

### **1. 3D printing in chemistry education**

*Symposium Organizer:* Alexey Leontyev

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: From the manufacturing of customized laboratory equipment to visually representing electronic and molecular structures, 3D printing has become a valuable tool in the classroom and the laboratory. With 3D printing becoming increasingly accessible to educational institutions the number of applications has rapidly increased in the past years. The goal of this symposium is to explore different applications of 3D printing in chemistry education. Key questions to answer: What is the curriculum context of implementing 3D printing? How are students engaged in the learning process and technical aspects of 3D printing? What is the evidence that supports instructional effectiveness of 3D printing implementation? What resources are needed for an adoption of your instructional innovation?

### **2. A day in the life of my classroom**

*Symposium Organizer:* Oluwatobi Odeleye | Amy Johnson

*Proposed Audience:* College, High School, General Audience

Symposium Description: What is your current classroom environment like? What are some tools you use (or have used) to cultivate a student-centered classroom? How do your learning objectives correlate with your classroom activities? Are you excited about active learning and how to potentially increase the rate of student success in your course? This symposium invites speakers to share how a typical session in their classroom/laboratory is structured and then to reflect on and discuss the teaching philosophies that have guided their teaching practices. Further, a presenter may wish to include what works well and what doesn't about the method(s) presented, how they came to adopt the practice(s), and/or tips and hints for implementation. The goal of this symposium is to highlight different philosophies on teaching, to provide an opportunity for participants to learn about new teaching practices that revolve around student centered learning, and to engage in discourse that helps educators evaluate or re-evaluate teaching methods utilized in their classrooms and laboratories.

### **3. Accelerated Chemistry: Teaching One Course at a Time**

*Symposium Organizer:* Kaitlyn Mahoney

*Proposed Audience:* College

Symposium Description: Many colleges offer accelerated chemistry classes, either lecture, lab, or both. These classes can be offered during a regular academic semester or during a winter or summer session. This symposium is designed to allow educators the opportunity to share a range of views of how best to design and run an accelerated chemistry course. Presentations could include topics such as: logistics of a short-format course (costs, people, supplies, etc), best practices (syllabus, schedule design, etc), curriculum considerations (successes and hurdles), assessment planning, or other related topics.

#### **4. Active Learning in Organic Chemistry**

*Symposium Organizer:* Vincent Maloney

*Proposed Audience:* College

Symposium Description: Studies over the past two decades have shown the use of active learning pedagogies in the classroom result in positive student learning outcomes in science courses. These improved outcomes include higher test scores and final grades, improved conceptual understanding of content, lower withdrawal rates and improved attitudes toward science. There are a number of techniques that can be implemented to introduce more active learning into any environment, including those that can be incorporated into traditional lectures, used to completely flip the classroom, or create hybrid courses. This symposium includes presentations of organic chemistry faculty who have implemented active learning, broadly defined, in their organic courses. Previous participants of the Active Learning in Organic Chemistry workshop sponsored by Chemistry Collaborations, Workshops & Community of Scholars (cCWCS) are particularly encouraged to submit abstracts that include instructional implementation of active learning strategies.

#### **5. Active Learning in Physical Chemistry**

*Symposium Organizer:* Jodye Selco

*Proposed Audience:* College

Symposium Description: How do you engage your students in learning Physical Chemistry? Come share your strategies and pedagogies that have students actively engaged in learning physical chemistry.

#### **6. Addressing Underrepresented Groups in STEM**

*Symposium Organizer:* Daniel Cruz-Ramirez de Arellano

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: Addressing the underrepresentation of many populations in Science, Technology, Engineering, and Mathematics (STEM) academic majors and careers is one of the great challenges of being a 21st century science educator. There are many components of an individual's identity that could make them a part of one of these underrepresented groups. These components of personal identity include (but are not limited to): gender identity and expression, racial and ethnic identity, sexual orientation, being an individual with a disability, and others. The issues faced by these underrepresented groups in academic environments are diverse and often multi-faceted. This symposium, open to researchers and practitioners, aims to address these issues with paper submissions that characterize the experiences of these populations, describe curricular interventions that help increase representation, share successful programs and best practices that target these populations, and any other research or educational endeavor that somehow addresses underrepresented groups in STEM.

## **7. Aligning Assessment Practices with Inquiry Learning**

*Symposium Organizer:* Adam Schafer | Ellen Yeziarski

*Proposed Audience:* High School, Middle School

Symposium Description: The Next Generation Science Standards, many state standards, and district administrators encourage implementing inquiry learning activities in the classroom. Although teachers have access to professional development and educational resources focused on implementing inquiry practices and creating inquiry-aligned lessons, assessment practices have not kept pace with the reforms in pedagogy. Improving assessment practices requires crafting assessment items and analyzing data from such items with more depth and precision. In this symposium, teachers will present chemistry assessment materials developed and implemented in their classrooms. Each presentation will include an overview of the assessment materials, significant characteristics of assessment implementation or design, and an overview of the assessment results. Presenters are encouraged to illustrate how their findings may be useful to other teachers and/or professional development designers.

## **8. Alternative ways to teach important concepts in Organic Chemistry**

*Symposium Organizer:* Klaus Himmeldirk

*Proposed Audience:* College

Symposium Description: The symposium seeks to explore alternative ways to help students understand difficult concepts in sophomore organic chemistry classes. How can lectures, demonstrations, and laboratory experiment be used for an improved teaching of subject matter such as acid-base chemistry, intermolecular forces, reaction mechanisms, resonance effect, NMR interpretation? Presenters are invited to share their experience with novel approaches and to contrast their methods with established ways of teaching.

## **9. Applications of Learning How to Learn in the Chemistry Curriculum**

*Symposium Organizer:* Sylvia Esjornson

*Proposed Audience:*

Symposium Description: This symposium presents practitioner's reports of the application of learning how to learn in the chemistry curriculum. Talks address how to teach learners how to teach themselves, in general, or in a chemistry application. How are you getting the students to be learners? How do you demonstrate what is the work of learning? How do you know the learners are doing the work of teaching themselves? How do you know the learners are learning anything? What kinds of assignments do you use to promote self-teaching? How are the activities implemented and what have you learned from your implementation history? Are your learners self aware of what they are learning, how they know they have learned it, and what they will learn next? What are your success criteria, how do you assess them, and how do you reconcile them with semester grades? Theoretical frameworks, methodology, and/or analysis of practical applications are to be presented.

## **10. Arithmetic the key to success in STEM especially Chemistry the central Science**

*Symposium Organizer:* Michael Castaldi

*Proposed Audience:* College, High School, Middle School

Symposium Description: Looking for a way to have all students successful in chemistry especially those who are afraid of Mathematics and science topics

## **11. Beyond AP: 2nd-Year Chemistry Electives in High School**

*Symposium Organizer:* Teresa Marx

*Proposed Audience:* High School

Symposium Description: While many high schools work to expand the number of students taking Advanced Placement courses, some schools have successfully built electives to appeal to students interested in health professions and STEM fields. This symposium will be structured in round-table format to allow attendees to share and discuss curriculum resources, professional development opportunities, and labs that can be run in a high school setting. Presentations will focus on Organic Chemistry, Biochemistry, and Materials Science electives. In addition, there will be a sharing session on other concepts that may be used to design chemistry-specific units in interdisciplinary electives (such as Forensics, Consumer Science, and Food Science).

## **12. Big 10 Gen Chem Labs: Advances, Innovations, and Challenges**

*Symposium Organizer:* Eric Malina

*Proposed Audience:* College

Invited speakers only. Symposium Description: This symposium will provide a forum for discussing the current state of the general chemistry labs at universities in the Big 10 Conference. Topics of discussion, while aimed at large, research-oriented chemistry departments, will be relevant to most any other size chemistry department. This symposium invites presentations that outline any innovative approach to teaching general chemistry labs (curriculum, TA training or mentoring, facility management, etc.), whether successful or not. The organizers believe that a lot can be learned from innovations that work and those that don't work as expected.

## **13. Biochemistry Education: Discussions of the Laboratory Environment**

*Symposium Organizer:* Kimberly Linenberger Cortes

*Proposed Audience:* College

Symposium Description: Biochemistry education is unique in that students must synthesize learning from many courses (e.g., chemistry and biology) and attain a high-level of representational competence to be successful. Additionally, biochemistry education is unique in that the host department for undergraduate biochemistry courses can be found in many disciplines such as chemistry, biochemistry, microbiology, and medicine. Thus, research studies and discussions of practice within the laboratory can be found in many journals and spanning a number of disciplines. The purpose of this symposium is to provide a forum for biochemistry

education researchers and practitioners to present their work in the biochemistry teaching laboratory.

#### **14. Biochemistry Education: Discussions of the Lecture Learning Environment**

*Symposium Organizer:* Thomas Bussey

*Proposed Audience:* College

*Symposium Description:* This symposium will focus on teaching innovations and educational research related to the biochemistry lecture learning environment. The biochemistry classroom can provide students with the opportunity to grow and develop their understanding of the molecular life science concepts and practices. However, as many biochemistry educators can attest, this potential for student learning is not often fully realized. We invite those teaching lecture courses in all areas of biochemistry to share their work with specific interest in active learning pedagogies. We encourage all symposium speakers to include some form of assessment such as results from surveys, exam questions, student interviews, or formal assessment instruments in their presentation.

#### **15. Bringing Civic Engagement and SENCER to Chemistry Courses and Curricula**

*Symposium Organizer:* Matthew Fisher

*Proposed Audience:* College, High School

*Symposium Description:* SENCER (Science Education for New Civic Engagements and Responsibilities) is a science education reform project that for over 15 years has advocated for using complex civic issues as a starting point for learning science. This symposium will provide an overview of the SENCER approach as well as examples of how this approach has been incorporated into chemistry courses.

#### **16. Building a Culture of Learning for Chemistry Students**

*Symposium Organizer:* Daniel Albert

*Proposed Audience:* College, High School

*Symposium Description:* A significant amount of learning in chemistry courses takes place outside of the classroom with students working on various assignments and problems. The transition to significant out of class learning is especially difficult for first-year students which often leads to student attrition from STEM majors and ultimately STEM careers. The symposium will examine projects that seek to assist students in making this transition by building a learning culture that exists to support them outside of the classroom. What initiatives have been successful for engaging students in chemistry coursework outside of class? What roles do peers, faculty, and staff play in fostering a culture of meaningful learning? How can existing campus resources, such as tutoring programs, be leveraged to help build communities of learners? What effective practices exist for engaging students in learning communities/cultures on college campuses? What are the barriers to building a culture of learning? All attendees will be invited to participate in the discussion and share past experiences and ideas for fostering a learning culture for chemistry courses.

### **17. Building an Identity as a Scientist from Orientation to Graduation.**

*Symposium Organizer:* Brenda Blacklock

*Proposed Audience:* College

Symposium Description: Becoming part of the community of chemists and building an identity as a scientist is important as undergraduate students move through their degree programs. This symposium will examine how undergraduate students are encouraged to “join the club” through freshman orientation, first-year and sophomore seminars, capstone projects, membership in a Chem Club, and other forums.

### **18. Building Bridges to Transition Two-year Students to Four-year Programs**

*Symposium Organizer:* Laura Anna | Aimee Miller

*Proposed Audience:* College

Symposium Description: Nearly half of all undergraduate students enroll in a community college to begin their degree work. Many STEM students also start work on their degree by taking their introductory chemistry courses at a two-year college. The educational route these students follow is often complex and non-linear towards transfer to and completion of a four-year program. These non-traditional pathways present unique challenges in and out of the classroom for the educators who are trying to serve this important and diverse group of students. This symposium will explore how two-year and four-year institutions are partnering to serve this diverse group of students starting chemistry studies at two-year colleges. Chemical educators and administrators from two and four-year institutions are invited to share collaborations and partnerships between programs that promote successful transfer and degree completion for chemistry students starting out at two-year colleges.

### **19. CERtainly You Can Do Inquiry in Chemistry**

*Symposium Organizer:* Amiee Modic

*Proposed Audience:* High School, General Audience

Symposium Description: Argument Driven Inquiry (ADI), Claim Evidence Reasoning (CER), and other inquiry-related buzzwords are popular in science right now, and with good reason; they provide students with authentic science problems to solve collaboratively and an opportunity for students to communicate their results in a cohesive manner. If you're like many chemistry teachers the idea of letting students loose in the lab to "discover chemistry" can be scary. That being said, well-implemented lessons that incorporate ADI and CER as part of the learning process allow students to explore safely and truly own their learning. Presenters share perspectives, reflections, and suggestions about the implementation, advantages, and potential pitfalls of CER and ADI lessons.

## **20. Chemical Education Xchange: Engaging with Contributors**

*Symposium Organizer:* Jon Holmes

*Proposed Audience:* College, High School

Invited speakers only. Symposium Description: The Chemical Education Xchange (ChemEd X, [www.chemedx.org](http://www.chemedx.org)) is a virtual home for high school and higher education chemistry instructors. Designed to be a collaborative space, ChemEd X contributors will engage with you by highlighting and expanding upon ideas and activities they have shared at ChemEd X. The symposium is designed to be interactive; expect to participate in hands-on activities shared by some presenters. Attendees are encouraged to register for a free account at [www.ChemEdX.org](http://www.ChemEdX.org) and bring their preferred device to access the website during the symposium. Find out more about the materials available at ChemEd X and how you might engage with and contribute to this growing community.

## **21. Chemistry and Community Outreach: Ideas and Events**

*Symposium Organizer:* Paul Morgan

*Proposed Audience:* College

Symposium Description: This symposium is a place to share experiences and gain some insight on chemistry and STEM outreach planning, presentation and use as a teaching tool. Talks within the symposium will address ideas, events and experiences related to community outreach. Example topics could include: successful and unique outreach events; development of college/university learning experiences centered on outreach events; the assessment of college/university student learning experiences centered on outreach events.

## **22. Chemistry Education Research about Multiple Representations**

*Symposium Organizer:* Stacey Lowery Bretz

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: Learning chemistry requires a student to make observations with their senses, explain those observations using a particulate model of matter, and develop fluency in the symbols used to communicate the properties and reactions of matter. Johnstone first referred to these as the macroscopic, submicroscopic, and symbolic domains of chemistry. This symposium will feature the findings of qualitative and/or quantitative chemistry education research studies that characterize student thinking with multiple representations, develop assessments to measure thinking about multiple representations, or report results of evidence-based pedagogy to improve student understanding of multiple representations.

## **23. Chemistry Education Research: Graduate Student Research Symposium**

*Symposium Organizer:* Jordan Harshman

*Proposed Audience:* General Audience

Symposium Description: This symposium has a long history of providing a great constructive platform for graduate students to present their work on topics involving chemistry education

research. The goal of this particular forum is for the audience to provide feedback in a way that does not intimidate or overly-challenge the presenter, but instead, professionally advises the student in a way that helps them grow into a better presenter and researcher. This symposium is hosted by the Younger Chemistry Education Scholars committee of DivCHED as part of their larger mission to foster growth in the future generation of chemical education researchers.

#### **24. Collaboration Cubed: Two-Year College Chemistry Faculty Thrive on Collaboration, Creativity and Connections.**

*Symposium Organizer:* Kathy Carrigan

*Proposed Audience:* College, High School, Middle School, General Audience

*Symposium Description:* Two Year College Chemistry Teachers from across the country have many creative perspectives on teaching chemistry to the diverse population of students that step onto our campuses. This is an opportunity to share what is working for you and to build connections as you collaborate with other Teachers facing similar issues and successes. We are interested in topics such as transfer agreements with 4 year Institutions, building equity and inclusion in STEM, distance learning, Allied Health Chemistry, Undergraduate Research, even contract negotiations and using the ACS guidelines for Two Year Colleges, along with many other topics to build student success. The collaboration between colleagues that are built at 2YC3 conferences last a lifetime and benefit students across the country.

#### **25. Collaborative and Cooperative Learning**

*Symposium Organizer:* Julia Chamberlain | Brett McCollum | Layne Morsch

*Proposed Audience:* College

*Symposium Description:* Collaborative and cooperative learning continues to be an important area of focus in chemistry education as colleges and universities aim to improve student engagement. In this session, invited experts will share their research on collaborative and cooperative learning methods, environments, and technologies.

#### **26. Communicating Chemistry Via Social Media**

*Symposium Organizer:* Clarissa Sorensen-Unruh | Glenn Hurst

*Proposed Audience:* College, High School, Middle School, General Audience

*Symposium Description:* As of 2015, the number of active users on Facebook exceeded 1.5 billion. On any given day, over half of its users log-on to the social networking site. The average user is connected to 80 community pages, groups and events, and posts about 90 pieces of content each month<sup>1</sup>. Approximately 72% of high school and 78% of college students spend time on Facebook, Twitter, Instagram, and other social media platforms each day<sup>2</sup>. Twitter's 330 million registered users will produce 500 million tweets per day<sup>3</sup>. Social media usage has not been widely adopted in scientific disciplines but is gaining traction as a means to communicate with peers and the public. Leading scientific societies are advocating for increased science communication by the science community as evidenced by recent letters<sup>4,5</sup> and features<sup>6,7</sup> in *Science* and *Nature* among others. With such ubiquitous use of social media



platforms amongst students and the general public, utilization of these platforms by instructors in order to effectively communicate chemistry is becoming increasingly popular and important. In fact, recent studies and classroom implementations have shown that social media can be used as a feedback mechanism to empower students to create and share new knowledge with instructors, their peers, and the world. The exciting possibilities surrounding the use of social media to facilitate international chemistry education has prompted the collaboration of the Biennial Conference Committee, DivCHED in the USA with the RSC Tertiary Education Group in the UK. This interactive symposium will feature contributions from practitioners who are utilizing social media platforms to engage and educate students, scientific professionals, and the general public about chemistry. 1Facebook:

<http://www.facebook.com/press/info.php?statistics>; Van Eperen, L. and Marincola, F.M. (2011) How scientists use social media to communicate their research. *Journal of Translational Medicine* 9, 199. 2[http://www.technicianonline.com/opinion/article\\_d1142b70-5a92-11e5-86b4-cb7c98a6e45f.html](http://www.technicianonline.com/opinion/article_d1142b70-5a92-11e5-86b4-cb7c98a6e45f.html) 3<https://www.omnicoreagency.com/twitter-statistics/> 4[http://science.sciencemag.org/content/357/6354/880.2.full?\\_ga=2.209045008.326272985.1512148087-354960609.1512148087](http://science.sciencemag.org/content/357/6354/880.2.full?_ga=2.209045008.326272985.1512148087-354960609.1512148087) 5<http://science.sciencemag.org/content/357/6358/1362.2> 6<http://www.sciencemag.org/features/2014/02/scientists-guide-social-media> 7<http://blogs.nature.com/naturejobs/2017/08/23/social-media-as-a-scientist-a-very-quick-guide/>

## **27. Communication in chemistry: Engaging students with oral communication in lecture and laboratory classes**

*Symposium Organizer:* Kathryn Kloepper | Garland Crawford

*Proposed Audience:* College, High School, General Audience

Symposium Description: Equally important to the technical proficiency that chemistry instructors promote is the development of transferable skills. The ability to communicate effectively to a wide range of audiences continues to be a critical skill identified by employers and graduate programs. Additionally, student learning often is assessed through presentations and can provide a gauge for comprehension not available in a written format. The goal of this symposium is to discuss best practices for incorporating oral communication skills development into chemistry classes. Both formal and informal methods of promoting student oral communication are of interest. What are the best ways to help our students develop this important soft skill? How does one give constructive feedback? PowerPoint presentations may be a common way to evaluate student success in public speaking, but what other options are there? What role can chemistry labs, both instructional and research, have in helping students improve as oral communicators? How do oral communication experiences help with student learning and engagement? Speakers are encouraged to address how they answer some of these questions but may also explore additional areas. Submissions from all levels of chemistry courses, including non-majors and high school courses, are encouraged.

## **28. Community outreach throughout all grade levels**

*Symposium Organizer:* Karen Kaleuati

*Proposed Audience:* College, High School, General Audience

Symposium Description: Student groups in high school and college reach out to students in elementary and middle schools to share their passion for chemistry. These groups, not only help students with their chemistry and communication skills, but help to grow relationships among the students and with their faculty. Throughout this symposium, we'll explore: 1) ways to engage students 2) activities that will excite younger students 3) student group's most successful demonstrations/labs

## **29. Course-embedded research experiences in the first and second year curriculum**

*Symposium Organizer:* Nichole Powell | Brenda Harmon

*Proposed Audience:* College

Symposium Description: Research experiences allow students to practice being scientists; to be exposed to the way chemists approach problems, how knowledge is acquired, and the use of evidence to support that knowledge. The ability to embrace uncertainty, not knowing the "right" answer, is an integral aspect of this experience, but it is often a difficult process for freshmen and sophomores. This symposium invites discussion on the use of research projects in the first and second year laboratory curriculum. Presentations should include important aspects of the successful incorporation of research projects into the curriculum as well as the challenges faced in the development of the program. The inclusion of tools used in the assessment of student gains related to the development of scientific inquiry skills is also encouraged.

## **30. Creating a Local Professional Learning Community**

*Symposium Organizer:* Teresa Marx | Ariel Serkin

*Proposed Audience:* General Audience

Symposium Description: Presenters will share information about their experiences in building a local professional learning network, as well strategies for hosting successful professional development programs. Specific topics include: fundraising, logistics, publicity and outreach, troubleshooting, community support. The symposium will be organized in a round-table format to allow participants to share successes and discuss challenges.

## **31. Creativity in the Classroom: Games and Manipulatives that Encourage Learning**

*Symposium Organizer:* Tracy Terry

*Proposed Audience:* College, High School, General Audience

Symposium Description: Who says learning chemistry isn't fun? Educational games and manipulatives are interactive and fun ways to stimulate interest in chemical concepts. They are used to teach, assess, and reinforce chemistry topics. Presentations in this symposium highlight games and manipulatives used to teach chemistry. All types of games, from computer games to

board games to card games, are discussed. Creative and imaginative manipulatives that help students visualize chemical concepts are welcome. Presentations that assess the effectiveness of these techniques are also included.

### **32. Current Research on the Undergraduate Chemistry Laboratory**

*Symposium Organizer:* Nikita Burrows

*Proposed Audience:* College

*Symposium Description:* Chemistry faculty generally agree that the laboratory is an important component of the chemistry curriculum. However, there may be less agreement among faculty about the goals and learning objectives for the laboratory and how laboratories should be designed and assessed. This symposium will focus on current qualitative and quantitative research related to the undergraduate chemistry laboratory curriculum. Contributed papers should address research related to any aspect of the undergraduate laboratory. This includes, but is not limited to, general chemistry, organic chemistry, biochemistry, instructors, students, laboratory curriculum, pre-laboratory assignments, laboratory assessments, cognitive, affective or psychomotor factors, etc. Related research on laboratory design for exploring student's engagement in chemistry laboratory may also be addressed.

### **33. Developing and Supporting Chemistry Teachers**

*Symposium Organizer:* Sarah Boesdorfer

*Proposed Audience:* College, High School, Middle School

*Symposium Description:* With numerous changes taking place in chemistry education, including the adoption of the Next Generation Science Standards by many states, changes to the AP Chemistry curriculum and test, and continued efforts to improve student achievement in general chemistry, both novice and experienced chemistry teachers are being asked to adapt their teaching practices. This symposium intends to provide a space to share, explore, and analyze methods in which educators, researchers, and programs are supporting chemistry teachers at all levels to change and develop their teaching practices. Chemistry teachers are included in this group as well as they also work to improve their own practice and their colleagues's practice. This symposium welcomes submissions which discuss chemistry teachers, their teaching practices, and their development.

### **34. Discourse Frameworks in Active Learning Chemistry Classrooms**

*Symposium Organizer:* Lisa Shah

*Proposed Audience:* College, High School

*Symposium Description:* Recent investigations of discourse patterns in active learning chemistry courses have provided novel insights into how students think, learn, and engage with each other. Findings from these studies have informed instructional and curricular adaptations aimed at improving the quality of student discourse and conceptual understanding in these settings. This symposium will highlight the application of specific discourse frameworks for investigating unique research questions and contexts across K12 and higher education.

### **35. Engaging non-science majors in chemistry through current scientific topics**

*Symposium Organizer:* Kathleen Hess

*Proposed Audience:* College

Symposium Description: How can we engage students that are non-science majors to learn about current scientific topics? Climate change, renewable energy, green chemistry, recycling and designer drugs are examples of current topics that have chemistry at the center of the science. The broad implications for the environment and society make these topics of interest to students who are non-science majors. This symposium welcomes presentations that focus on creative ways to engage non-science majors in chemistry through current scientific topics. The presentation can detail efforts within a traditional non-science major course or the creation of a completely new course. Courses that incorporate interdisciplinary study of a scientific topic for non-science majors are also welcome.

### **36. Engaging students in organic chemistry**

*Symposium Organizer:* Barbara Murray

*Proposed Audience:* College

Symposium Description: This symposium includes presentations of a variety of methods for engaging students in organic chemistry. These could range from individual creative activities to year-long methods of teaching using new pedagogies and anything in between.

### **37. Engaging Students in Physical Chemistry**

*Symposium Organizer:* Craig Teague

*Proposed Audience:* College

Symposium Description: Presentations in this symposium may include new laboratory or classroom exercises, new approaches to the structure of the physical chemistry curriculum, active learning pedagogies, the inclusion of contemporary research topics in the curriculum, and the interface of physical chemistry with other disciplines. Discussions will include issues in the physical chemistry curriculum and strategies to improve student engagement.

### **38. Enhancing student learning and retention in introductory “gatekeeping” chemistry courses**

*Symposium Organizer:* Supaporn Kradtap

*Proposed Audience:* College, High School, General Audience

Symposium Description: The introductory first and second year chemistry courses, especially General Chemistry and Organic Chemistry, are viewed by some as “gatekeeping” courses to weed out students from pursuing their future careers of choice. Students enter colleges and introductory chemistry courses with widely varying backgrounds from extremely well-prepared with AP course experiences to at risk students who lack vital skills, such as basic math, necessary for the course. Therefore, it is a difficult task to teach these courses and to balance

the main goals of covering necessary content fundamentals for the next upper-level courses while engaging students of all abilities in class to learn what they need to know in a short period of time. Even though some institutions are able to offer tutoring sessions, not all students can participate. Rather than depending only on the institutional level resources, what can we, the instructors of these courses, do now to help students persevere and improve their learning? This symposium is the space for educators to share teaching pedagogies, intervention strategies, class management techniques, and teaching materials/activities that enhance student learning and motivation to increase the rate of successful completion in these introductory courses.

### **39. Finalizing Education of Chemistry Majors: How do we better prepare chemistry graduates for careers in industry and graduate school?**

*Symposium Organizer:* Bratoljub Milosavljevic

*Proposed Audience:* College, General Audience

*Symposium Description:* Although much effort has been invested in helping high school graduates to transition from the high school level to the college level and to increase their retention, very little attention has been devoted to narrow the gap between chemistry graduates and chemistry professionals. The purpose of the proposed symposium is to initiate the discussion and find answers to questions such as: How well prepared are BS Chemistry majors for their postgraduate endeavors? How can they be more competitive on the job market or more efficient in graduate school? This session would initiate a dialog between industry and university representatives to evaluate current pedagogical approaches and propose new curricula in order to increase the graduates' employability. Pedagogical considerations would leverage the activation of foundational knowledge and skills and integrate these core abilities with technical and soft skills to develop dynamic problem solving skills, which in turn would make our students more effective in graduate studies.

### **40. Food Chemistry**

*Symposium Organizer:* Keith Symcox

*Proposed Audience:* College, General Audience

*Symposium Description:* This symposium will explore the uses of food and food related topics as a teaching tool in chemistry. Both stand alone courses as well as modules of existing courses that enhance student understanding of chemical topics are encouraged to present here. Submissions of innovative coursework are encouraged.

### **41. General Papers**

*Symposium Organizer:* William Donovan

*Proposed Audience:* College, High School, Middle School, General Audience

*Symposium Description:* Submissions to this symposium are encouraged from presenters that feel that their work does not fit into any of the predefined symposia. The organizer will build sessions of similarly-themed presentations.

#### **42. General Posters**

*Symposium Organizer:* Kathryn Haas | William Donovan

*Proposed Audience:* College, High School, Middle School, General Audience

**Symposium Description:** All attendees who wish to present their work in the form of a poster should submit abstracts to this symposium. A poster provides a concise and visual description of the work that serves as a backdrop for interactions between the author and session attendees. Attendees rotate through posters, stopping to read and ask questions at their convenience while authors answer questions and provide clarifications and additional information. More information about posters can be found in the Poster Guidelines document on the submission site's main page.

#### **43. George R. Hague Jr. Memorial AP Chemistry Symposium**

*Symposium Organizer:* Kathleen Kitzmann

*Proposed Audience:* College, High School

**Symposium Description:** This symposium is designed for teachers of Advanced Placement Chemistry. Topics covered will include ideas, demos, labs, and other best practices related to AP Chemistry. We will also have input from the College Board and the AP Chemistry Test Committee regarding the 2018 Exam. The symposium honors the many outstanding contributions made by George Hague to chemical education.

#### **44. Get To Know the USNCO: Chemistry Excellence at the High School Level**

*Symposium Organizer:* Melissa Barranger-Mathys

*Proposed Audience:* College, High School

**Symposium Description:** Have you heard of the Chemistry Olympiad and wondered what it's all about, how to get involved, how to get your students involved? This symposium will explore the structure, activities, and benefits of the United States National Chemistry Olympiad (USNCO) program. Excellent chemistry students at the High School level can qualify to attend the study camp at the Air Force Academy; and representatives of the team, chosen from the study camp, travel and compete internationally. The presenters will cover several aspects of the USNCO team such as, qualifications to be on the team, study camp experience, mentor preparations, and more. .

#### **45. Green Chemistry in High School, College & University Curricula (and Beyond!)**

*Symposium Organizer:* Andrew Dicks | Loyd Bastin

*Proposed Audience:* College, High School, Middle School, General Audience

**Symposium Description:** This symposium will highlight the incorporation of green and sustainable principles throughout the chemistry curriculum as well as through co-curricular activities such as clubs, organizations and service-learning opportunities. It will examine classroom teaching modules/courses, learning methods, educational research, laboratory

experiments and experiences having their roots in the Twelve Principles of Green Chemistry (e.g. new strategies for teaching toxicology concepts). The focus will be on green chemistry materials and models designed to educate high school students as well as undergraduates at community colleges, four year colleges and graduate institutions.

#### **46. Helping Students Learn Chemistry: Visualizations, Analogies, Games, and Toys**

*Symposium Organizer:* Jodye Selco

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: What tricks do you use to help students learn chemistry - the "invisible" science? Come learn about tested and successful tricks that help students learn.

#### **47. Helping Students Learn How to Learn: Metacognition (and more!) in the Chemistry Classroom**

*Symposium Organizer:* Paula Weiss | Margaret Haak

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: Many incoming students today are not equipped with the skills to be successful in general chemistry courses. This symposium will focus on best practices and novel ideas on how to build these skills in the general chemistry classroom without sacrificing content.

#### **48. How Do We Know That?**

*Symposium Organizer:* Larry Dukerich

*Proposed Audience:* College, High School

Symposium Description: One of the Science and Engineering Practices advocated by NGSS is to develop and use models. Specifically, the language for this practice states that students should be able to 'Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.' However, all too frequently textbooks provide students little or no evidence for models that describe the structure or behavior of matter. In order for students to be able to critically evaluate the merits and limitations of models, they should be given the opportunity to examine and evaluate the supporting evidence. In this symposium teachers will describe efforts to allow students to better understand how our models have evolved.

#### **49. Improving Student Learning Strategies in Chemistry Courses.**

*Symposium Organizer:* Ted Clark

*Proposed Audience:* College, High School

Symposium Description: In introductory STEM courses student learning strategies that led to success in high school often do not lead to success in first and second year Chemistry courses. The role of the instructor for addressing this need is far reaching, and includes pre-class activities, in-class activities, homework, and pre-exam activities, since each of these domains

affords opportunities for improving student approaches toward learning. In this symposium, strategies for improving student learning will be discussed, along with ways to encourage students to adopt such strategies.

### **50. Innovating Inorganic Chemistry Education at the Intersection of Research and Practice**

*Symposium Organizer:* Jeffrey Raker

*Proposed Audience:* College

**Symposium Description:** The collaboration of educators and educational researchers can support teaching and learning improvements that are rapid, relevant, and accessible. Inorganic chemistry education is unique in the undergraduate curriculum in that there is significant faculty autonomy in topic coverage and pedagogical approach. Thus, inorganic chemistry education is an excellent context for developing and evaluating evidence-based instructional materials. The goal of this symposium is to provide a forum for educators and educational researchers to share their efforts to develop, adapt, and adopt research-based materials and teaching strategies for use in undergraduate inorganic chemistry courses. Submitted talks should express how classroom practice has informed educational research or how educational research has informed classroom practice. This symposium is co-organized by the Interactive Online Network of Inorganic Chemists (IONiC) and the DivCHED Chemistry Education Research Committee.

### **51. Innovative Ways to Lower Course Material Costs**

*Symposium Organizer:* Jacqueline Nikles | Mitzy Erdmann

*Proposed Audience:* College

**Symposium Description:** The rising cost of higher education and the financial impact on students and their families has become a growing concern among educators and higher education institutions. Textbook costs have risen 800-1,000% over the past 30 years, and it is estimated that a student may spend as much as \$1300 in an academic year on books and supplies. While students are often very creative about seeking out less expensive alternatives (textbook rentals, using an older edition, sharing with another student or not purchasing a textbook at all), some of these alternatives may negatively impact their academic success. This symposium will focus on the wide variety of ways educators and their institutions have implemented to make course materials more affordable without impacting the quality of the course content. The symposium will have a morning and afternoon session with a discussion panel at the conclusion of the day consisting of the speakers from both sessions.

### **52. Integrating civic engagement into chemistry courses**

*Symposium Organizer:* Amy Johnson

*Proposed Audience:* College, High School, General Audience

**Symposium Description:** Chemistry courses are an ideal context in which to meaningfully link scientific content with issues of local, national, and/or global importance. In this symposium, we invite authors to discuss all aspects of embedding real world problems into their courses,



including but not limited to: What civic issues have you integrated into your courses and why? What types of readings, case studies, activities, and assessments have you employed? What data do you have on the impact of incorporating civic engagement on student success, retention, and/or motivation? How have you managed the pragmatic issues involved, such as having enough time to revise the course, figuring out how and where to incorporate civic issues into the curriculum, accommodating standardized assessments, etc.? What barriers have you faced from administrators, colleagues, and/or students and how did you address them? What benefits have you, your students, your school, and/or your community noticed from engaging students in these public, multifaceted issues? What advice do you have for others embarking on revising courses to connect students to their local and global community? We'll conclude our session with a group discussion of how to carry the ideas presented into our classrooms and communities.

### **53. Integrating Laboratory Safety Education Into the Chemistry Curriculum**

*Symposium Organizer:* Renee Link

*Proposed Audience:* College

*Symposium Description:* Danger is inherent in any laboratory work, and so learning to work safely in a laboratory setting is an essential part of a science education. Traditional approaches to imparting this knowledge in undergraduate laboratory courses has mainly consisted of assigning reading on safety, providing a safety quiz, and presenting a list of safety hazards relevant to each experiment. Recent laboratory accidents across the country have highlighted the necessity of effective safety education and have raised questions regarding whether we in the undergraduate education community are doing enough to ensure our graduates know how to assess laboratory hazards and conduct operations in a safe manner. Speakers will describe efforts underway to incorporate and integrate laboratory safety education into the chemistry curriculum at the class or program level.

### **54. Interdisciplinary Collaboration in Chemistry Courses: Practices and Challenges**

*Symposium Organizer:* Bozena Widanski

*Proposed Audience:* College

*Symposium Description:* Interdisciplinary approaches are not new to chemistry pedagogy, frequently occurring between chemistry and other sciences. However, collaboration among chemistry, library, and liberal arts faculty offers myriad opportunities to reinforce student learning through development of information literacy competencies, critical thinking skills, and oral and written communication skills. Presentations in this symposium will provide examples of best practices, tips for success, and suggestions for avoiding problems in interdisciplinary collaboration to improve teaching and learning.

### **55. Issues in teaching and learning in a biochemistry course for nonmajors**

*Symposium Organizer:* Corina Brown

*Proposed Audience:* College, General Audience

**Symposium Description:** A presentation of biomolecules and metabolic pathways is part of a biochemistry nonmajor course attended by students from several majors such as pre-health, dietetics students, sports and exercising science students. Thus, biochemistry course for nonmajors has a unique set of challenges for the instructors including time management, content expectations by programs, and students who may not have a strong foundation in the prerequisites for this course. Educators are invited to present on their development/management of course content, assessment of student learning, or evidence-based classroom instructional strategies. This session will conclude with a discussion in which the audience and the presenters will identify successful trends in teaching the course.

### **56. Learning About Quantitative Research in Chemistry Education Research**

*Symposium Organizer:* Jordan Harshman

*Proposed Audience:* General Audience

**Symposium Description:** With the growing practice of both chemical education research and implementation of chemistry education tools and activities, there are many novel and exciting ways in which statistical, mathematical, and numerical analysis is being implemented. Invited speakers will not only discuss their quantitative research, but the focus will be for experts to present a specific technique, method, or procedure and show the audience a) why they implemented the technique, b) how they implemented the technique, and c) an interactive discussion where the speaker will engage the audience about how to conduct the technique for themselves. Because of the emphasis on how to implement the discussed technique, a double time slot symposia (2 20-minute blocks) is preferred to give time for researchers to talk about their research, provide an interactive lesson on the methods discussed, and supply ample time for questions and discussion.

### **57. Learning About Theoretical Frameworks in Chemistry Education Research**

*Symposium Organizer:* Brittland Dekorver

*Proposed Audience:* College, High School, General Audience

**Symposium Description:** There is a growing interest in the chemistry education community for engaging in educational research to strengthen educational practice. Sound educational research is guided by solid theoretical frameworks that guide researchers in the design of their studies and in the collection, analysis, and interpretation of data. Invited speakers with experience in conducting and publishing chemistry education research will actively engage the audience in strategies for selecting and using theoretical frameworks to support chemistry education research. Each presentation will incorporate an extended discussion so that attendees have time to ask questions and discuss issues.

### **58. Metacognitive strategies for supporting students in learning chemistry**

*Symposium Organizer:* Ben Meacham

*Proposed Audience:* High School

*Symposium Description:* This symposium will provide a variety of strategies that teachers can use to support their students with becoming more self-aware of their own thinking processes throughout the learning process. In addition to promoting the correlation between metacognitive abilities and achieving higher-order thinking, such strategies will apply to communication, teamwork, literacy, modeling of chemical processes, brain science, and writing quality scientific explanations.

### **59. Models and modeling in Introductory Chemistry**

*Symposium Organizer:* Laura Slocum

*Proposed Audience:* High School, Middle School, General Audience

*Symposium Description:* Model development and use is central to the scientific process, and provides students with a framework for recognizing and working with key principles of how nature works. New NGSS standards require students to be able to make and use models of nature. In this symposium modeling teachers will focus on efforts to organize the introductory chemistry course around models rather than the bewildering array of topics found in conventional texts.

### **60. Mom the Chemistry Professor: Personal Accounts & Advice from Chemistry Professors who are Mothers**

*Symposium Organizer:* Kimberly Woznack

*Proposed Audience:* College, General Audience

*Symposium Description:* Is it possible to balance the demands of a professorship, while still starting and raising a family? When would be the “right” time to have children with respect to the tenure clock? While the number of “Mom the Chemistry Professor” role models is on the rise, there are still many female graduate students and post-docs who may not seriously consider a career in academia due to the perception that the professoriate is not compatible with motherhood. The second edition of “Mom the Chemistry Professor”, published by Springer, features personal accounts from women who have balanced academic careers with motherhood. Authors from the book will share their personal accounts and advice for those considering a career in academia.

### **61. More bang for your buck: (More) effective active learning methods in General Chemistry**

*Symposium Organizer:* Mark Blaser

*Proposed Audience:* College, High School

*Symposium Description:* Active learning methods can provide significant advantages over traditional instructional practices. A wide variety of active learning approaches can (potentially) improve student engagement and increase student learning. But ... which one(s) are most

worth trying? What are the pros and cons of each? How high is the activation energy for a given method? How important are the details of the instructional mechanism used? This symposium will focus on active learning methods that instructors have found to offer "more bang for your buck" in General Chemistry; i.e. ones that offer larger gains in engagement and/or learning for a given approach.

### **62. New Directions in Academic Lab Safety**

*Symposium Organizer:* David Finster | Monique Wilhelm

*Proposed Audience:* College, High School

*Symposium Description:* Safety in academic labs is taking on more importance in both high schools and colleges. This symposium will address best practices in academic lab safety instruction and department strategies to foster safe laboratories across the educational spectrum. It is expected that presentations will stimulate robust conversations about current and future practices.

### **63. NSF Programs that support undergraduate education**

*Symposium Organizer:* Robert Boggess | Cindy Burkhardt

*Proposed Audience:* College

*Invited speakers only. Symposium Description:* This Symposium will feature speakers whose projects have been funded by the National Science Foundation in support of undergraduate education (IUSE, ATE, Noyce Scholarship Program, S-STEM, etc.) through the Division of Undergraduate Education (DUE). These projects have developed new educational materials, new strategies for delivering educational material, meaningful evaluation of learning gains, means to support faculty development, scholarships for STEM students, and so forth, all aimed toward improving the learning of chemistry or other STEM disciplines by undergraduate students with diverse backgrounds and career aspirations. A NSF Program Officer will present an overview of current NSF programs and will participate in a question/answer session.

### **64. One-pot synthesis for student success in general chemistry**

*Symposium Organizer:* Vickie Williamson

*Proposed Audience:* College, High School

*Symposium Description:* In general chemistry, we often face a push to increase students' success, or at least decrease the percentages of D/F/W students. This translates to instructors finding nimble strategies for a "one-pot synthesis" to improve the success efficiency of our students even when they enter with different aptitudes and skills. What catalysts are needed to avoid unwanted intermediates and repeated classes, which increase students' time and costs, deplete valuable classroom resources and delay completion of STEM degrees? This symposium welcomes presentations on curriculum transformations, interventions, and evidence-based research on how to improve success rates of underprepared general chemistry students.

## **65. Overarching Undergraduate Curriculum Reform**

*Symposium Organizer:* Douglas Mulford | Leah Williams | Robert Harris

*Proposed Audience:* College, General Audience

**Symposium Description:** In the past few years there have been several institutions that have committed to innovative reform across the undergraduate chemistry curriculum. This symposium focuses on those programs seeking to make changes across multiple courses or labs as opposed to single course reform. Talks focusing on challenges to reform and implementation as well as the results of reform are welcomed. Reform efforts in progress are welcomed in addition to those that have completed rollout. Presenters are encouraged to highlight assessment efforts and plans.

## **66. Overcoming challenges through science outreach. Bringing positive science experiences to non-traditional audiences.**

*Symposium Organizer:* Graeme Wyllie

*Proposed Audience:* College, High School, Middle School, General Audience

**Symposium Description:** Providing positive science experiences is critical in not only encouraging the scientists of tomorrow but also generating a positive reaction to science from the general public. Traditional science outreach takes place in a range of venues from the classroom to community hubs such as the library or after school or summer camps and often serves multiple audiences across a wide range of ages. Yet, we should not exclude those who face additional challenges or barriers from gaining such experiences and this symposium is designed to share examples of how to overcome the barriers which might prevent access to positive science experiences. Examples of barriers or handicaps which may be encountered might be financial, language, or mental or physical disability. Presenters are encouraged to share details on either ongoing programs or projects or one-off events and how they coped with the additional challenges provided by the audience.

## **67. Peer instruction across the postsecondary curriculum**

*Symposium Organizer:* Rebecca Gibbons | Shalini Srinivasan | Caitlin Zumalt | Jeffrey Raker

*Proposed Audience:* College

**Symposium Description:** Peer instruction has been supported by evidence to improve student outcomes and process skills throughout the undergraduate chemistry curriculum. A variety of techniques such as PLTL, peer instruction, learning assistants and peer mentoring have been developed, adapted and applied in educational environments on a national and international scale. This symposium, targeted at the college level, will highlight the impact of collaborative learning techniques on cognitive outcomes, affective outcomes and retention. Emphasis will be placed on researchers and practitioners who can speak to the use of assessment and evaluation techniques to improve peer instruction in the undergraduate chemistry classroom.

## **68. Performance Expectations in General Chemistry**

*Symposium Organizer:* Donald Wink

*Proposed Audience:* College, High School

Symposium Description: Following on the work of a joint DivCHED / SOCED task force, the ACS Education Division has hosted two workshops on General Chemistry Performance Expectations (GCPE). The workshop has engaged more than two dozen institutions in the process of considering how the three dimensions of the Framework for K-12 Education can be used in general chemistry. This symposium will feature reports from participating institutions as they implement this strategy within their classrooms.

## **69. Persistence in STEM: What can we do to support students?**

*Symposium Organizer:* Barbara Gonzalez

*Proposed Audience:* High School, General Audience

Symposium Description: Students' persistence in STEM is of great concern for educators and researchers. In this symposium, we are going to explore different activities educators and researchers are pursuing in classrooms and colleges to support students' persistence in STEM. These activities include, but are not limited to research studies of factors that affect students' persistence and results from programs implemented at the university or college level to support students. We invite researchers and practitioners to share their findings with the community.

## **70. Present and future directions in organic chemistry laboratory courses**

*Symposium Organizer:* Noel Paul

*Proposed Audience:* College

Symposium Description: This symposium seeks to foster a discussion of innovations in course content and execution by bringing together chemical educators who instruct undergraduate organic chemistry laboratories. Presenters are invited to offer their perspectives on the development of new experiments or teaching modules, the utilization of digital resources for visualization, problem solving, or scientific recordkeeping, or strategies to streamline the learning experience. Advancements in the realization of large enrollment laboratory courses are of special interest, as are advancements that may be scalable to that environment.

## **71. Problem Solving as a Pedagogical Method (PSPm) in Chemistry**

*Symposium Organizer:* Sara Madsen

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: Imagine at this moment that you are in your classroom. The classroom learning environment might be traditional, guided-inquiry, active learning, active research, flipped, perhaps several of these in combination, or in different approaches unmentioned. However, the tie that binds us together in these environments as educators is the problem solving thread that we try to weave into our students. Contrarily, students might perceive that

problem solving should involve a manual; like putting a lawn mower or a barbeque together. However, problem solving as a pedagogical method is very broad in range. For instance, you might have a specific problem solving method used to teach only aspects of chemical equilibrium. Or maybe, you have a problem solving method that teaches the interconnectivity between all the basic cell metabolic cycles. Or, you have a problem solving method that helps students quickly master organic chemical synthesis. However, in general, the approach to solving a particular problem involves a beginning and an end. The outcome of problem solving as a pedagogical method could assist educators to probe at which points in the problem solving process where students are limited in building a viable solution to the problem and or learning how problems are solved. Presenters are welcome to bring their pedagogical problem solving approaches to this symposia. The symposia is open to a wide range of courses; such as, GOB, general chemistry, organic chemistry, inorganic chemistry, graduate level courses. Presenters are encouraged present their techniques on how they work with problem solving in any aspect of science.

## **72. Promoting Argumentation in the Chemistry Laboratory**

*Symposium Organizer:* Dawn Del Carlo

*Proposed Audience:* College, High School, General Audience

*Symposium Description:* This symposium aims to provide educators who have researched, implemented, or attempted to implement the practice of argumentation into their laboratory classrooms a place to discuss their findings and experiences. Presentations can be researcher or practitioner based. We are especially interested in those that recognize the connection between research and practice or address the successes and failures of their implementation. Discussion panels will take place at the end of each session, time permitting.

## **73. Promoting Teaching and Learning Chemistry Through Engaging Case Studies**

*Symposium Organizer:* Li Qiong Wang

*Proposed Audience:* College, General Audience

*Symposium Description:* The purpose of this symposium is to promote the case studies in undergraduate chemistry teaching and learning. The case study method has been widely used in professional schools of business, medicine and law. Recently it gains popularity in undergraduate colleges and universities. In stead of traditional teaching, students will be reading literatures on real cases and then come to the class with questions to discuss. The instructor will lead the discussion. The advantages of such teaching are to increase the critical thinking skills for students and stimulate their learning. In addition to the discussion in the classroom, students will be involved with the engaging hands-on laboratory activities that are directly related to their case study to further enhance their learning. For example, in our new chemistry and art course, students will be asked to read the case study on the statue of liberty and then in the class, the topics such as the historical and culture significances and the urgent needs for the conservation due to the corrosion will be discussed. Hands-on activities associated with the corrosion and conservation of the statue of liberty will also be implemented.

#### **74. Qualitative Research in Chemical Education: In Pursuit of Whys and Hows**

*Symposium Organizer:* Thomas Bussey | Stephanie Ryan

*Proposed Audience:* College

Invited speakers only. Symposium Description: The Chemistry Education Research (CER) and Younger Chemistry Education Scholars (YCES) Committees are co-hosting a symposium highlighting the role of qualitative research in chemical education research. Many educational research questions focus on what, when, or where learning and teaching occurs. To answer these types of questions, a variety of statistical measures are employed. However, to ask questions about why or how something is occurring, qualitative methodologies can/should be utilized. During this symposium, invited speakers will present 40-minute talks about their research and their use of qualitative methods to answer questions of why or how.

#### **75. Research at the Interface of Chemistry and Mathematics Education**

*Symposium Organizer:* Kinsey Bain

*Proposed Audience:* College, General Audience

Symposium Description: The transfer of learning between chemistry and mathematics is a rich area for inquiry. Presentations are welcome which have an evidence-based understanding of how students use mathematics or mathematical models to understand chemistry at the undergraduate level. Alternatively, presentations which have an evidence-based understanding of chemistry topics that promote applications of mathematical modeling in order to understand chemical phenomenon are encouraged as well.

#### **76. Research in Chemistry Education**

*Symposium Organizer:* Thomas Bussey

*Proposed Audience:* College

Symposium Description: This symposium provides a broad forum for chemistry education research (CER) including but not limited to quantitative, qualitative, mixed methods, and action research studies. A submitted abstract and presentation should be aligned with the criteria for CER published in the Journal of Chemical Education and address (1) the motivation or purpose for the research and type of problem investigated, (2) the research question(s), (3) the conceptual and methodological frameworks chosen to guide the study, and (4) the findings and implications of the study. Presentations should focus primarily on the findings and interpretation of data. This symposium is sponsored by the ACS DivCHED Committee on Chemistry Education Research.



## **77. Research-based Activities in Chemistry Classroom and Laboratory**

*Symposium Organizer:* Min Li

*Proposed Audience:* College, High School, Middle School, General Audience

**Symposium Description:** This symposium focuses on developing research-based activities in chemistry classroom and laboratory. The innovative ideas of integrating research-based activities are encouraged in the symposium. Research skills is essential for all chemistry students and plays an important role in higher education. However little research-based activities are integrated in the chemistry classroom and laboratory for reasons like, inflexible curriculum design and schedule. Research-based activities can be in a variety of formats, such as topic-specific discussion, written report, presentation, online posting in classroom and experiment design in laboratory. Such activities will enhance student learning of chemistry knowledge in classroom and laboratory and will prepare students with more research and analytical skills for their future careers.

## **78. Review of the 2018 Chemistry Exam Results**

*Symposium Organizer:* Trinna Johnson

*Proposed Audience:* High School

**Symposium Description:** Participants in this session will examine the results of the 2018 AP Chemistry Exam with the Chief Reader for AP Chemistry. Exam topics and questions that students found most challenging will be identified, discussed, and analyzed. Participants will compare the challenging topics from the 2018 AP Chemistry Exam to those that were most challenging to their own students. They will then consider how to develop individual methods for implementing best practices in their own schools and classrooms to address these topics. Finally, participants will also learn about instructional strategies for the course topics as they are taught at the college level and how these impact the AP course and exam.

## **79. Roots of success and retention for the chemistry degree**

*Symposium Organizer:* DeeDee Allen

*Proposed Audience:* College, High School, General Audience

**Symposium Description:** The focus of this symposium is on the research and best practices that promote success and retention in the field of chemistry, specifically at institutions of higher education. Presentations may address academic and/or socioeconomic roots that promote success and retention at different academic stages including early interests all the way through the community college and four-year institutions. Also valuable would be to highlight specific barriers and challenges encountered on the paths to completion. Of specific interest are the following questions: What initiates or promotes interest in chemistry? How is that interest sustained through degree completion? What fosters success? How is success measured at different institutions? What are viable recruitment and retention practices for students majoring in chemistry?

## **80. Science Online: Creating Engaging and Interactive Virtual Classrooms**

*Symposium Organizer:* Kristi Mock

*Proposed Audience:* College, High School

Symposium Description: Science courses do not easily lend themselves to the online platform. There is not much group work in the traditional science course so we must be creative in the ways we foster interactions both between the individual student and the material and also between students. This symposium will look at the ways we are finding to encourage and engage our online learners.

## **81. Spiral (Two-Cycle) Organic Chemistry**

*Symposium Organizer:* Michael Garoutte

*Proposed Audience:* College

Symposium Description: For decades, a spiral, or two-cycle, curriculum has been employed in varied university settings in place of a traditional two-semester organic chemistry sequence. One rationale for using this approach is that it allows the first semester to serve a dual purpose as a standalone survey course, avoiding “course proliferation.” More significantly, studies have repeatedly shown that student retention improves when this approach is used, without sacrificing student performance. This symposium is designed to continue the exploration of the spiral approach to teaching organic chemistry, report results of its implementation, and foster further development of resources to assist educators wishing to adopt this approach.

## **82. Student-centered inquiry learning with an emphasis on process skills in the classroom and laboratory**

*Symposium Organizer:* Gail Webster

*Proposed Audience:* College, High School, Middle School

Symposium Description: This symposium will provide an opportunity for practitioners (high school through university level) to present work focusing on student-centered pedagogies (such as PBL, PLTL, POGIL, or TBL). Emphasis will be placed on approaches that require students to be actively engaged on a regular basis with a focus on improving process skills such as communication, metacognition, teamwork, critical thinking, or problem solving. Presentations that contain assessment of these student-centered approaches in class and lab are especially welcome.

## **83. Supplemental Support Initiatives for Introductory Chemistry Student Success**

*Symposium Organizer:* Aimee Miller | Laura Anna

*Proposed Audience:* College, General Audience

Symposium Description: Introductory chemistry is an early part of most science programs and sometimes serves as an unintentional barrier to student completion of STEM degrees. This symposium will explore classroom and institutional initiatives that introduce supplemental learning opportunities aimed at enhancing student success in introductory chemistry courses.

Have you or your institution tried something new to supplement introductory chemistry instruction? How are best practices from individual classrooms transferred more broadly within a department or school? What aspects have you found to be most valuable for students? What design features have been used to motivate students to participate in supplemental instruction? All are invited to share innovations for supplemental support in classrooms or programs that increase student success in introductory chemistry and keep STEM programs accessible to all students.

#### **84. Supporting the growth and impact of the chemistry education research community**

*Symposium Organizer:* Deborah Herrington

*Proposed Audience:* College

Invited speakers only. *Symposium Description:* As a discipline, Chemistry Education Research (CER) is still relatively young and small. Though CER has come a long way since its emergence as a discipline in the 1970s and the creation of the first CER PhD programs in the early 1990s, there is still much to be done to make CER a widely accepted and recognized discipline. For example, a 2012 publication from the National Academies Press looking at Discipline Based Education Research (DBER) reported only 29 programs in the US where graduate students can earn a Ph.D. in chemistry for CER. Currently post-doctoral opportunities in CER are still quite limited. Further, though chemistry departments across the country have begun to hire one or more CER faculty, many of these faculty face the challenge of educating students and their colleagues about what CER scholarship involves. As a result, they often have to navigate ill-defined expectations for tenure and promotion. This symposium aims to bring together CER faculty from a wide range of institutions at a variety of points in their careers to frame a discussion for the CER community about the role each of us plays in developing and growing CER as a discipline. Topics will include the current state of CER as a discipline, educating your colleagues about CER, developing effective collaborations, the importance of undergraduate CER programs, starting a CER research program at a PUI or research institution, effective mentoring, networking, and the role of the post-doctoral experience.

#### **85. Supporting Under-Represented Minorities to Increase Undergraduate Retention and Success**

*Symposium Organizer:* Kristy Mardis | Andrea Van Duzor | Robert Lesuer

*Proposed Audience:* College

*Symposium Description:* The purpose of this symposium is to provide a forum to discuss diverse approaches for supporting undergraduate minority students in chemistry. Issues that may be addressed include: barriers and systemic challenges, community building, the effect of active learning, science identity and self-efficacy, and effective mentorship. Presenters are encouraged to report preliminary data on research in progress or programmatic structures they have implemented in this area. Symposium presenters and the audience are also encouraged to pose questions for discussion on issues addressed during the session. A panel discussion will follow the presentations.

### **86. Takin' it to the Streets. Chemistry outside the classroom.**

*Symposium Organizer:* Michael Morgan

*Proposed Audience:* High School, Middle School, General Audience

Symposium Description: Teaching chemistry is not limited to activities in a classroom or laboratory. This symposium will focus on activities such as public outreach, academic competition, and other forms of non-traditional chemistry related activities. Chemistry Clubs, National Chemistry Week, Chemists Celebrate Earth Day, Chemistry Olympiad, and Science Bowl will be discussed.

### **87. Teaching Chemistry at Minority-Serving Institutions**

*Symposium Organizer:* Alexey Leontyev

*Proposed Audience:* College, General Audience

Symposium Description: The number of Minority Serving Institutions (MSIs) is rapidly increasing in the United States. For example, Hispanic-serving institutions had increased from 137 in 1990 to 409 in 2013. Of the many factors that increase the persistence of underrepresented students, the quality of teaching ranks as one of the highest. While these (and more) strategies are effective for all students, not just those at an MSI, they are particularly important to close the retention gap for underrepresented students. The main goal of this symposium is to provide an opportunity to share “best practices” to increase retention rates with a broader community of practitioners. These approaches may include ways to: improve faculty-student interactions, engage students in the classroom and laboratories, help students to build confidence, foster campus-wide community building, and encourage external collaborations with the greater community to help all students succeed in chemistry.

### **88. Teaching chemistry in the context of forensic science**

*Symposium Organizer:* Amanda Harper-Leatherman

*Proposed Audience:* General Audience

Symposium Description: This symposium will give an opportunity for those teaching forensic science or teaching chemistry using forensic science concepts to describe the latest teaching techniques, pedagogies, laboratories, and other innovations in the field.

### **89. Teaching Large Classes: The Good, The Bad, & The Ugly**

*Symposium Organizer:* Alicia Paterno

*Proposed Audience:* College

Symposium Description: This symposium will discuss successes, trials, and tribulations in the large chemistry classroom. Topics may include course management strategies, technology, mentoring teaching assistants, and other topics that pertain to teaching large classes. A desired result of this symposium is the formation of a support network of faculty who teach large classes at different colleges and universities.

## **90. Teaching nuggets for AP and general chemistry**

*Symposium Organizer:* Paul Price

*Proposed Audience:* College, High School

Symposium Description: Veteran teachers of AP and general chemistry know to prepare themselves for the multitude of questions and misunderstandings students will exhibit over a variety of topics. In the course of trying new approaches to present material, we may be lucky and hit upon an original approach, enlightening demonstration, or clarifying problem that significantly aids student understanding. Join educators on both sides of the high school / college interface as they present some of their favorite teaching nuggets to help all students improve their comprehension.

## **91. Teaching transferable skills in the chemistry laboratory curriculum: real research, real training**

*Symposium Organizer:* Binyomin Abrams | Rosina Georgiadis

*Proposed Audience:* College

Symposium Description: The ACS Guidelines for Bachelor's degree programs place a substantial emphasis on preparing students to enter the workforce or postgraduate education (section 7). While lecture courses may be the primary vehicle of content-based instruction, it is primarily the laboratory experiences that will prepare our majors for the work that they will do upon graduation. In this symposium we will focus on novel approaches designed to improve, supplement, or replace the traditional laboratory courses with an emphasis on teaching transferable skills that will prepare undergraduate chemistry students for research experiences, post-graduate study, and the workforce. Sample papers: -Georgiadis, Rosina. Teaching instrumentation with virtual machines to train chemists with expert-like skill in the laboratory - Streu, Kristina. Transformation of a laboratory course beyond asynchronous "round robin" instruction -Abrams, Binyomin. Stop writing/teaching lab reports: integrating authentic research-based writing into quantitative analysis courses -Vardar-Ulu, Didem. Updating the undergraduate biochemistry lab course for majors

## **92. Technology Integration in Chemistry Education and Research (TICER)**

*Symposium Organizer:* Tanya Gupta

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: This symposia invites papers from instructors and chemical education researchers on their experience with integrating technology in classroom and chemistry education research; the impact of technology integration on student learning, and recommendations for successfully implementing technology based teaching and learning of chemistry. The papers will involve a range of presentations that include but are not limited to the use of Simulations, Visualizations, Games-Based Learning & Assessment, YouTube videos, Handheld and mobile devices, Interactive Whiteboards, Student Response Systems, Student created media (podcasts, videos), Collaborative Tools (Wikis, Google Docs etc), Social media (Facebook, Twitter etc) in chemistry education.

**93. The 3 Ps of Student Engagement in the Flipped General Chemistry Classroom: Preparation, Participation, and Performance**

*Symposium Organizer:* Lisa Hibbard

*Proposed Audience:* College

Symposium Description: Recent chemical education research has shown that implementation of a flipped (or blended) learning pedagogical approach in the general chemistry classroom can lead to effective student engagement, deeper learning, and improved student performance. Student preparation prior to class allows for increased levels of participation and more meaningful peer and student-teacher interactions during face-to-face classroom sessions. Reinforcement of concepts through post-class performance assessments promotes subject mastery. This symposium will present the various ways in which the flipped learning environment can be developed and utilized in the general chemistry course sequence with a focus on activities and assessment strategies that promote improvements in course performance.

**94. The Application of Non-Traditional Qualitative Frameworks in Chemistry Education Research**

*Symposium Organizer:* Alex Kararo

*Proposed Audience:* College, General Audience

Symposium Description: As chemistry education continues to grow, novel qualitative frameworks are beginning to emerge into the field. The purpose of this symposium is to present how novel non-traditional qualitative frameworks are being applied to chemical education research. Speakers will be expected to shift the focus from results of a study towards how a framework informed the development of a research study and analysis of the results. Possible frameworks can include grounded theory or ethno-anthropology that are widely used in the social sciences, but rarely adopted in chemical education research. This symposium will introduce non-traditional qualitative frameworks that will allow for a new way to study the field.

**95. The Effects and Research on Peer Leaders in Peer-Led Instructional Methods**

*Symposium Organizer:* Anthony Chase

*Proposed Audience:* College, General Audience

Symposium Description: This symposium presents the opportunity to expand a large and still growing field of CER research in peer led instructional methods. Peer-Led Team Learning (PLTL), Peer-Led Guided Inquiry (PLGI), and other methods have highlighted the usefulness of instruction facilitated by near peer mentors. Studies continue to demonstrate the benefits of both participating in peer-led programs as well as serving as a peer leader in a program such as these. This symposium will focus specifically on the experience of being a peer leader. Manuscripts in this symposium will focus on the impact of instructional methods that include a peer-led strategy such as those mentioned above and their subsequent impacts on peer

leaders. This series of presentations will inform the CER community on the status of this line of research as well as provide feedback to presenters from experts in the field as to how to move forward in this area. Submissions for this symposium will be considered based upon their relation to the previous work done in peer-led methods as well as novelty of implementations (different context, changes in details of the intervention, different assessment procedures, etc.).

**96. The pros and cons of multi-week research projects in the general chemistry laboratory.**

*Symposium Organizer:* Graeme Wyllie

*Proposed Audience:* College

*Symposium Description:* Many general chemistry lab courses have moved away from the traditional Experiment of the Week format and focussed on providing multi-week projects which incorporate many of the experiences traditionally found in the research lab. There are many benefits to such projects which often allow freshman students to gain skills which may not be traditionally learned in the general chemistry lab, become more invested in the project and work on real world problems. POGIL provides a structure and learning cycle paradigm for many such projects but there are multiple examples out there of projects which have evolved independently of this framework and this symposium is designed to share details on those including both the successes and maybe the things that did not work so well. Assessment methods and data can also be discussed where available.

**97. To green or not to green? Approaches for including green chemistry in a traditional academic setting: teaching, research and service**

*Symposium Organizer:* Amy Cannon

*Proposed Audience:* College

*Symposium Description:* Traditional academic settings pose unique barriers for young professionals who are interested in implementing green chemistry in their research, teaching and service. Few universities and colleges have the capacity to run dedicated green chemistry courses and it is rare for faculty to be hired specifically for their green chemistry experience. In addition, early-career faculty may have little influence over the labs they teach and may encounter difficulties while trying to implement changes within the routine of existing infrastructure of an established department. Due to these real constraints or just perceptions, early-career faculty often find challenging to implement green chemistry into their work, something they cannot approach until after the tenure process. This session focuses on highlighting resources aimed specifically at early-career faculty and aims to provide examples of mechanisms to implement green chemistry and sustainable science solutions in research and teaching while building peer support for tackling obstacles in a traditional academic setting. Special attention will be dedicated to 'students-as-partners' approaches for facilitating the production and implementation of outreach/public engagement projects as part of the degree program. The overarching goal of the session is to equip early-career faculty with knowledge and skills to bring green chemistry to all aspects of their professional work, teaching, research and service, and build the peer support that would allow them to feel empowered to do it.

Faculty members who have successfully navigated the tenure process while using green chemistry as an innovative tool for research and teaching as well as early-career faculty who have successfully engaged peers and supporters to gain momentum for their work in green chemistry will share their experience in this session.

### **98. Training Graduate Students to be Professional Teaching Assistants**

*Symposium Organizer:* Jennifer Monahan

*Proposed Audience:* College

*Symposium Description:* The goal of this symposium is to share best practices in training graduate students to be successful teaching assistants. Graduate teaching assistants (GTAs) are instrumental in the chemical education of undergraduate students within the American university system. Many chemistry departments have initiated GTA training programs. These range from short summer “boot-camps” to year-round training. A variety of questions will be considered: What types of planning is necessary for effective training sessions? What are the benefits or pitfalls to various training schedules? How to balance the transfer of chemical knowledge, pedagogical development, professionalism, and safety? Can the research development of a GTA be supported by teaching responsibilities? How to assess the success of a training program?

### **99. Understanding animations: Is it really what is happening?**

*Symposium Organizer:* Sevil Akaygun | Resa Kelly

*Proposed Audience:* College, High School, General Audience

*Symposium Description:* Understanding chemistry requires making sense of the macroscopic phenomena at the symbolic and submicroscopic levels; however, moving among three levels of representation is often challenging for students. Various tools, including visualizations have been used to enhance students’ understanding of chemical processes. Instructors usually integrate available submicroscopic animations in their classes and expect students to understand what is happening among the particles. Students were rarely asked to connect experimental evidence observed in macroscopic representation of a phenomenon to submicroscopic representations of that particular phenomenon, explain or comment on what is happening, and make judgment if the the changes they experimentally observe matches with what they observe in submicroscopic representations of the phenomenon. The purpose of the symposium is to share research and teaching practices that emphasize the role of animations as imperfect models for making sense of chemistry. How do you introduce these models with their many limitations so that students are introduced to their strengths and limitations? We are interested in both research studying how students respond to animations that are recognized as imperfect models, how teachers and experts view these tools, and authentic examples of teaching practices that explore animations as imperfect models.



### **100. Updating the American Chemical Society's Guidelines for Programs that Offer the Bachelor's Degree.**

*Symposium Organizer:* Michelle Brooks

*Proposed Audience:* College

Invited speakers only. Symposium Description: The Committee on Professional Training (CPT) of the American Chemical Society is responsible for administering the ACS approval process for departments that offer the Bachelor's degree. ACS publishes guidelines that describe the characteristics of excellence and rigor expected for programs that offer ACS certified Bachelor's degrees. The current guidelines, which were approved in early 2015, are periodically revisited to maintain their currency. CPT is in the early phases of considering revisions to the guidelines, a process that is guided by feedback from the community and typically takes about three years. Speakers will address broad areas of chemical education encompassed by the guidelines. Time will be available for small group discussion and feedback from participants on the ACS approval process.

### **101. Using manipulatives in a chemistry classroom**

*Symposium Organizer:* Alice Putti

*Proposed Audience:* College, High School

Symposium Description: Manipulatives can be a powerful tool to help students learn difficult chemistry concepts such as equilibrium, electrochemistry, acid-base and more. When students use models to visual what is occurring on an atomic level, this increases their engagement level, deepens understanding and can address common misconceptions. This symposium will focus on using manipulatives in group activities or direct instruction. Presentation abstracts must include a description of the manipulatives and how and why they are used in the lesson or activity.

### **102. Using Science Fiction to Teach Chemistry**

*Symposium Organizer:* Keith Kostecka

*Proposed Audience:* College, High School, Middle School, General Audience

Symposium Description: Science fiction, a genre of speculative fiction, typically deals with such topics as futuristic science and technology, space travel, time travel, faster than light travel and extraterrestrial life. In recent years, physics and biology instructors have used science fiction to help in teaching important science concepts in these two areas. Chemistry instructors, following our physics and biology colleagues, are now beginning to use science fiction as a tool in the teaching of chemistry from middle school classrooms all the way to college/university settings. This symposium will display the efforts of these chemical educators in how they are using print-based science fiction and/or "video" based science fiction in their teaching. Development of instructional chemistry "units" and even full chemistry courses featuring significant science fiction content will also be featured.

### **103. Using Specification Grading to Assess Learning Outcomes in Chemistry**

*Symposium Organizer:* Heidi Fletcher

*Proposed Audience:* College, High School, Elementary/Middle School (all)

Symposium Description: Grade performance can be misleading when it is used as a determining factor for assessing whether or not course objectives have been met. Especially, when the use of partial credit is used and may mean that a student only partially grasped everything and fully mastered nothing. In addition, a student who has performed well in a course based on their grade may have actually earned the majority of their points on general content and not necessarily on essential skills required for their success in future chemistry courses. Specification grading allows for assessing whether essential skills have been mastered. This system involves identifying course outcomes as either essential or general skills. Chemistry instructors that have adopted such a grading format are invited to share how they have determined the essential skills they require mastering, how they have implemented such a grading system (i.e. course objectives, grading outline, schedule of administering the ESAs, examples of the ESAs, a comparison of the number of retakes, and student grade distributions compared to previous years, etc.) and determining the effectiveness of the ESAs in their courses.

### **104. Views from the Classrooms of Award Winning Chemistry Teachers**

*Symposium Organizer:* Deanna Cullen

*Proposed Audience:* High School

Symposium Description: Many excellent chemistry teachers have been recognized for their work by receiving a variety of awards, including the James Bryant Conant, ACS Regional Awards, the Beaumier award in Canada and other science teacher awards. These teachers have much to share with other educators about best practices in the classroom. Winners typically have an opportunity to present an award address but, how many of us get to hear their actual award presentations and learn from their experience? This symposium will give attendees a chance to meet and benefit from these award-winning teachers, as well as find out more about how to nominate a teacher for one of these awards and how each award selection process works.