will be on green chemistry and sustainability materials and models rooted in the Twelve Principles of Green Chemistry that are designed to educate high school, community college, four-year college, and graduate students. These materials will include classroom teaching modules/courses, learning methods, educational research, laboratory experiments and experiences, and the integration of toxicology into the chemistry curriculum. This session will highlight collaborations between K-12 educators and academic partners.

Speakers:
1. 12:00 – Opening Remarks and Instructions

2. 12:05 - Janie Butler and Natalie O’Neil, “Fostering a Green Chemistry Education Community of Practice with K-20+ Stakeholders”

By utilizing professional learning communities across the education continuum for 12 years, Beyond Benign has empowered a community of educators, who are change-makers and innovators in their fields, to practice sustainability through chemistry. Beyond Benign programs support educators from elementary to graduate school through professional development and educational resources that assist educators to adopt greener practices in their classrooms and laboratories. This presentation will cover the Beyond Benign programs, highlighting the community of practice and resources created by the community for the community as well as synergies between the K-12 and higher education programs. The collaborations between K-12 and higher education stakeholders will be spotlighted as these initiatives are aligned with Beyond Benign’s theory of change required for supporting a healthy population and a stable environment.

3. 12:25 - Jennifer Sherburn and Erika Fatura, “Introducing Pre-service Teachers to Chemical Safety and Green Chemistry”

It is important we educate pre-service teachers about chemical safety before they establish their own classroom practices. So often they inherit chemical stockrooms full of unsafe materials and carry on demonstrations that have “always been done” without awareness of the risks they are bringing into their new classrooms. Using green chemistry as a catalyst, we hope to address this need and lack of exposure with pre-service teachers using a presentation focused on the following learning targets.

- Understand the importance of lab safety.
- Practice replacement labs.
- Gain access to safety resources.
- Understand green chemistry principles.

In our research we have found veteran teachers are unaware of lab safety resources, which further emphasizes the need for direct instruction to pre-service teachers about chemical safety.
4. 12:45 - Robert Baldo, “Making Green Chemistry Available to All: Bringing the Wonder of Science From Elementary to Higher Education Learners”

Green Chemistry and sustainable science are crucial to be taught to all learners. While the lab skills and mechanisms have historically been tailored for that of a high school learner, elementary students benefit greatly by instilling the importance of sustainability when they are first learning about science. This way of teaching changes how students think about science and nature and causes students to expand their learning outside our classrooms. Therefore, if elementary students are exposed to topics regarding water use, conservation, and are exposed to proper laboratory skills, as they enter middle and high school, they will continue to be willing participants in their education. This active participation will allow for the instruction of Green Chemistry and Sustainable Science to achieve a deeper, longer lasting understanding. However, to get to our elementary students, we have to first reach the elementary educators. As a Professor at Bridgewater State University, I provide programs for pre-service and in-service teachers, presenting them with curriculum ideas and the background knowledge necessary for their understanding to take back to their classrooms. The participants are immersed in the hands-on lessons, as their students will be, to allow them to make the lessons their own. If they are comfortable teaching the lesson, their students will get more from the instruction. The courses include a range of educators from kindergarten to high school allowing for discussion across grade spans. This dialogue breaks down barriers related to misconceptions that, "only high school teachers teach 'real' science." The wonder of science is alive in a 5 year old looking at a leaf. We need to keep this wonder alive throughout their lives, as they become the stewards of our world.

4. 1:05 - Steven Kosmas, “Integrating the 12 Principles of Green Chemistry Through Student Centered Activities”

The purpose of this presentation is to provide teaching materials that can be used immediately to integrate green chemistry into your course. Dr. Carol Dweck’s growth mindset research will be discussed. After introducing the concept of different mindsets, the presentation will focus on employing a green chemistry growth mindset.

Focusing on a specific case study, I will speak about my own experience. Through work with my ACS Coach, I have addressed the concerns in the Flint Michigan area and used the principles of green chemistry within my science club to come up with award winning ideas. The partnership with the institution and my high school students cultivated and curated a community of enthusiasts for green chemistry and real-life problem solvers.

5. 1:25 – Break

6. 1:40 - Cassie Knutson and Jane Wissenger, “Greening Minnesota High School Classrooms through Teacher Workshops”

This presentation will describe summer workshops designed to provide training and resources for high school teachers to incorporate green and sustainable chemistry into their classrooms. The three-day workshops offered a balance of classroom instruction, laboratory time to explore experiments, and curriculum development opportunities. An introduction to green chemistry and sustainability was presented as background material then modeled through hands-on laboratory experiments including novel polymer experiments developed by the presenters and greener replacements to traditionally more hazardous experiments adapted from Beyond Benign. Participants had personal or collaborative team work time to develop a plan for incorporation into their classrooms. The polymer experiments illustrated
modern approaches to sustainable plastics and how scientists are addressing accumulation of plastics in the environment. The polymer experiments also offered a mechanism for inclusion of engineering principles and next generation science standards into the curriculum. The lecture and laboratory content were connected through the pillars of sustainability and the twelve principles of green chemistry. These workshops were implemented in the state of Minnesota and attracted teachers from both rural and urban school districts. Three years of data demonstrated that participants were extremely likely to incorporate one more of the experiments in their curriculum and a high level of satisfaction with the workshop format, content, and leadership.

7. 2:00 - Douglas E. Raynie and Matthew L. Miller, “Partnering for Green Chemistry Education”

This presentation describes a partnership between South Dakota State University and the nonprofit Beyond Benign toward advancing green chemistry education in the training of high school teachers. In the development of green chemistry practitioners, educating those educators at the base of the developmental pyramid is of prime importance. Our partnership began in the summer of 2017, when SDSU hosted the ChemEd 2017 conference for high school teachers. One of the optional programs was a two-day workshop instructed by Beyond Benign, utilizing those in their Lead Teacher program. During this workshop, participants developed a knowledge of green chemistry and curriculum resources to bring this knowledge into their classrooms. An emphasis was placed on reducing hazardous chemicals, reinforced by extensive use of laboratory experiments. Participating teachers could receive continuing education units (CEUs) through SDSU. From this partnership, SDSU and Beyond Benign announces a graduate certificate in green chemistry education. This novel certificate, which can be delivered entirely online, is designed for practicing high school teachers, though anyone working in the chemistry field may benefit. The certificate program consists of 12 credits of graduate coursework and can be completed in one year. This presentation will discuss the summer workshop, including a presentation of the resulting impacts. Then the parameters of the graduate certificate will be presented.

8. 2:20 - Ken Hoffman and Andy Dicks, "Designing Green Chemistry Labs for High- and Middle-School”

The day is coming when we no longer have to preface "chemistry" with "green". This presentation outlines teaching and learning methods for introducing green chemistry principles to high and middle school students, through a student-directed, inquiry-based critical analysis of how experimental “success” is measured. By designing a precipitation experiment students are introduced to green chemistry principles and metrics as an alternative to experimental yield as a success criterion. Electronic resources will be referenced.

9. 2:40 – Brief Closing Remarks and Links