College Chemistry Canada
La Chimie Collégiale au Canada

Newsletter

VOLUME 41, ISSUE 2 NOVEMBER, 2018

In This Issue

THE 2018 C3 CONFERENCE EXPLORED CLASSROOM TO CAREER

Heather Kaminsky, Ledcor Chair, Oil Sands Environmental Sustainability, NAIT

Amy Cannon, Executive Director, Beyond Benign, MA, USA

Charles Lucy, Dept. of Chemistry, University of Alberta

NAIT, Edmonton, Alberta, hosted the 2018 C3 conference with three plenary talks, 27 contributed talks and 2 poster presentations. Dr. Lucy presented the details about and the importance of a career development course for chemistry students. Dr. Cannon highlighted resources and approaches to train our students in more sustainable practices, including Beyond Benign's Green Chemistry Commitment. Dr. Kaminsky discussed the importance of training technicians and involving them in applied research. This conference was also in collaboration with University of Alberta, Campus Saint-Jean and included a dedicated session on Green Chemistry.

IN RECOGNITION OF…..

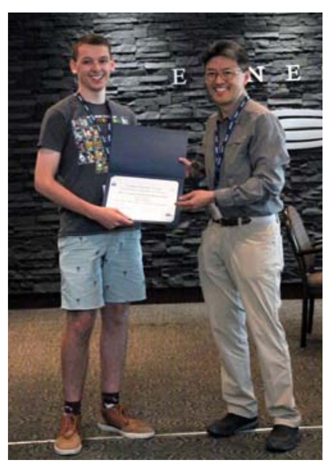
A number of awards were presented at the 2018 C3 conference banquet.

The C3 Host Student Scholarship was awarded to Marc Ang. Marc just completed first year of Chemical Technology program at NAIT.

The C3 General Student Scholarship was awarded to Brian Gilbert who is pursuing a B.Sc. and a B.Ed. at the University of Calgary.

The C3 Award for Chemical Education was awarded to Sharon Brewer for her influential and significant contributions to advancing the field of chemical education at the college and university level.

Marc Ang receives the C3 Host Student Scholarship from Paula Hawrysz



Brian Gilbert receives the C3 General Student Scholarship from Jimmy Lowe

Sharon Brewer receives the C3 Award for Chemical Education from Jimmy and Kathy Darvesh

VOLUME 41, ISSUE 2

GROUP PHOTOS…..

Attendees of the 2018 C3 conference

***Current and past C3 presidents: (**from left to right) Lawton Shaw, Sudhir Abhyankar , Dietmar Kennepohl , Suzanne Gardner, Bill Blann , Jimmy Lowe, Bruno Cinel. Picture taken at conference banquet at Ernest's.*

CHEM ED CONFERENCES FOR 2019

There are a number of options for professional development in chemistry education in 2018, including our own C3 conference:

222nd Conference of the 2YC3, March 29-30, 2019

This conference, from our sister organization in the US, will be hosted by Valencia College, Orlando, FL. Contact and program chair is Daeri Tenery: dtenery@valenciacollege.edu.

46th College Chemistry Canada (C3) Conference, May 24-26, 2019

The 2019 Conference will be hosted by Camosun College in Victoria, B.C.

102nd Canadian Chemistry Conference and Exhibition , June 3-7, 2019

The 2019 conference will be held in Quebec City, QC. Watch this website for more information: http://www.csc2019.ca/.

Gordon Research Conference - Chemistry Education Research and Practice, June 16-21, 2019

Bates College in Lewiston, ME, US, will be hosting the 2019 Gordon Research Conference. The theme for this conference is Using Education Research to Foster Meaningful Chemistry Learning. The contact chair is Vicente Talanquer. More information can be found at: https://www.grc.org/chemistry-education-research-and-practice-conference/2019/.

24th ChemEd Conference, July 21– July 25, 2019

North Central College, located in Naperville, Illinois will be hosting the 24th ChemEd conference from July 21 to 25. More information can be found at: https://www.chemed2019.com/.

FLASHBULB CHEMISTRY IN THE LECTURE AND LABORATORY

Mel Schriver (mel.schriver@crandallu.ca), Crandall University, Moncton NB.

The excitement of explosions and combustion with precise stoichiometric control all in a package safe for first year university chemistry students to handle is what camera flashbulbs offer to the college chemistry instructor. Camera flashbulbs are essentially sealed glass envelopes containing a precise mass of a combustion metal in an atmosphere of pure oxygen (see Figure 1a). These flashbulbs were manufactured from the 1930's to the 1970's. The development of electronic flash units in the 1970's spelled the end of flashbulb manufacturing in North America with the last plant closing in the early 1990's. Precise amounts of metal and oxygen were crucial to

FLASHBULB CHEMISTRY IN THE LECTURE AND LAB —CONTINUED

the bulb to bulb illumination reproducibility. The combustion metal varied from magnesium in the early bulbs to aluminum (and aluminum alloys) and finally a switch to zirconium in the early 1960's. All the bulbs feature an outer layer of lacquer or plastic that made them safe to use domestically.

The combustion reactions of the three primary combustion metals demonstrate significantly different stoichiometry's and oxidation states (equations 1-3).

$Mg(s) + O_2(g) \rightarrow 2MgO(s)$ (1)
$4Al(s) + 6O_2(g) \rightarrow 2Al_2O_3(s)$ (2)
$Zr(s) + 2O_2(g) \rightarrow ZrO_2(s)$ (3)

Later flashbulbs included a blue dot of $CoCl_2$ which turned pink if the glass envelope cracked. Additionally, the ignition wire changed from manufacturer to manufacturer until the early 1960's when rhenium was selected as the optimum metal. The early flashbulbs were monstrously large (equivalent in size to a household 100 watt incandescent bulb and dangerous using the same size Edison socket). This size however makes them ideal for lecture demonstrations. We set up a demonstration involving three simple pedestal lamps fitted with a 100 watt incandescent bulb, a 100 watt incandescent bulb with the glass hood removed and finally a Photoflash 50 flashbulb. The first lamp demonstrates simple physical incandescence while turning on the second lamp demonstrates air combustion of the tungsten filament while the third lamp dramatically shows combustion incandescence in a chemical reaction.

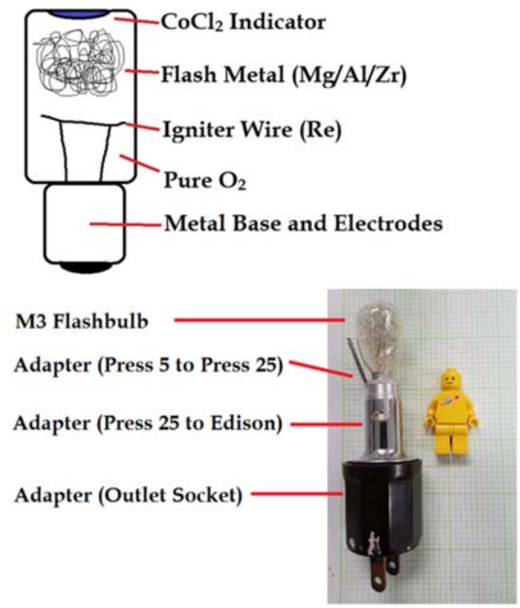


Figure 1. Apparatus for Flashbulb Chemistry: 1a (top) schematic of a typical flashbulb manufactured in the 1970's, 1b (bottom) Apparatus for bulb ignition using adapters available from online sources and local hardware stores.

In the laboratory, we have found that the ideal flashbulbs for student use are the M2 / M2B and M3 / M3B bulbs. We insert the bulbs into a series of adapters that facilitates holding / clamping the bulbs and igniting them with a 9 volt battery (see Figure 1B) using the outlet adapter prongs as electrodes. The students are introduced to measurement, observation and the use of statistics in the laboratory to determine the significance of mass differences using the bulbs pre and post flash. Each group then dissects a flashbulb to determine the mass of the combustion metal. The final part of the laboratory is to have the students ignite a bulb while it is immersed in an open coffee cup calorimeter containing approximately 100 g of water (Figure 2). The experiment is done while monitoring the temperature (in our case using a Vernier LabQuest 2). The graph of the temperature during the experiment (Figure 2) reveals the initial constant low temperature followed by a heat pulse synchronous with combustion and then the slower thermal capture of the heat released from the bulb by the water. Using simple calorimetry calculations the students discover that the combustion metal in the M2 bulbs is not the same as the metal in the M3 bulbs with the best fit being aluminum in the M2 bulbs and zirconium in the M3 bulbs.

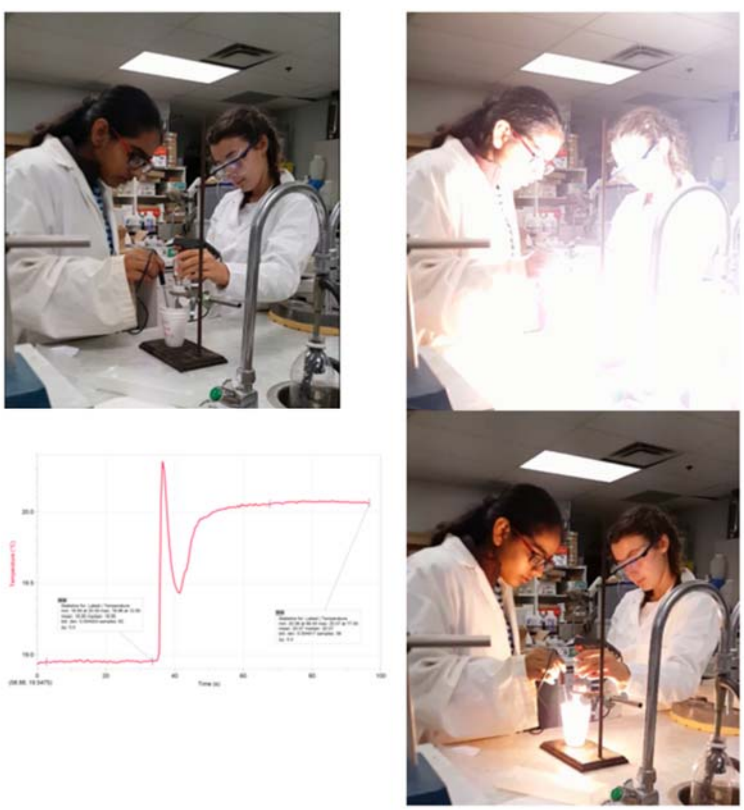


Figure 2. Flashbulb calorimetry Clockwise from upper left using framerate times from mp4 video: Time = 0, Time = 99 ms, Time = 132 ms. Bottom left: Vernier LabQuest 2 graph of time versus Temperature for M3 bulb ignited in 100 g of water contained in an open coffee cup calorimeter.

FLASHBULB CHEMISTRY IN THE LECTURE AND LAB —CONTINUED

There are two dated references in the chemical education literature of flashbulbs being used in the laboratory[1,2]. One could reasonably ask why a laboratory should now be based on a non-renewable resource such as camera flashbulbs. The benefits include the near ideal nature of the flashbulbs in terms of chemistry and safety and, perhaps surprisingly, the per bulb costs can be minimal. In short, the world was not quite ready for the end of the use of flashbulbs and relatively large stores of new-in-box bulbs manufactured in the 1970's are still available online in lots of 144 bulbs giving a per bulb price of less than $0.50 for a total average consumable cost of less than three dollars per group. As long as this relatively low consumable cost continues we argue that chemical educators should be encouraged to include flashbulbs in their lecture demonstrations and laboratories.

References

1. Hornyak, F. M. (1961). A flashbulb bomb calorimeter. *Journal of Chemical Education, 38*, 97.
2. Banks, R. C., Carter, L., & Peterson, E.P. (1975). Heat of combustion of zirconium. A general chemistry experiment. *Journal of Chemical Education, 52*, 235.

UNIVERSAL DESIGN FOR LEARNING IN THE LAB:

Fostering collaboration and community

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

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 (CAST, 2018). UDL has three guiding principles; students should be provided with multiple means of representation, action, expression and engagement (CAST, 2018). Within those three principles is a set of nine guidelines and 33 checkpoints. Here, I'll discuss how I incorporate into my undergraduate lab checkpoint 8.3 'foster collaboration and community' using team-based learning.

Team-based learning has been studied and written about extensively in the classroom setting. I highly recommend the book *Team-Based Learning A Transformative Use of Small Groups in College Teaching* and the website http://learntbl.ca/ for more details on using this method. In the lab I incorporated team-based learning using the following eight steps.

1. Address previous negative group work experience. During the first lab meeting we discussed qualities of a good team member, the importance of team work, and development of inter-personal skills. We looked at chemistry employer surveys for skills employers desired in their new hires. These desirable skills are often the inter-personal skills we will be developing with the team-based approach.
2. Choose teams. At the beginning of the term students were assigned in teams and worked with the same team throughout the term. I chose teams that were as diverse as possible, there were students in second to fourth year in the lab, each with varying lab experiences. I was transparent with this process, so students would not think that teams may have an unfair advantage.
3. Deliver frequent feedback. During the lab I would deliver verbal feedback, highlighting when teams were working well together. The majority of the lab reports were handed in individually, but two reports were done as a team. One team lab report was a lower stakes written report to gain feedback and one higher stakes final lab project.
4. Choose team work activities carefully. This is definitely an area that I could improve upon. For the reports I had the teams submit a written lab report. This (obviously) resulted in the team dividing up the work, which defeated the purpose of collaborating and problem solving as a team. It's recommended that more application type assessments are presented and to avoid tasks that can be divided among team members.
5. Ensure individual and team accountability. Each student was responsible for completing their own prelab assignment so they could contribute to the team during the experiment. Team members were held accountable using the Planner Office365 application. The app allowed me to monitor the team discussions and view files, ensuring all were contributing equally to their group projects.

UNIVERSAL DESIGN FOR LEARNING IN THE LAB —CONTINUED

6. Use class time for team work. The majority of the work done by the team was completed during lab time. Since students are very busy, it is often difficult to find time for the team to meet as a whole.
7. Develop and support team cohesiveness. Team work was incorporated in the first lab where teams competed against other teams during a safety quiz using the online quiz website, Kahoot.com.
8. Create evaluation scheme that included peer evaluation. It is recommended to do peer evaluations at mid-term (for individual feedback on how their team views their contributions) and at the end of course for their final grade.

Overall, the team-based approach was very enjoyable, from both the student and instructor perspective. The peer evaluations were all very positive. Students improved upon their inter-personal skills and learned how to work well on a team.

References

Michaelsen, L.K., Knight, A.B., & Fink, L.D. *Team-Based Learning A Transformative Use of Small Groups in College Teaching*; Stylus Publishing, LLC: Sterling, 2002.

CAST. Universal Design for Learning Guidelines version 2.2. http://udlguidelines.cast.org (accessed Aug 17, 2018).

Jim Sibley. Learn TBL. http://learntbl.ca/ (accessed Aug 17, 2018).

Teaching in higher ed. Episdoe 073 Team-Based Learning https://teachinginhighered.com/podcast/team-based-learning/ (accessed August 17, 2018) - *Jim Sibley, the author of learntbl.ca website is interviewed about team based learning on the Teaching in Higher Ed podcast. During the podcast he explains the process, team selection and challenges with team-based learning.*

Kondo, A.E. & Fair, J.D. (2017). Insight into the Chemistry Skills Gap: The Duality between Expected and Desired Skills. *Journal of Chemical Education*, *94*, 304-310. - *I show this article to students, it surveys what skills future chemistry employers desire in new chemistry hires.*

IMPROVED INTERFACE OF THE WEB-BASED TEACHING TOOL *myDALITE*

Yann Brouillette (ybrouillette@dawsoncollege.qc.ca), Dawson College, Westmount, QC.

Have you ever tried to engage your students outside of class? Can students collaborate on simple tasks even before a topic has been approached? During the 45th C3 Conference at NAIT in Edmonton last May, attendees were introduced to myDALITE: The *Distributed Active Learning Interactive Technology Environment*. It is a free web-based tool designed on the principles of Peer Instruction that promotes student's self-explanation and explanation to others, asynchronously. Using myDALITE, your students can answer conceptual questions and then learn by reasoning through their answers and trying to convince each other. The myDALITE platform also provides immediate and detailed feedback to instructors, offering important support to an active learning approach. Learners write explanations for conceptual questions, reflect on and compare these explanations to those of peers and experts, as well as vote on the most convincing explanations before, during or after class.

Try it out: https://mydalite.org/en/
Watch tutorials: https://www.youtube.com/channel/UCHMPP0rG7ZQdPb68s8NF-bg

The tool can be used through a Learning Management System (LMS) such as Moodle, or as a stand-alone. At present, you can choose from a growing bank of over 600 chemistry questions, focussing mainly on organic and general chemistry topics. Multiple new features have been added to the platform since the summer. For example, you can now search the bank of questions per topics, create new questions and generate group reports. A series of tutorial videos is also being produced to help new users adopt the tool.
Overall, myDALITE is a simple, effective and versatile approach that supports student engagement and allows for implementation of collaborative learning. It is also being developed by one of C3's members. Don't be shy to try it out and send your feedback.

LATEST FROM THE LITERATURE

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

In an article titled "A simplified Method for the 3D Printing of Molecular Models for the Chemical Education", *Journal of Chemical Education, 2018, Vol. 95(l), p. 88-96*, Jones and Oliver describe how the basic molecular structure can be created in- house or easily sourced online from databases such as UniProt or PubChem. This method brings 3D printing to a wider audience, thus helping to spread its use in chemical pedagogy, and may also be used in self-directed learning exercises by students themselves.

Using think-aloud interview protocols, Rodriguez, Bain, Hux and Towns carried out a study of 40 students to find out how students integrate their chemistry and mathematics skills. The results are published in "Productive features of problem solving in chemical kinetics: more than just algorithmic manipulation of variables" first published on 19 *September 2018 in Chemistry Education Research and Practice.*

Raker, Gibbons and Cruz-Ramierz de Arellano articulate the "Development and evaluation of the organic chemistry-specific achievement emotions questionnaire (AEQ-OCHEM)" in the *Journal of Research in Science Teaching, first published September 4, 2018.* The authors suggest that tools that measure achievement emotions in the context of instructional laboratories and undergraduate research are needed for more robust considerations of affect in Science, Mathematics and Engineering.

Several common characteristics of the journey towards tertiary teaching expertise have been deduced through a detailed analysis of transcripts that originated from interviews conducted with ten recognized excellent tertiary chemistry teachers. These are described in an article in *Chemistry Education Research and Practice,* first published on August 31, 2018, DOI: 10.1039/C8RP00187A.

In a column titled "South Africa pushes science to improve daily life" published in *Nature, on September 6, 2018,* the government outlines sweeping changes that aim to refocus research efforts on poverty, unemployment, drought and other national problems.

Coming to grips with formulas is key to communicating chemistry. Kristy Turner takes inspiration from grammar and vocabulary lessons in modern foreign languages and shares her top tips in the column "Six tips for teaching chemical formulas" published in *Education in chemistry, June5, 2018.*

Australian Journal of Education in Chemistry, 2018, 76 pp 7-13, describes "Aspirin and Its Colored Complexes: How This Drug Reacts with Metal Ions". The ions used are Fe(III) and Cu(II). The complexation reactions are easily observed thanks to the intense color variations, nevertheless the identity of the extracted and synthesized compound has been verified using thin-layer chromatography, UV-vis, fluorescence and infra-red spectroscopy, and mass spectrometry. This experiment demonstrates that varying the ligand and the transition metal can give rise to different structures, and hence different optic properties.

This article is followed by another five-page article [in the same journal and issue] that includes more detailed supplementary information.

A paper published online on September 05, 2018, in the *International Journal of Science Education*, https://doi.org/10.1080/09500693.2018.1517423, and titled **"**Tutor-student interaction in undergraduate chemistry: a case of learning to make relevant distinctions of molecular structures for determining oxidation states of atoms", Mannesh, *et. al.*, explore challenges involved in supporting student's learning and examine critical aspects of determining oxidation states of atoms in complex molecules.

In an article titled "Hundreds of helium compounds could be hiding in Earth's mantle" published in *Chemistry World, 16 April, 2018* Katrina Kramer describes the formation of the species that result when helium can react with salts that have an uneven number of anions and cations, like magnesium fluoride, MgF_2. This follows the 2017 publication that describes the formation of a compound that results when helium reacts with sodium.

I finish this column with the good news: as most of you know, Chem-13 News started going as an online publication starting last month, September 2018. They turned 50 this year (1968-2018). Where does the time go?. Starting this year, they will post monthly issues online. The web publication is live and currently over 600 published articles from the last 50 issues have been posted.

The online access is FREE for everyone and that is the good news!

More to come in the next issue of the C3 Newsletter…………..

TWO SIDES TO EVERY COIN – SMART PHONES IN THE CHEMISTRY CLASSROOM

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

It is an understatement to say that, in this modern age, the smart phone has infiltrated most aspects of our day-to-day life. This is especially true when I consider the smart phone habits of the young people who attend my first and second year chemistry classes. This truism became altogether more poignant this past academic year when I watched all of my carefully considered smart phone policies disintegrate into mayhem. I was prompted to investigate the issue further by consulting the educational literature on smart phones in the (chemistry) classroom. Like with most contentious issues, I found two sides to this technological coin.

The positive side

In a 2011 article published in the Journal of Chemical Education[1], Williams and Pence make the following optimistic statement: "Smart phones are already used by a large number of students and are becoming increasingly popular. These devices have many valuable capabilities that have a tremendous potential for use in chemical education."

In the article, they describe smart phones as "powerful computers" which can access (with the help of apps) a plethora of educational material, some of it specific to chemistry and chemistry classrooms. They mention apps for chemistry calculations, molecule drawing and three-dimensional visualization and access to web-based databases. According to Williams and Pence, the future looks very good for the incorporation of these devices to support student learning.
Since this article, many other articles have been published that support the notion of smart phones as potent educational tools and which describe chemistry-specific apps for use in the classroom, teaching lab, and research labs. In a 2013 article[2], Libman and Huang provide a now somewhat dated, but comprehensive, review of the various chemistry-related apps. They organize a multitude of apps according chemistry discipline (Analytical, Physical, Organic, Inorganic), academic level or target user (high school, undergraduate, professional chemist), and availability on IOS verses android devices. The possibilities seem endless!

Some recent articles examine how instructors have integrated apps into a rich teaching experience, involving in-class polling (with apps like Socrative, PollEverywhere), problem solving using 3-D visualizations and simulations, and general lecture presentation[3,4]. Other articles describe the creation of new apps, such as a recent publication[5] detailing an undergraduate organic chemistry gaming app called Chirality-2. This app allows students to identify functional groups, contrast intermolecular forces, compare isomers, find chiral centers, and practice naming molecules.

There are also articles that focus more on lab-specific applications. For instance, one article describes the design of a simplified spectrophotometer using a cell phone application and the RGB values of pixels in the camera view[6]. A second article reports on an app that records and converts colour information into beeps and vibrations[7]. When applied to the detection of an indicator colour, this can be used to assist the colour-blind and the visually impaired to detect the end point of a titration. A general weakness, however, of these publications on chemistry-related smart phone apps is that the evaluation of the usefulness of the app is primarily based on the annotated comments of students and teachers and does not involve a controlled studied of learning gains. A notable exception is a recent study involving systematic pre- and post-tests which compares frequent verses infrequent users of in-house developed chemistry education apps[8].

SMARTPHONES IN THE CLASSROOM —CONTINUED

The flip side

Clearly smart phones offer a tremendous potential for learning in the college setting generally, and the chemistry classroom, specifically. What could be the problem?

Simply put, these devices in the hands of the Net Generation, our students, are being used too frequently, for too long, and with too many apps simultaneously.

Studies show that adolescents and young adults are using their devices on average upwards of 7.5 hours per day[9], sending over 150 text messages[10] and logging close to two hours on Facebook[11]. Further, usually students are engaged in several media platforms simultaneously. This media multitasking ultimately increases the overall media absorption. This behaviour extends to the college classroom. Researchers have found 70-90% of students text during class (even when policies are in place)[12] and on average spend about 21% on mediums for off-task purposes[13]. This behaviour also extends to study time outside of class. One report[14] found that college students stayed on task only 65% of a 15 min study period – otherwise they were involved in "cyber-slacking". In another study[15], researchers monitored 60 undergraduates during a three hour study period. On average, students were distracted 35 times for > 6 seconds by media unrelated to the act of studying.

Students will often underestimate the length of time they spend per day engaged in media multitasking. Further, they will overestimate their capacity to effectively multitask[9]. Current research reveals that for higher order tasks, which require focus, humans are not wired to multitask. Rather, any apparent form of multitasking is in fact a *task-switching* process[16]. In this process, the individual must make the decision to stop the first task, actively divert attention, and begin the second task. While this process may occur rapidly (and not noticed by the individual), it does consume cognitive resources and generally leads to a poorer performance overall.

Numerous studies (as reviewed in references 9 and 16) over the past decade have shown that **frequent media multitasking** in class or while studying **correlates** with **lower GPA**, **poorer performance on tests and exams**, **more shallow modes of information processing and increased distractibility.** It is worth noting, however, that as important this observation is, most studies have not established direct casual relations. For instance, it is not clear whether frequent media multitasking is leading to a lower GPA or whether students who are less successful academically are more inclined to engage in frequent multitasking.

Perhaps the most important question for me at this point is what can I do as a college professor to engender a positive learning space in the chemistry classroom with respect to smart phones? Much of the literature suggests that attempts to administer an outright ban are generally not successful[17]. Others advocate for a general tolerance for media multitasking. Supporting this approach are claims like "students will do it anyways" and "students should be responsible for their own learning". I might have been inclined to adopt this second approach were it not for the fact that several studies have provided evidence that media multitasking can hinder the learning of nearby peers who are not using media[18].

In a recent review[18], Flanigan and Kiewra offer a number of concrete suggestions. In addition to educating students about the negative consequences of excessive multitasking, they and others advocate for providing incentives for students to voluntarily relinquish their mobile devices. The incentive may include a small percentage point increase in grade or some other reward currency. While for educators, it may be counter-intuitive to provide a reward for what should be expected behaviour, this approach appears to be favourably embraced by students and creates a positive learning environment.

In summary, in this article I outline two sides of the smart phone technology coin as applied to the chemistry classroom. Moving forward successfully will require finding the balance to harness the smart phone's tremendous computing properties while curbing our human inclination for distraction.

References

1. Williams, A.J. & Pence, H.E. (2011). Smart phones, a powerful tool in the chemistry classroom. *Journal of Chemical Education*, *88*, 683-686.
2. Libman, D. & Huang, L. (2013). Chemistry on the go: Review of chemistry apps on smartphones. *Journal of Chemical Education*, *90*, 320-325.
3. Wijtmans, M., van Rens, L., & van Muijlwijk-Koezen, J.E. (2014). Activating students' interest and participation in lectures and practical courses using their electronic devices. *Journal of Chemical Education*, *91*, 1830-1837.

4. Ranga, J.S. (2018). Multipurpose use of Explain Everything iPad app for teaching chemistry courses. *Journal of Chemical Education*, *95*, 895-898.ones, O.A.H., Spicjkova, M., & Spencer, M.J.S (2018). Chirality-2: Development of a multilevel mobile gaming app to support the teaching of introductory undergraduate-level organic chemistry. *Journal of Chemical Education*, *95*, 1216-1220.
5. Kuntzleman, T. S. & Jacobson, E.C. (2016). Teaching Beer's law and absorption spectrophotometry with a smart phone: a substantially simplified protocol. *Journal of Chemical Education*, *93*, 1249-1252.
7. Bandyopadhyay, S. & Rathod, B.B. (2017). The sound and feel of titrations: a smartphone aid for color-blind and visually impaired students. *Journal of Chemical Education*, *94*, 946-949.
8. Ping, G. L. Y., Lok. C., Yeat, T.W., Cherynn, T.J.Y, & Tan, E.S.Q. (2018). "Are chemistry educational apps useful?" – a quantitative study with three in-house apps. *Chemistry Education Research and Practice*, *19*, 15-23.
9. May, K.E. & Elder, A.D (2018). Efficient, helpful, or distracting? A literature review of media multitasking in relation to academic performance. *International Journal of Educational Technology in Higher Education*, *15*, 13-29.
10. Wentworth, D. K. & Middleton, J. H. (2014). Technology use and academic performance. *Computers & Education*, *78*, 306–311.
11. Junco, R. (2012). Too much face and not enough books: The relationship between multiple indices of Facebook use and academic performance. *Computers in Human Behavior*, *28*, 187–198.
12. Kornhauser, Z. G. C., Paul, A. L., & Siedlecki, K. L. (2016). An examination of students' use of technology for non- academic purposes in the college classroom. *Journal of Teaching and Learning with Technology*, *5*, 1–15.
13. McCoy, B.R. (2016). Digital distraction in the classroom phase II: Student classroom use of digital devices for non-class related purposes. *Journal of Media Education*, *7*, 5-32.
14. Rosen, L. D., Carrier, L. M., & Cheever, N. A. (2013). Facebook and texting made me do it: Media-induced task-switching while studying. *Computers in Human Behavior*, *29*, 948-958.
15. Calderwood, C., Ackerman, P. L., & Conklin (2014). What else do college students "do" while studying? An investigation of multitasking. *Computer & Education*, *75*, 19-29.
16. Kirschner, P.A. & de Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, *67*, 135-142.
17. Berry, M.J. & Westfall, A. (2015). Dial D for Distraction: The making and breaking of cell phone policies in the college classroom. *College Teaching*, *63*, 62-71.
18. Flanigan, A.E. & Kiewra, K.A. (2018). What college instructors can do about student cyber-slacking. *Education Psychology Review*, *30*, 585-597.

COMING SOON: STEPS FOR FULL COMPLIANCE WITH GHS/WHMIS 2015

François Gauvin (fgauvin@ustboniface.ca), Université de Saint-Boniface, Winnipeg, MB.

.

On December 1st 2018, the transition will be over between the "old" **Workplace Hazardous Material Information System 1988** (WHMIS) and the new **WHMIS 2015** adapted from the **United Nations' GHS** (**G**lobally **H**armonized **S**ystem of Classification and Labelling of Chemicals). On that date, all workplaces in Canada (including academia) will have to fully apply WHMIS 2015[1].

This article intends to describe the main steps (there are four) that can guide your school towards full compliance with WHMIS 2015. Depending on the size of your academic institution, you may have professionals or technical personnel directly in charge of your chemical inventory and chemical safety; these persons will probably take care of these steps. But as a teacher or professor in a smaller college or school, you may have to do all this by yourself. As chemists or chemistry instructors, we understand the paramount importance of knowing the chemicals we work with.

Nationwide, the **WHMIS 2015 Program** (linked to the Canadian Hazardous Products Act[2], HPA, and Hazardous Products Regulations[3], HPR) is under the authority of **Health Canada** but the **local application** of this program is under the responsibility of **provincial and territorial workplace safety and health agencies**. It is therefore recommended to check both the federal and your provincial regulations during your GHS/WHMIS 2015 and Chemical Safety compliance process.

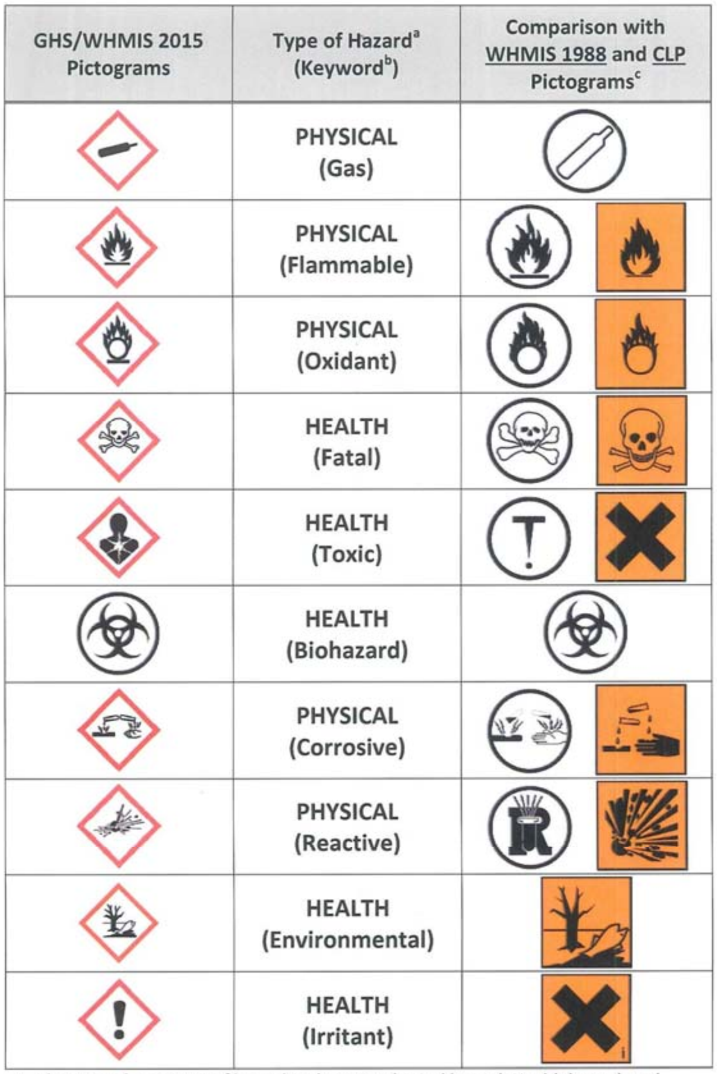
First step: The inventory of your chemicals

A good **chemical safety program** begins with an **inventory** of your products. Such inventory should contain relevant **safety information** about the commercial chemicals that you have. Among several possible pieces of information, the following might be considered as the main ones (others might also be required):

- Product Name,
- CAS Number,
- Quantity (g, mL, L, etc.) and Physical State (s, *l*, *g*, *aq*),
- Supplier's Name and Catalog Number,
- Location (room or warehouse number, cabinet and shelf codes, etc.).

VOLUME 41, ISSUE 2

Table 1 : GHS/WHMIS 2015 Pictograms (compared with WHMIS 1988 and CLP)



GHS/WHMIS 2015 Pictograms	Type of Hazard[a] (Keyword[b])	Comparison with WHMIS 1988 and CLP Pictograms[c]
	PHYSICAL (Gas)	
	PHYSICAL (Flammable)	
	PHYSICAL (Oxidant)	
	HEALTH (Fatal)	
	HEALTH (Toxic)	
	HEALTH (Biohazard)	
	PHYSICAL (Corrosive)	
	PHYSICAL (Reactive)	
	HEALTH (Environmental)	
	HEALTH (Irritant)	

a There are three types of hazard in the GHS: Physical hazard, Health hazard, and Environmental hazard. The GHS Environmental hazard has not been integrated to WHMIS 2015.

b These keywords are not standard. They are the ones we used to briefly describe the main hazards of the chemicals while performing/reviewing the inventory.

c Depending on the products age, different kinds of pictograms were noticed on their labels. Since WHMIS 1988 and CLP pictograms were applied prior to GHS/WHMIS 2015, their presence on bottles can be indications of products age.

While reviewing your inventory, you may (at the same time) want to **revisit the storage conditions** of your chemicals in function of their respective **compatibilities**. To do so, an "analysis" of your chemical list needs to be performed and this may take time. To reduce or optimize the latter, one may want to look for a shorter way of **classifying hazards**. Detailed compilations of all hazards (GHS H-coded statements) and precautions (GHS P-coded statements) are found in Safety Data Sheets of products but, as a first move, putting the emphasis on label **pictograms** can be a good way to start a chemical hazard analysis. WHMIS 2015 involves 10 types of pictograms and these can be added to the five items listed above. **Table 1** shows the 10 GHS/WHMIS 2015 pictograms, the types of hazards they represent (with a descriptive keyword), and their comparison with the "old" WHMIS 1988 and the "old" CLP[4] European pictograms. These points can help sorting out your products.

Knowing that WHMIS 1988 and "old" CLP systems were applied prior to GHS, you can estimate the relative "age" of a chemical from the type of pictograms you see on its label. If the pictograms are GHS ones, you know the substance is not "too old". But if you see WHMIS 1988 or "old" CLP pictograms on bottles, you may need to consider disposing of those chemicals prior to December 1^{st}. Obviously, if there is an **expiration date** on a label, the latter should also be considered in your decision of keeping a substance or not.

Second step: The Safety Data Sheets (SDSs)

Once you have your inventory in hands, make sure you have up-to-date **Safety Data Sheets (SDSs)** for all your products. SDSs can usually be found as links and/or PDF documents from suppliers' webpages. Make sure everyone can have an easy access to the SDSs in the workplace (*i.e.* in the laboratory). SDSs can be kept as **paper copies in binders**, or as **links** easily **accessible from a computer** in the laboratory. According to GHS/WHMIS 2015, **SDSs must contain 16 sections**. Significant relevant safety information is provided in these documents (name of product, name and coordinates of supplier, list of hazards, list of precautions, etc.); make sure you consult them when preparing chemical samples or solutions. It is also a good idea to **integrate the use of SDSs in your courses and laboratories**; the sooner students get used to them, the better it is when they go on the workplace.

Third step: The Labels (Suppliers and Workplace)

GHS/WHMIS 2015 describes two kinds of labels: the **Suppliers labels** and the **Workplace labels**. According to the regulations (HPR), each type of label must contain a minimum amount of information. This should not be a problem with the suppliers' labels since they have to comply with the regulations. For us (chemists and chemistry instructors), we specifically need to be careful with our workplace labels. The latter must contain, at least, three pieces of information:

1) Product name (or a suitable identification like a formula or structure).
2) Safe handling precautions and main hazards identification (major pictograms, H-codes, and P-codes).
3) Reference to the SDS (hence the need to have the SDS not too far away).
4) In order to facilitate handling of the many samples and solutions we prepare, our department agreed to add two other items on our workplace labels:
5) Date of preparation.
6) Name of the person who prepared the sample or solution.

This way, not only we comply with GHS/WHMIS 2015, but we can also trace all homemade samples and preparations in our laboratories. **Figure 1** shows an example of workplace (laboratory) label used at the *Université de Saint-Boniface* science laboratories.

Figure 1: Example of laboratory label (*Université de Saint-Boniface*)

1. **Name (formula) of product**
2. **Hazards and precautionary statements, and pictograms**
3. **Reference to SDS (*FDS*) of the product**

Fourth step: The Training (General and Specific)

Finally, one must not forget that **all the personnel** (colleagues, professors, professionals, technicians, … and students working in laboratories) **must be properly trained towards GHS/WHMIS 2015**. There are basically **two kinds of training**: **General** and **Specific**. At the *Université de Saint-Boniface*, the **general training** (the "Education" part required by the law and regulations) is provided *via* a course we designed **online** through our eCAMPUS/Moodle® learning management system. Everybody can follow this training as a start.

Then, we provide **specific "in-laboratory" hands-on training** for each course that has a laboratory component. During these specific trainings, we provide an overview (main points) of GHS/WHMIS 2015 (which personnel and students had already seen online) and then we cover **general laboratory safety**. For the GHS/WHMIS 2015 part, we **analyse the SDS** of typical products that are used in the specific laboratory course (in terms of hazards, precautions, etc.) so that students (and colleagues!) are made aware of the risks they are exposed to.

Conclusion

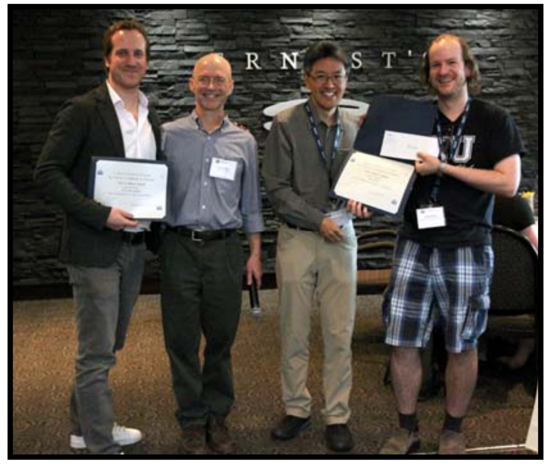
In this article, the four steps we apply at the *Université de Saint-Boniface* to reach full compliance with GHS/WHMIS 2015 were described. Typically, the steps begin with establishing a complete inventory of chemicals; then come the prescribed steps for applying GHS/WHMIS 2015, *i.e.* learn how to use SDS, how to read and design labels, and the training of the people who shall be exposed to hazardous substances during their work. All in all, GHS/WHMIS 2015 system provides a tool to make people aware of the risks they are exposed to, and we can also make it a very good teaching tool.

References (all websites accessed October, 2018)

1. https://www.canada.ca/en/health-canada/services/environmental-workplace-health/occupational-health-safety/workplace-hazardous-materials-information-system/whmis-2015.html.
2. http://laws-lois.justice.gc.ca/eng/acts/H-3/.
3. http://laws-lois.justice.gc.ca/eng/regulations/SOR-2015-17/.
4. Classification, Labelling and Packaging Regulations (European Commission) : https://ec.europa.eu/growth/sectors/chemicals/classification-labelling_en.

A CALL FOR NOMINATIONS

Each year College Chemistry Canada presents awards in a number of categories including 1. C3 Award in Chemical Education, 2. C3 Host College Student Scholarship, and 3. the C3 General Student Scholarship. More information about these awards can be found on the C3 website, but it is worth noting that the deadline for nominations for the 2019 awards is fast approaching (January 1 for the Chemical Education award and March 31 for the General Student Scholarship). Also note that contributors to the C3 newsletter are eligible for the C3 Editor's Award. Winners of this year's Editor's Award (Yann Brouillette and Jessie Key) are featured in the adjacent picture.



Yann Brouilette and Jessie Key receiving C3 Editor's award from Carl Doige and Jimmy Lowe.

THE PRESIDENT'S MESSAGE

Greetings C3 members,

I hope you are having a great beginning to your term start as the cycle of the Fall semester starts again. I'll be brief as this mega-newsletter has full page articles from our contributors and packaged together by our editor Carl. If you missed the conference, there will be many stories about the open snack bar, Chemmies and the return of the Editor's Award!

Along with the fun times and friendships, our conferences provides excellent PD opportunities for colleagues from high school, colleges, university and industry. One speaker at the 2018 Conference at NAIT reminded me of the main reasons why C3 is an important organization. Kristy Erickson's (Red Deer College, AB) felt motivated and encouraged from her previous C3 experience to develop her "student-as-instructor teaching activity for VSEPR shapes" in order to make her first C3 presentation.

I would like to thank Brenda Addison-Jones (Douglas College, BC, Past-Treasurer) for her service as Treasurer to the C3 community. Congratulations to Paula Hawrysz (NAIT, AB) as our recent President-Elect and John Eng (U of Lethbridge, AB) as our incoming Treasurer.

If you are interested in an executive position or a regional director position (no experience necessary), please contact us for more information.

Please mark your calendar for the 2019 C3 Conference at Camosum College (Victoria, BC).

All the best for a fun and memorable Fall term!

Jimmy

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