College Chemistry Canada
La Chimie Collégiale au Canada

Newsletter

VOLUME 42, ISSUE 1 FEBRUARY, 2019

In This Issue

- *Invitation to 46th College Chemistry Canada (C3) Conference*
- *C3 Conference Plenary Speaker - Peter Mahaffy*
- *C3 Award for a Creative Chemist*
- *Universal Design for Learning: Choice in Lab Assessments*
- *Latest from the Literature*
- *Knowledge and Skill of Chemistry Educators*
- *President's Message*
- *The Top Ten with ….Paula Hawrysz*

46TH COLLEGE CHEMISTRY CANADA (C3) CONFERENCE, MAY 24-26, 2019

You are cordially invited to attend the 46th College Chemistry Canada Conference, May 24 - May 26, 2019, at Camosun College, Lansdowne Campus in Victoria, BC. The theme for the 2019 C3 Conference is "The Art of Chemisty".

Registration is available for the full conference only. Click here for online registration. Early registration rates apply until March 31, 2019.

Presentations are invited from everyone in the teaching community - the following are some ideas for potential topics:

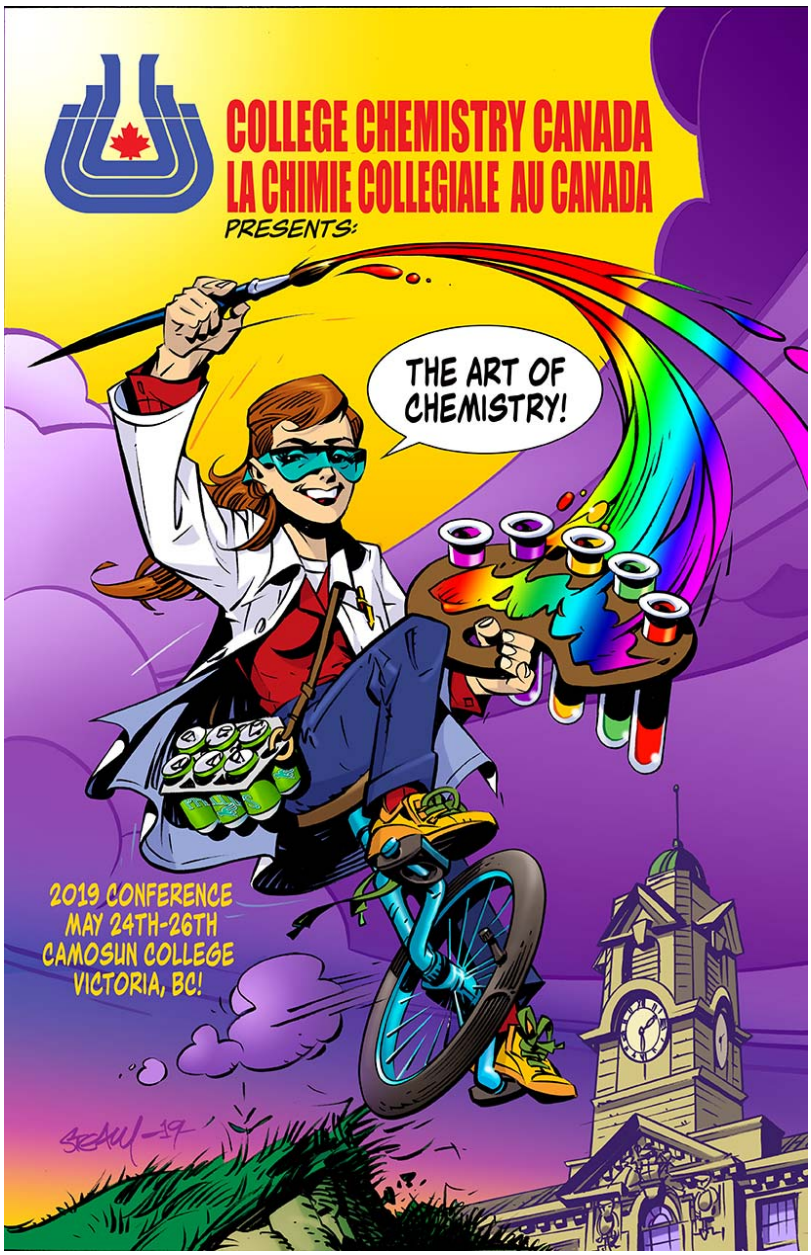
- Creative Education Ideas: The Bigger Picture
- Shifts and Deltas: Chemical Education for the 2020's
- Green and Sustainable Education
- Bringing Chemistry to Life: Applied Learning

Deadline for abstract submission is April 30, 2019. Click here for abstract submission.

Visit the conference website for information about the conference program, optional activities, accommodation, and conference sponsorship. Some of the optional activities include whale watching, tour of Ocean Networks Canada, and a guided tour of Victoria on scooters.

Conference Organizers:

John Lee
Andrea Fong



VOLUME 42, ISSUE 1

COLLEGE CHEMISTRY CANADA 2019 CONFERENCE PLENARY SPEAKER

Dr. Peter Mahaffy
Professor of Chemistry and Co-director of King's Centre for Visualization in Science (KCVS) , The King's University, Edmonton

Peter Mahaffy is Professor of Chemistry at the King's University in Edmonton, Canada and co-director of the King's Centre for Visualization in Science (www.kcvs.ca), which provides digital learning resources used by over 750,000 students, educators and the public from over 100 countries each year. His current research and professional work is at the interfaces of chemistry education, the uses of interactive technological tools to facilitate the learning of science, sustainability/green chemistry, chemical safety and security, and the responsible uses of chemistry.

Peter recently completed six years of service as chair of the International Union of Pure & Applied Chemistry's (IUPAC) Committee on Chemistry Education (CCE), where he co-facilitated the process to obtain UN designation of 2011 as the International Year of Chemistry and served on the IYC-2011 Management Committee. He was a charter member of the International Council of Science (ICSU) Committee on Freedom and Responsibility in the Conduct of Science, and served on the temporary working group on education and outreach for the Organization for the Prohibition of Chemical Weapons (OPCW), which received the Nobel Peace Prize in 2013.

Peter has over 45 refereed publications in science and science education, and presented 80 plenary, keynote or invited lectures and numerous workshops to scientists, educators, and the public on six continents in the past six years. He has received national and international awards for his work in chemistry education and science communication.

Also connected to Peter's work is a call for papers for a 2019 special issue in the Journal of Chemical Education on the topic **"Reimagining Chemistry Education: Systems Thinking, Green & Sustainable Chemistry".** Click here for details.

CREATIVE CHEMIST'S TEACHING APPROACH CRYSTALLIZES IN NATIONAL AWARD

Twenty-four years ago, Sharon Brewer (seen in the picture below) swore to herself that if she ever stopped refreshing course content and dreaming up new, exciting labs, it was time to call it quits. Now, as her chemistry students examine e-cigarette fluid in an analytical chemistry lab, Brewer knows keeping content relevant and timely is key to engagement.

"I always promised myself to never teach the exact same content year after year. Every summer I try to develop new labs and change things up. If I ever stop wanting to update content to make things relevant to students, I'm done teaching. Once you get students interested, that's when the real learning happens," she said.

While she prides herself on keeping content fresh, it is often quite challenging. Zeroing in on and selecting an addition to course content can be difficult.

"Because there are so many unique and exciting options out there, making it do-able and realistic for myself with time constraints in labs can be challenging."

But what exactly does it mean to stay current with chemistry?

Brewer makes it a priority to include labs that require students to analyze things they eat, or products they come into contact with on a daily basis. For instance, students are tasked with analyzing dried mushrooms and must develop a method to separate components in an alcoholic spirit sample.

Members of the national chemistry community have taken notice of Brewer's accomplishments. Last spring, she was awarded the College Chemistry Canada (C3) Award in Chemical Education. The organization recognizes people who make substantial contributions to chemical education at the college or university level. Brewer was surprised to hear the news, but knows her supportive department recognizes the importance of staying current. That helped enormously in her winning the award.

CREATIVE CHEMIST'S TEACHING - continued

With every lab and in curriculum development, Brewer makes it a priority to encourage and inspire active problem-solving and critical thinking in the classroom.

"That's what I like about chemistry and that's what I try and encourage students to appreciate. It's simply the most fun part about teaching. Teaching is never easy for me, but when you get them interested, or excited, it's just the best thing in the world," she said.

The chemistry department's work reaches beyond the confines of TRU. They hold yearly meetings with area high school teachers and organize the TRU chemistry contest which includes a day camp that shows students an exciting side of chemistry they wouldn't normally be exposed to.

A highlight of Brewer's research has been creating a teaching resource developed with colleague Bruno Cinel called the BC Integrated Laboratory Network (BC-ILN). The BC-ILN allows smaller institutions to send samples to the TRU labs outfitted with more advanced analytical equipment and test those samples remotely.

"We have the ability to share these instruments over the Internet for teaching purposes. Now students at other smaller institutions or high schools who wouldn't normally have access, can have it. They send the samples, we put it in an autosampler and they control the analysis from where they are. It's really been a ton of fun to provide access and do research on its impact," Brewer said.

Her rewarding teaching career started with a once-in-a-lifetime chance when she was in graduate school at Carleton University. She had the opportunity to develop a third-year chemistry course and teach it–as a teacher's assistant.

"It was fun, but also terrifying! A lot of my students were older than I was, but I loved teaching. I thought it was such a great experience because I got to teach something I had developed. That absolutely cemented my career direction," Brewer said.

As for advice for the teachers of tomorrow, Brewer said it's important to be kind to yourself.

"Think about your audience. Do your best, reflect and evaluate your teaching later. Don't be too hard on yourself, because we all have to start somewhere," she said.

This article was previously published in Inside TRU newsroom story . It is republished here with permission.

UNIVERSAL DESIGN FOR LEARNING IN THE LAB: GIVING STUDENTS CHOICE IN LAB ASSESSMENT TYPE

Kelly Resmer (kelly.resmer@msvu.ca), Mount Saint Vincent University , Halifax, NS.

Universal Design for Learning (UDL) is a set of principles that taps into brain networks of recognition, strategic and affective domains to engage the why, what and how of learning[1]. UDL has three guiding principles; students should be provided with multiple means of 1) representation, 2) action, and 3) expression and engagement[1]. Within those three principles is a set of nine guidelines and 33 checkpoints. Incorporating aspects of UDL can help provide options and support to accommodate a variety of learners. Here, I'll discuss how I incorporate into my undergraduate lab checkpoint 7.1, 'Optimize individual choice and autonomy' by giving students choice on their lab assessments.

In a small lab section of less than 15 students, offering students a choice on lab assessments is possible. After completing the experiment, students can submit one of three possible summative assessments to demonstrate their understanding. The choices are to submit a written lab report, an oral lab report or a conference style poster (electronically). I point out that these are authentic assessments since often scientists present their research findings in journal articles or at conferences with poster or oral presentations. For all the assessment types, detailed grading rubrics are provided in advance so grade expectations were clearly communicated.

A written formal lab report is an option for a lab assessment since chemistry students are very familiar with this form of com-

UNIVERSAL DESIGN FOR LEARNING IN THE LAB - continued

munication and some students prefer writing their results to demonstrate their understanding. The oral lab report option involves students communicating their understanding to the instructor in a one on one session. To facilitate this, I use Doodle poll (Doodle.com) where I populate the meeting times with times that work for my schedule. Students then pick the time that works for them and we meet in my office. Some students chose to do a PowerPoint presentation followed by questions, while other students just bring copies of their graphs, calculations and discuss their experiment. Finally, for the poster assessment, students are provided with a website with poster templates[2]. We discuss early in the term what features make a good poster and what to avoid when creating a poster.

Overall, offering choice to students on how they will be assessed leads to students feeling more connected to their learning and increases engagement[1]. Students are submitting work that they are most confident in. Further, the variety of report-types makes grading enjoyable.

References and Resources

1. CAST. Universal Design for Learning Guidelines version 2.2. http://udlguidelines.cast.org (accessed January 28, 2019). For research on offering student choice see: http://udlguidelines.cast.org/engagement/recruiting-interest/choice-autonomy/choice-autonomy-research.
2. Purrington, C. Designing Conference Posters, 2018 https://colinpurrington.com/tips/poster-design (accessed January 28, 2019).
3. CAST Professional learning. Top 10 UDL Tips for Assessment. http://castprofessionallearning.org/project/top-10-udl-tips-for-assessment/ (accessed January 28, 2019) – this provides an excellent checklist to consult with designing assessment activities, many additional resources in this website, it's worth checking out.

LATEST FROM THE LITERATURE

Sudhir B. Abhyankar (sudhir@grenfell.mun.ca), Memorial University of Newfoundland, Corner Brook, NL.

This year marks the 150th anniversary of Dmitri Mendeleev first arranging the known elements into an orderly system based on their properties. Chemists and physicists from across the world gathered in Paris on Jan. 29, 2019 to officially launch the International Year of the Periodic Table (IYPT). Laura Howes' article in the Chemical and Engineering News, January 30, 2019, volume 97, issue 5, describes the numerous events that took place in Paris. Keynote speaker and Nobel Laureate, Ben Feringa, touched on a theme shared among many of the talks at the IYPT opening ceremony: the importance of international collaboration. Chemists "have a universal language using the elements and molecules," he explained. "We have no borders."

The importance of student-training to carry out chemistry outreach activities is described in an online publication: Date (Web): January 29, 2019, by Justin Pratt and Ellen Yezierski titled "Goodwill without Guidance: College Student Outreach Practitioner Training" DOI: 10.1021/acs.jchemed.8b00882. Results of the study indicate little involvement from chapter advisors, widespread practice of "winging it" or using trial and error when teaching children, and little training overall. Comparisons to Cognitive Apprenticeship Theory show a primary emphasis on modeling and coaching, with little metacognitive considerations. Implications for outreach teaching and training (for both practitioners and national chemistry organizations) are presented in light of these findings. The article will be published soon in the Journal of Chemical Education.

Beier et. al. have explored the effectiveness of project-based learning (PjBL) courses on student attitudes, major choice, and career aspirations in science, technology, engineering, and mathematics (STEM). They found that engaging in at least one project-based course during the first four semesters affected student perceptions of STEM skills, perceptions of the utility value of participating in STEM courses, and STEM career aspirations. The article is published in the Journal of Research in Science Teaching, pages 3-23 volume 56, issue 2, January 2019.

In the article titled "Who produces knowledge? Transforming undergraduate students' views of science through participatory action research, published in Science Education, volume 102, issue 6 [https://doi.org/10.1002/sce.21453], Weinberg, Trott and McMeeking highlight the Undergraduate Research Experiences (UREs), which include interdisciplinary, engagement-oriented,

LATEST FROM THE LITERATURE - continued

and collaborative experiences, that have the potential to benefit students in unique ways. Findings of the study emphasize participants' altered views of the respective roles of academic researchers and community members in generating knowledge, the value of interdisciplinary research, and the potential of innovative UREs to foster positive change—in academic and community contexts.

In recent years, researchers have worked diligently to identify more effective means of facilitating student learning. Some promising pedagogical techniques that have emerged include the flipped-class model and test-enhanced learning. These pedagogical strategies have been incorporated into a multitouch book. A multitouch book is a dynamic platform that allows instructors to combine text, videos, interactive figures, and quizzes into an electronic book. A multitouch book was created and implemented in an organic-chemistry sequence. The multitouch book described in this report titled "Using a Multitouch Book to Enhance the Student Experience in Organic Chemistry" presented the course material in a manner that more effectively matched the students' learning preferences, which led to a higher level of usage than the traditional textbook. Complete description of the preparation and use of this book can be found: Publication Date (Web): January 25, 2019 DOI: 10.1021 acs.jchemed.8b00703, and the article will be published soon in the Journal of Chemical Education.

In a report published in Chemistry World, 5th December 2018, David Bradley reports that the world record for the longest carbon -carbon bond has been broken. Until March 2018, Peter Schreiner's team at the Justus Liebig University Giessen, Germany, had held the record for longest carbon–carbon bond since 2011 with a 170 pm alkane bond. Their record was toppled by Yusuke Ishigaki and Takanori Suzuki of Hokkaido University and their colleagues with a carbon–carbon bond in a dispiro (dibenzocycloheptatriene) that was 10 pm longer, making it 1.2 times the length of a conventional alkane bond.
Now, Xu-Qiong Xiao and his team at Hangzhou Normal University, China, have synthesized a series of 1,2-diamino-o-carboranes that have carbon–carbon bonds in their inner cluster that range from 163 pm to just over 193 pm. The original paper can be found in : X-Q Xiao et. al., Angewandte Chemie International Edition, 2018, DOI: 10.1002/anie.201812555 .

Stieff, Werner, Fink and Meador examine the effectiveness of adding an online component to the general chemistry laboratory in which students view pre-laboratory instructional materials through online videos prior to completing general chemistry laboratory activities. The results of their study suggest that online pre-lecture videos have significant potential for improving student learning in the general chemistry laboratory and for reducing demand on institutional resources for associated courses. Their work is published in Journal of Chemical Education, 2018, 95, 8, 1260-1266.

And finally, a report released by the United States National Institute of Standards and Technology (NIST), on 21st May 2018, and titled "A Turning Point for Humanity: Redefining the World's Measurement System" outlines the major changes to the SI system. Three of the units, the kilogram (mass), the ampere (electric current) and the kelvin (temperature) were redefined. This has made them more precise and easier to measure around the world. The report also includes an informative brief history of SI.

KNOWLEDGE AND SKILL OF TERTIARY CHEMISTRY EDUCATORS

Carl Doige (cdoige@okanagan.bc.ca), Okanagan College, Vernon, BC.

Teaching is a challenging and nuanced social activity, which unfolds in the complex dynamics of a classroom. Effective college/university teaching requires that the instructor interweave many different levels of knowledge including content and pedagogy.

The instructor needs not only a clear understanding of the content appropriate to the level that is being taught, but must also have a deeper knowledge of the fundamentals which constitutes the discipline. Without such an understanding, the instructor may misguide students and this, in turn, could result in students facing learning challenges and possibly developing misconceptions about the content area.

The instructor must also have some mastery of pedagogy; that is, the instructor should be aware of current theories on how students learn and be able to implement a number of strategies for content delivery, classroom management, assessment, and evaluation. In the mid 1980's, Shulman[1] proposed that instructors' mastery of content and pedagogy do not occur in isolation and that

KNOWLEDGE AND SKILL—continued

experienced instructors develop a mastery of a specialized knowledge, which he referred to as pedagogical content knowledge (PCK). This knowledge includes insights on how to transform the content in a way that it can be learnt by a novice. It would include "the most powerful analogies, illustrations, examples, explanations, and demonstrations"[1]. PCK brings with it an awareness of content areas which are likely to be difficult for students and also an awareness of strategies to overcome these difficulties. This knowledge is specialized in that it is not necessarily available to the content expert or pedagogy expert.

Research suggests, however, that many instructors are not aware of their own specialized knowledge as it is developed tacitly and is transformed into practice in an unconscious manner. This situation can have serious effects in terms of succession training. Experienced and effective instructors may retire without the opportunity to pass on their PCK – and new instructors must develop this knowledge from scratch. While this situation is not unique to chemistry education, Bucat[2], in his 2004 publication, laments that this is a form of 'professional amnesia' and calls for the chemistry education community to systematically create and document a pool of PCK.

Over the past three decades educational researchers have tweaked and debated Shulman's original ideas. As a result of a worldwide PCK summit in 2012 (described in Neumann et. al. 2018 review[3]), a consensus model for PDK was published in 2015, and a number of research tools have been developed to probe and document teachers' professional knowledge and skills. Of particular import are the research instruments, first published in 2004, referred to as Content Representations (CoRes) and Pedagogical and Professional –experiences Reperetoires (PAP-eRs)[4]. CoRes are a series of questions designed to draw-out and characterize a teaching strategy for a 'big idea', while the PAP-eRs capture specific examples of classroom practice. Examples of CoRe questions include[5]:

- Identify one 'big idea' or topic that you teach.
- What is most important for students to know about this idea?
- What do you know about students' thinking that influences your teaching of this idea?
- How will you ascertain students' understanding or confusion around this idea after teaching?

Most of the focus of PCK research has been on the exploration of science teaching at the primary, and particularly the secondary level, with the aim of characterizing expert-teaching and assist with professional development and the training of pre-service teachers[6]. Much less has been reported about teaching at the tertiary using a PDK framework, although in the context of chemistry education, a few studies have been reported on the PDK of chemistry professors in connection to topics such as the amount of substance[7], quantum mechanics[8], and organic chemistry[9].

Given that there are key differences between teaching at the secondary versus tertiary level, it has been suggested that the applicability of the PDK model to tertiary context be more thoroughly investigated[6]. Some of the differences include the fact that tertiary science teachers have advanced graduate training and will likely have developed a deeper content knowledge, at least in some areas, than secondary teachers. This is contrasted by the fact that secondary teachers will have experienced explicit training in pedagogical theory, teaching strategies and knowledge of student difficulties. Such training is typically absent in the career trajectory of most tertiary teachers. Further, it should be noted that the student-contact time (from classroom, extracurricular sports and clubs) is structured differently in the two contexts.

Two recent publications from an Australian group have probed more deeply the characteristics of PDK for tertiary chemistry professors. In the first publication[5], chemistry educators from 25 different institutions participated in a series of workshops where they responded to CoRe questions, either individually or in small groups. Analysis of the responses produced 19 subtopics commonly taught in chemistry, each with associated teaching strategies, possible student difficulties and assessment strategies. The data has been shared in a highly searchable and freely accessed website: http://chemnet.edu.au/chem-pck).

The second publication[6] applied the CoRe questions to ten expert tertiary chemistry teachers. The goal was to extract and identify signposts of expert teacher professional knowledge and skill. These signposts include:

- Expertise in seeking and receiving feedback from students and encouraging active engagement,
- Awareness of the importance of an increased focus on concepts and reducing content,

- Development of personal classroom strategies from experience, and
- Purposeful reflective practice and the willingness to adapt teaching approaches.

It should be apparent that, collectively, these two publications are enacting the earlier recommendation by Bucat[2] of a systematic development of a pool of PDK to support chemistry teaching across the generations.

Participants of C3 conferences and readers of this newsletter no doubt place high priority on advancing their own professional development with the goal of supporting the optimum learning for their students. Exploring and improving one's own PCK will predictably have beneficial outcomes. While the CoRe questions were developed as research tools, they are readily available from the research studies[5,7], and can serve as a framework for personal reflective practice. Importantly, this is consistent with the last of signposts related to expert teacher professional knowledge and skills mentioned above.

References

1. Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*, 4-14.
2. Bucat, R. (2004). Pedagogical Content Knowledge as a way forward: applied research in chemistry education. *Chemistry Education Research and Practice*, *5*, 215-228.
3. Neumann, K., Kind, V., & Harms, U. (2018). Probing the amalgam: the relationship between science teachers' content, pedagogical and pedagogical content knowledge. *International Journal of Science Education*, retrieved from: https://doi.org/10.1080/09500693.2018.1497217.
4. Lehane, L. & Betram, A. (2016). Getting at the CoRe of it: A review of a specific PCK conceptual lens in science educational research. *Education Quimica*, *27*, 52-58.
5. Schultz, M., Lawrie, G.A. Bailey, C.H., & Dargaville, B.L. (2018). Characterization of teacher professional knowledge and skill through content representations from tertiary chemistry educators. *Chemistry Education Research and Practice*, *19*, 508-519.
6. Lawrie, G.A, Schultz, M., Bailey, C., & Dargaville, B.L. (2019). Personal journeys of teachers: an investigation of the development of teacher professional knowledge and skill by expert tertiary chemistry teachers. *Chemistry Education Research and Practice*, *20*, 132-145.
7. Padilla, K., Ponce-de-Leon, A.M., Rembado, F.M., Garritz, A. (2008).Undergraduate professors' pedagogical content knowledge: the case of the amount of substance. *International Journal of Science Education*, *30*, 1389-1404.
8. Padilla, K. & Van Driel, J. (2011). The relationship between PCK components: the case of quantum chemistry professors. *Chemistry Education Research and Practice*, *12*, 367-378.
9. Davidowitz, B. & Rollnick, M. (2011). What lies at the heart of good undergraduate teaching? A case study in organic chemistry. *Chemistry Education Research and Practice*, *12*, 355-366.

THE PRESIDENT'S MESSAGE

Dear C3 colleagues,

Happy New Year – Gung Hay Fat Choy! I hope your term is going well. A quick reminder that we have the nominations open for the C3 Educator's Award and Student Award. Please find the time to recognize the efforts of our colleagues and students.

From my short winter break, I read a few chapters of "Learn Better" by Ulrich Boser. You can find this book in your local library or even your institute. I found this to be a good read as it details the process of learning in whatever your life stage is. There are some great strategies for students and instructors.

If the you missed the news, Paula Hawryssz (NAIT) is our President-Elect and will be beginning her term this June, 2019. You can get to know Paula with 'Top Ten Questions' article in this newsletter. Don't forget this is your college chemistry community newsletter and any submissions or ideas are welcome.

Time goes by fast and we are approaching our 2019 conference at Camosun College in 'mild weather' Victoria. Please check the C3 newsletter/webpage for updates and registration information. I hope to see many of you there in May for another set of C3 memories.

All the best, Jimmy

THE TOP TEN WITH…PAULA HAWRYSZ

Get to know your President-Elect. Jimmy Lowe sent questions to President-Elect, Paula Hawrysz . Paula responded to 11 questions to get the bonus mark.

1. **What motivates you to work at NAIT?** The students – most days. I truly enjoy interacting with young people. Teaching them chemistry, a subject I'm passionate about, is a huge bonus.
2. **What makes a workplace healthy?** My first thought: more veggies and exercise but - Independent thinking, learning and expression with a willingness and openness for collaboration, cooperation and acceptance.
3. **One way to make meetings better:** Preparation of an agenda, staying on task and allowing for participation and freedom of expression. But mostly brownies.
4. **Describe the big 'a-ha' moment one of your students had.** You shouldn't pick up a beaker of boiling water from a hotplate using paper towel (this was just this last week).
5. **The future of post-secondary education is …** I'm not sure how to answer this – long and prosperous?
6. **Why did you get involved with C3?** The people/membership. Meeting and interacting with like minded people. The C3 community diversity and their openness to share and accept. And the conferences that make it all come together.
7. **What lesson has organizing a C3 conference taught you?** Like a wedding, 60% is about the food and the fun. That and you need a really good organizing team.
8. **What is a course/class you would like to take?** I would like to learn how to do metalsmithing.
9. **Do you have a non-work related passion or hobby? What is it?** I am at a point in my life where my children are grown and I am able to explore many different things. My current passion is learning to play hockey. I have been playing 1-2 times a week for about 5 months and the thrill never goes away.
10. **What could you use right now if someone would invent it for you?** Some days there is no time for creative thinking.
11. **What inspires you the most?** I find inspiration in many things – my family, my friends, my students, my colleagues. Every day is different and presents new challenges and experiences I am always grateful for the influences that are around me.

Paula Hawrysz (center) with Laura Lucan and Jimmy Lowe

C3 EXECUTIVE AND BOARD MEMBERS

C3 Executive

President	Jimmy Lowe	BCIT, BC
President-Elect	Paula Hawrysz	NAIT, AB
Treasurer	John Eng	University of Lethbridge, AB
2019 Conference Coordinator	John Lee	Camosun College, BC
Editor	Carl Doige	Okanagan College, BC
Web Master	John Lee	Camosun College, BC
Secretary	Todd Stuckless	Langara College, BC

Regional Directors

Atlantic region	Katherine Darvish	Mount Saint Vincent University, NS
Quebec	Yann Brouillette	Dawson College, QC
Ontario	Kris Quinlan	University of Toronto, ON
Prairies	François Gauvin	Université de Saint Boniface, MB
	Bryan Rowsell	Red Deer College, AB
BC/Yukon	Jessie Key	Vancouver Island University, BC