Harris Teaching Workshop

Electronic Resources for Teaching Chemistry

University of Alberta

May 9-10, 2013

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Participants at the Harris Workshop used Google Docs to produce real time reports of the discussions. The following captures the dynamic and chaotic nature of conversations between passionate teachers. For those that participated in the Harris Workshop, the comments will serve as reminders of what was discussed. For those who were not able to participate, this document will provide a rambling but complete sense of the discussions, and links to many useful resources. If you are interested in any of the content or have further questions, please feel free to contact either of the co-organizers at the addresses above.

Finally to all participants, thank you for your enthusiasms and insights. We hope to see you at future Harris Teaching Workshops.

Sponsors

McGraw-Hill: Contact Michelle Ritchie <Michelle_Ritchie@mcgrawhill.ca>

Sapling Learning Company: Contact Jesse Reich <jesse.reich@saplinglearning.com>

TopHat Monocle : Contact David Liptrot (dave@tophat.com)

Wiley : Contact Beth Iskiw <biskiw@wiley.com>

Nelson : Contact Leanne Newell <leanne.newell@nelson.com>

Research Corporation

Department of Chemistry at U. Alberta

Faculty of Science at the University of Alberta

Tentative Schedule

Thursday, May 09 **E3-25 Chemistry (Gunning-Lemieux) Centre**

9:00-9:30 am	Introduction and Welcome by organizers
9:30-10:15 am	Breakout Discussion Groups 1: Why?
10:15-10:45 am	Coffee, Participant Bingo and Displays, E4-43
10:45-11:00 am	Reports from Breakout 1
11:00-11:30 am	Vendor seminar 1 (Wiley)
11:30-noon	Vendor seminar 2 (Sapling Learning)
12:00-1:00 pm	Lunch, Participant Bingo, and Displays, E4-43
1:00-1:30 pm	Vendor seminar 3 (Nelson)
1:30-2:00 pm	Vendor seminar 4 (TopHatMonocle)
2:00-2:45 pm	Breakout Discussion Groups (Session 2): How?
2:45-3:15 pm	Coffee, Participant Bingo and Displays, E4-43
3:15-3:45 pm	Reports from Breakout 2
3:45-4:15 pm	Vendor seminar 5 (McGraw-Hill)
4:15-5:30 pm	Test drive those resources Chem room W1-50: Wiley and Sapling. CCIS L1-150: Nelson and TopHatMonocle. CCIS L-1-207: McGraw-Hill.
6:00 pm	Social Hour (Champs Sports Bar, 11712 87th Avenue)
7:00 pm	Dinner, Aurora Room, Lister Conference Centre

After dinner, Jonathan Schaeffer, Dean of Science at U of A, will speak on *MOOCs: Manna, Mania, and Millions*. Dr. Schaeffer is an internationally recognized researcher on artificial intelligence. This fall the U of A will team with Udacity to offer a MOOC on DINO 101: Dinosaur Paleobiology.

Tentative Schedule

Friday, May 10	**E3-25 Chemistry (Gunning-Lemieux) Centre**
9:00-9:45 am	Breakout Discussion Groups 3: How?
9:45-10:30 am	Reports from Breakout 3
10:30-11:00 am	Coffee, E4-43
11:00-12:00 am	Test drive those resources
	Chem room W1-50: Wiley and Sapling
	CCIS L1-150: Nelson and TopHatMonocle
	CCIS L-1-207: McGraw-Hill
12:00-1:00 pm	Lunch, E4-43
1:00-3:00 pm	Show and Share (by request)
3:00-3:30 pm	Back to big picture [General discussion, Conclusions, and Follow-up Planning]
3:30-4:00 pm	Coffee and goodbyes

NOTE: Information regarding both electronic and traditional resources for our sponsors will be available during the coffee and lunch breaks in E4-43.

Internet

All rooms will have wireless internet access

- UWS, eduroam, or Guest access
- See handouts or Tyler

All rooms have LCD projectors.

Google drive used as living record of workshop (used to create this document)

Break-out Groups

1. Each break-out has a **topic** for discussion.
2. **Facilitator** gets discussion going, maintain discussion,...
3. **Recorder** records the important points and to report these back to the general group.
4. "Harris Workshop 2013 Summary" in Google Drive is a living record of the workshop.
5. If discussion strays from topic, GREAT!!!

Break-out Groups

1. "Why?" break-outs to start with big picture.
2. "How?" break-outs to **share** resources.
3. Demo your resources one-on-one during the “test drive”.
4. During the “How?” break-out sessions, please determine some resources to shared with the group as a whole on Friday “Show and Share” session.
5. In How? sessions reflect on how the specific technology addresses the needs identified in the “Why?” session.

Favorite Chem Educ Journals

Journal of Chemical Education (ACS)

Chemical Education Research and Practice (RSC)

Chemical Educator

STLHE Newsletters

Rankings of Chem. and Sci. Ed. journals:

J. Chem. Educ., 2012, 89 (1), pp 16–20

Favorite Chem Educ Websites/Resources

Chemical Education Digital Library (ChemEd DL)

Analytical Sciences Digital Library (ASDL)

King's Centre for Visualization in Science (Mahaffy)

Wireless Whiteboard (Hultin)

Odyssey Molecular Dynamics Simulations (Molecular Sandbox, Wavefunction)

JCE Chemical Education Xchange

Chem1 -Resources for Chemistry Educators (Steve Lower)

PhET Interactive Simulations

demonstrations.wolfram.com (James Harynuk)

Favorite Higher Educ and Sci Websites

SnoLab - Sudbury Neutrino Laboratory

Higher Education Quality Council of Ontario

Thermite of a Frozen Lake

Favorite On-Line Question Banks

ChemEd DL QBank Questions

Favorite Smart Phone Apps

D. Libman and L. Huang, Chemistry on the Go: Review of Chemistry Apps on Smartphones, *J. Chem. Educ.* **2013**, *90*, 320-325.

Break-out 1: Why in the class? Summary

- To visualize (molecular level, linking levels, simulations, etc.)
- Supports different learning styles
- Supports learning at all levels of Bloom's taxonomy
- Flexibility and patience in supporting many different learning and teaching needs of many students
- Assessment is fair and can be randomized
- Engages and motivates students
- Can contextualize learning

Break-out 1: Why in the class?

POV: instructor's

- easily customisable in real time; can edit in situ e.g new discussion points that come up
- assess comprehension instantly (feedback)
- how-to videos
- consistency within multiple instructors (across curriculum)
- various teaching styles (aids visual learners when graphics, video, multimedia used for e.g.)allows use of higher order Bloom's Taxonomy levels during and outside of lectures
- student focus may be on regurgitation and electronic resources help understanding versus memorization
- for dynamic concepts (i.e. can use animation); paper is sometimes limiting especially for molecular dynamics electronic resources are scalable
- online assessment can be like Bingo (different exams for each student) to reduce cheating i.e. use of algorithmic questions

Break-out 1: Why in the class? (continued)

POV students

- levels playing field
- anonymity (student comfort, less pressure, more engagement)
- students comfortable using them
- students have hardware already
- students uncomfortable with pen and paper
- helps with attention span limits when lecturing for long periods
- students need to develop familiarity with online learning environments for external examinations (e.g. GRE)
- provincial exams are moving towards fully online format
- students can revisit material later (accessibility) for reinforcement or if they skip class

Break-out 1: Why not in the class? (continued)

- too many resources overwhelm students; overexposure
- for the sake of adding technology
- instructors should not use it to avoid face time with students
- learning to use resources takes time for instructors and students especially navigating the software
- problems integrating technology may distract students

Concerns

- do students maximise these tools? what should be the instructor's role?
- instructors need training to catch up with students but on the other hand students may not be as savvy as instructors think e.g. using productivity tools vs social networks
- cost of implementing these tools

Break-out 1: Why for the lab?

- Themes (summarized by R. Stoodley, full notes follow)

- Electronic and face-to-face combination of teaching is stronger than sum of parts
- E-resources cannot replace labs
- E-resources in advance of lab can help students gain maximum possible from in-lab time?
- Broad range of e-resources is in use, including simulations, safety training, instructional videos (techniques and instruments), literature access, grading, administrative tools

Break-out 1: Why for the lab?

- J.Cooke: more and more students attached to handheld devices - can they learn better using that media?
  - maybe some people can benefit from this media compared to traditional methods e.g. video tutorials for lab
  - seems that more students 'get it' when they can actually see something on a screen
- D.Kennepohl: Literature and experience show that using face-to-face and electronic sources combined is useful e.g. compare to using a flight simulator
  - better learning if face-to-face is supplemented with electronic resources
- supplement not replace?

Breakout 1: Why for the lab?

- C.Lovallo: simulations are a good way to get someone to focus on something
- do students need actual equipment in front of them before they can fully understand/ interpret?
- J.Cooke: students have a lot of RAM but no hard drive
- we are dealing with a new generation of people?
- C.Lovallo:(Mount Royal) intro labs: students don't come out with good lab skills. 1 lab every 2nd week - not enough time for skill development - trying to develop new videos so students can see directly and understand before coming to lab.
    - dry lab simulations - students are encouraged to break things - safety/explosions

Breakout 1: Why for the lab?

- C.Lovallo: You exploded something -Why? i.e. what did they do to cause explosion?
- Improves learning and helps to understand the chemistry

- D.Kennepohl: min 400 hrs lab work - CIC accreditation
  - min 2000 hrs lab work - German accreditation
  - different approach to labs in Germany - spend most of their time in the lab. Lecture seems secondary. (Don't use electronic resources there)
- S.Nussbaum: France - also lots of labs but did use electronice resources for calculations, simulations etc .. still lots of lab hours

Breakout 1: Why for the lab?

S. Nussbaum: Why am I using electronic resources for the lab?

- to support guided inquiry in the lab
- a) dry week b) wet lab

students have to design own exp before coming to class (procedure in manual is in general format) - resources: lab manual, tech modules, slides shows with pictures of instrumentation, tutorials, calculations.

Diff exp have diff resources.

Chem 21 - tutorials for every lab.

- To be able to utilize the small amount of time allocated for the lab class for experimentation only.

Breakout 1: Why for the lab?

D.Kennepohl: Are people finding pressure to use elect res for financial reasons?

- UBC - not feeling it currently (budget already cut 10 yrs ago)
- Grant from university to create a blended/hybrid 1st year labs
- UofA - Just started the cuts ... 15-20% reduction
- Less TAs may translate into less time in the lab
- MOOCs?

Breakout 1: Why in the lab?

- Mount Royal: 10 yrs ago - money to develop a dry lab program .. program eventually disappeared. Put in online resources to provide more consistency between instructors.
- Online stuff cannot replace being in the lab
- S.Nussbaum(UBC) has virtual labs with feedback forms - student has to submitted
- E.Sullivan (UofC) - Sapling pre-labs (due night before lab) -TAs think students are more prepared - doesn't cut into tutorial time (students have 1 week to complete) - costs students $24 per term

Breakout 1: Why in the lab?

- C.Lovallo:Pitfall - instructor told not to give students >10hrs of work - therefore need to balance tutorials, quizzes etc outside of class time. Students are overworked?
  - Easy to throw stuff online
  - People who are using the resources are not the ones who need it. How to balance the time for students? How to create something that is efficient with minimum time input?

Breakout 1: Why in the lab?

- C.Lovallo:Instructors are trained to be in the lab but some are not tech savvy - trouble with 'buy-in' and how to use. If instructor is not on board, students also will not use the elect. resource.
- Why are we using electronic resources? (Instructors)
- Why should we use them? (Student Qu)
- N.Djokic (UofA organic) - Using a new virtual lab tutorial
  - Before lab, students have to go through interactive tutorial. MCQs designed to force students to go through tutorial - marks allocated.

Breakout 1: Why in the lab?

- These should not replace labs - should be a supplement.
- Will budget cuts affect this?

R. Stoodley:Electronic resources for admin?

- Clunky - takes times to learn to use
- grading, safety quiz online(J.Cooke, R. Stoodley), online pre-lab quiz, is there a way of making sure that the students have watched the video - should we force the students to use these resources? (e-class/moodle)

Breakout 1: Why in the lab?

- J. Cooke: publish each experiment individually online - no lab manual - cost saving for student
- J.Cooke: use googledrive for student joint projects;
  - 10% of class took a penalty for not doing the project work - did not want to be bothered
- S. Nussbaum: use system for literature - students have to read articles for projects - given access through this system (Vista/Connect). Password protected.
- class management system: WHMIS, each lab section, quiz - what happens if student chooses not to do it?

Break-out 1: Why on-line asynchronously (Content and Resources)?

- provide resources to help student learn
- alleviates time constraints
- reaches more students (as compared to office hours, for example)
- examples that more difficult to go through in class; step-by-step; give students chance to think about the material
- longer assignments
- online lectures and do problems in class
- students want to go online- have toys! (??)
- Fun for us (instructor) to do
- saves time for instructors
- students have more encouragement to learn, keep up with the course
- provides background material for weaker students to catch them up
- provides opportunities for practice beyond textbook
- students less stressed to copy everything down during class
- accommodate students who have different learning preferences
- accommodates instructor teaching preferences
- reaches students not on campus

Break-out 1: Why on-line asynchronously (Content and Resources)? (cont)

CHALLENGES: students don't use them, students get busy/confused, students not as savvy as we think, students want quick "consumer" stuff but we are trying to be more reflective, are we offering material that is sophisticated enough?

STRATEGIES: student need motivation (on exam, marks), students need structure, expectations need to be clearly layed out, color-coded practice problems (simple, medium, difficult), email students who have not completed a task as indicated by the online resource, put up resources that connect to what we are teaching, what they need to know. Identify CLEARLY what is extra or special topics.

Break-out 1: Why on-line synchronously?

- can't have synchronous without asynchronous
- students great multi-taskers (both good and bad); different group of people--want things to be done instantly
- enables remote learning & remote teaching & inter-institutional collaboration
- e-class live (Elluminate live or Adobe Connect)
- sychronously checking other break outs
- can't schedule enough rooms/don't have enough TAs - on-line synchronous seminar or same time inclass seminar

Break-out 1: Why on-line synchronously? (cont)

- synchronous for office hours
- has ability to record (repository of FAQs)
- reach a different group
- has possibility of risks--attendance low, need way to make sure people streaming are there and included in discussion; successful on-line teaching needs teaching presence and student presence, (community or social presence)
- scheduled time prompts engagement
- gaming is good example. Have Q&A sessions with teacher but also moderator to group questions & idiots

Break-out 1: Why on-line asynchronously (Assessment and Self-Assessment)?

- Very useful for self-assessment (but how do you encourage students to use)
- For grades, makes students do the work (but how do we determine who "really" does the work)
- Most useful for 1st and 2nd year? (bridge from high school)
- Useful to check/re-evaluate material covered by exams
- Useful to re-evaluate/summarize common mistakes
- Provides consistent grading and embedded feedback (either guidance to the textbook, lecture notes, or additional analogous example problems)
- Allows students multiple attempts to build confidence
- Frees up time for "important" stuff during the face-to-face times (e.g., nomenclature can be done online)
- There is a lack of resources (can be overcome by using commercial resources. Some questions at least in Alberta/Ontario about charging students extra beyond tuition to utilize resources for grading purposes)

Break-out 2: How in the class?

- Phil Hultin: iPad writing in class: Educreations - simple whiteboard app (FREE!) Wireless Whiteboard
  - Can record audio at same time
  - Student must register on educreations to view recorded lectures
- Peter Mahaffy: (1) Visualizing the Chemistry of climate change (2) Odyssey.
  - Visualization resources: kcvs.ca
  - explainingclimatechange.com
  - Odyssey: molecular dynamics - going to the multi-particle

Break-out 2: How in the class? (cont)

- Melanie Hoffman: Poll Everywhere (pollev.com)
  - Can be used for free up to 40 participants
  - $14/year/student OR $395 (instructor paid) f
    entire class

- Chris Addison: Molecular modelling using Gaussian
  - Students can access using blackboard plugin,
    institutions have gaussian/webmo site license

Break-out 2: How in the lab?

- Tutorials provide supplement to labs or act as pre-labs
- on-line tutorials developed in house and freely available
- combination of interactive lab demos and videos
- especially important for lower level labs for students who have never stepped foot into the lab
- helps to improve efficiency in the lab
- mandatory components such as pre-lab experiments/quizzes are used for safety preparation (inorganic UofA)

Break-out 2: How in the lab?

Challenges:

- What to do when students are not prepared and don't take advantage of available prep material? Do we let them fail as long as they are safe about it?
- Problems when we assume that students are more literate with data processing software (most of them can't use excel)
- When instructors aren't on board with the on-line resources, if the instructor doesn't stress the importance students are less likely to use it
- Instructors digital literacy?
- Students need constant reinforcement with not only experimental procedures, but with digital tools
- Learning curve in regards to the user interface with digital tools
- Time/money spent developing the tools
- Budgetary constraints force the development of dry-labs?

Break-out 2: How in the lab? (cont)

Solutions?

- we don't remember
- No perfect solution that can be applied across all courses
- Need to take into consideration course-level, philosophy of lab

Conclusion:

Electronic labs are not a replacement for hands-on lab experience, but serve an important purpose for lab preparation. Simulated labs should be followed up with a real experience.

Break-out 2: How in the lab? (cont)

- UBC (Sophia Nussbaum)- combination of dry & wet lab, guided-inquiry
- Dry lab is preparation for wet lab, where they design experimental procedure for wet lab
- Carnegie-Melon collaborated to design dry-lab tutorials- chemcollective
- Freely available software Virtual Lab via Chemcollective
- UBC (Robin Stoodley) - 3rd year labs amalgamated into one lab course (Physical, analytical, organic, inorganic)
  - Software used to manage the lab schedules
  - Students sign up for their own experiments and create their own schedule
  - Software serves pedagogy indirectly, but is a direct administrative tool

Break-out 2: How in the lab? (cont)

- UofA (Hayley Wan & Nada Djokic)
  - Virtu-O-chem, should be online and freely available soon
  - 161/261 & 263 Organic Chemistry pre-lab
  - Interactive demos and step-by-step lab procedure activities
  - Assumption is made students have never seen or used the equipment in the organic labs

Break-out 2: How on-line asynchronously (Assessment and Self-Assessment)?

Chris Lovallo

- ipad usage in classes @ Mt. Royal
  - using the ipad on the document camera so that students SEE what you are doing.
  - *EXPLAIN everything* - just like a whiteboard but also has a recorder to record your voice.
  - does teaching with an ipad help increase critical thinking of the students? Use an app to help implement a class activity. e.g. Periodic table trends.
  - VSEPR - from the app - *Modify Molecules* students with the ipad did better on the exit test but it took them longer. 25% better and could handle much more complicated structures.
  - Students with options for both model and ipad chose to use the ipad.
  - there are apps for virtual labs as well.

continued... Ian Hunt

- Organic Nomenclature Website
  - different pages to work through on student's own time, to alleviate class time.
  - questions that gradually increase in difficulty
  - offers conditional feedback, but is not randomized
  - you must work through 8 iterations to get to the final answer and cannot simply view final answer.
  - java script based
- Moodle
  - a free online tutorial based system. Open source content.
  - contains a drawing tool and requires a password log-in
  - started using this to provide assignment feedback (had complaints from students "I scored 100% on assig. but 50% on MT!!") working in groups can give artificial confidence.
  - allows wildcards - answers you didn't anticipate
  - it can generate random questions across all questions pools

continued....Anka Lekhi

- Comparison between 2 summer courses using on-line homework and not.
  - students agreed that the on-line homework helped improve their grades
  - comparison to the final exam grade shows no difference between the groups with on-line homework and the group without.
  - Comparison to just the repeat students - again no change.
  - TAKE HOME - students perceive improvement but with no actual improvement.... :(
  - students like on-line homework but not quizzes.
  - want immediate feedback and hints.
  - QUESTIONS
  - Do students actually retain better using online homework?
  - Did it affect student attitudes?
  - When we see that grades aren't improving - how do we convince our colleagues to embrace this technology?

Break-out 2: How on-line synchronously?

- CL: Spam...take student's question by e-mail, strip of identity, and send out answer to everyone on a News Forum so all can benefit from question.
- SFI results increase w.r.t. "uses in-class time effectively"
- Has a lecture TA to help with e-mail volume.
- Links office hours to Google Calendar, students can book 15 minute blocks (feature may not be supported at your institution)
- BB: lectures are recorded, two students recording, two cameras. Roughly 10 mins upload time from end of lecture to beginning of online access.

Break-out 2: How on-line synchronously?

- BB (cont): Real-time access is free, VOD access pay $50 per course per term for access, roughly 50% subscribe. 340 seat theatre, 700 or more subscribers.
- Performance is identical across in-person and VOD students.
- Exams done outside of class time in evening.
- Carleton University TV pays for exam proctoring and production.
- Class attendance is inversely proportional to online viewing.
- Uses instant messaging on Moodle to do online office hours each weeknight, 40-50 a night during peak times.

Breakout Group 3: How in the Class?

- Focus on e-resources for molecular level visualization - Demos of Avogadro, Orbital Viewer. Avogadro creates output that goes directly into computational programs like Gaussian
- Chemed-L is now a google group.
- King's Centre for Visualization in Science also has a stereo-molecular viewer for use with a geowall. Designed this way because colour is often used for other purposes in chemistry, and 3D rendering through colours can often be confusing.
- All of the above are free
- Caution is needed with language used to describe hybridization - atoms are not "hybridized". Need to emphasize that these are models to explain observations. Without this, good visualizations can be misleading
- Rapid prototyping machine at Red Deer College - can print 3D models in plastic. Bryan will present this at the C3 conference - tactile is important in visualization. Some of the pioneering work on this has been done at the Centre for Biomolecular Modeling at the U. Wisconsin- Milwaukee

Breakout Group 3: How in the Class? (cont)

- ChemDraw has 3D rendering using colours
- Needed - good visualization of a 3D potential energy surface, view in an oblique perspective, animate a random walk across the surface. Anything that can happen does happen, but not everything leads somewhere. An interesting surface with several local minima and a global minimum - ability to take a trajectory across it. Watch the stochastic processes, then pull out the minimum. Could also create a 3D model.
- Needed - good visualizations of reations that help students overcome their misconceptions about intentionality in reactions, when describing reaction mechanisms, for example. Organic chemists are repeat offenders with descriptions of processes that leave students with the impression that there is intentionality, for example, in an SN2 reaction.

Show and Share: Spamming (Lucy)

Any student e-mail question

- Strip question of identifiers
- Send answer to all students on e-mail list
- Complex questions discussed in class

Types of Questions

Administrative - clarify course rules or lab procedures

Question: How can I access to some old exams?

Question: Will the lab questions on the midterm refer to any of the experiments?

Content - clarify lecture material

Question: In diprotic acid, how come Kb1 = (Kw/Ka2) instead of (Kw/Ka1)?

Question: In # 14-35, why is the anode half reaction written as: H+ + e <---> 1/2 H2 (g) in the solutions. In table 2, its written as 2H+ (aq) + 2e <----> H2 (g).

Show and Share: Spamming (Lucy)

Moodle - use News Forum

- answer ~ 1 question per term per student
- only I know how many questions I don't answer

I really liked how Dr. Lucy set up a system where we were able to receive replies to all students questions. It was helpful because we all generally had the same questions.

I appreciated that Dr. Lucy actually cared about giving feedback to students. Emails, especially, were always answered with a lot of explanation. His answers were not quick and annoyed sounding which is refreshing.

Show and Share: Spamming (Lucy)

Bold indicates statistically significant improvements in Student Evaluations

The goals and objectives of the course were clear.

In-class time was used effectively.

I am motivated to learn more about these subject areas.

I increased my knowledge of the subject areas in this course.

Overall, the quality of the course content was excellent.

The instructor spoke clearly.

The instructor was well prepared.

The instructor treated the students with respect.

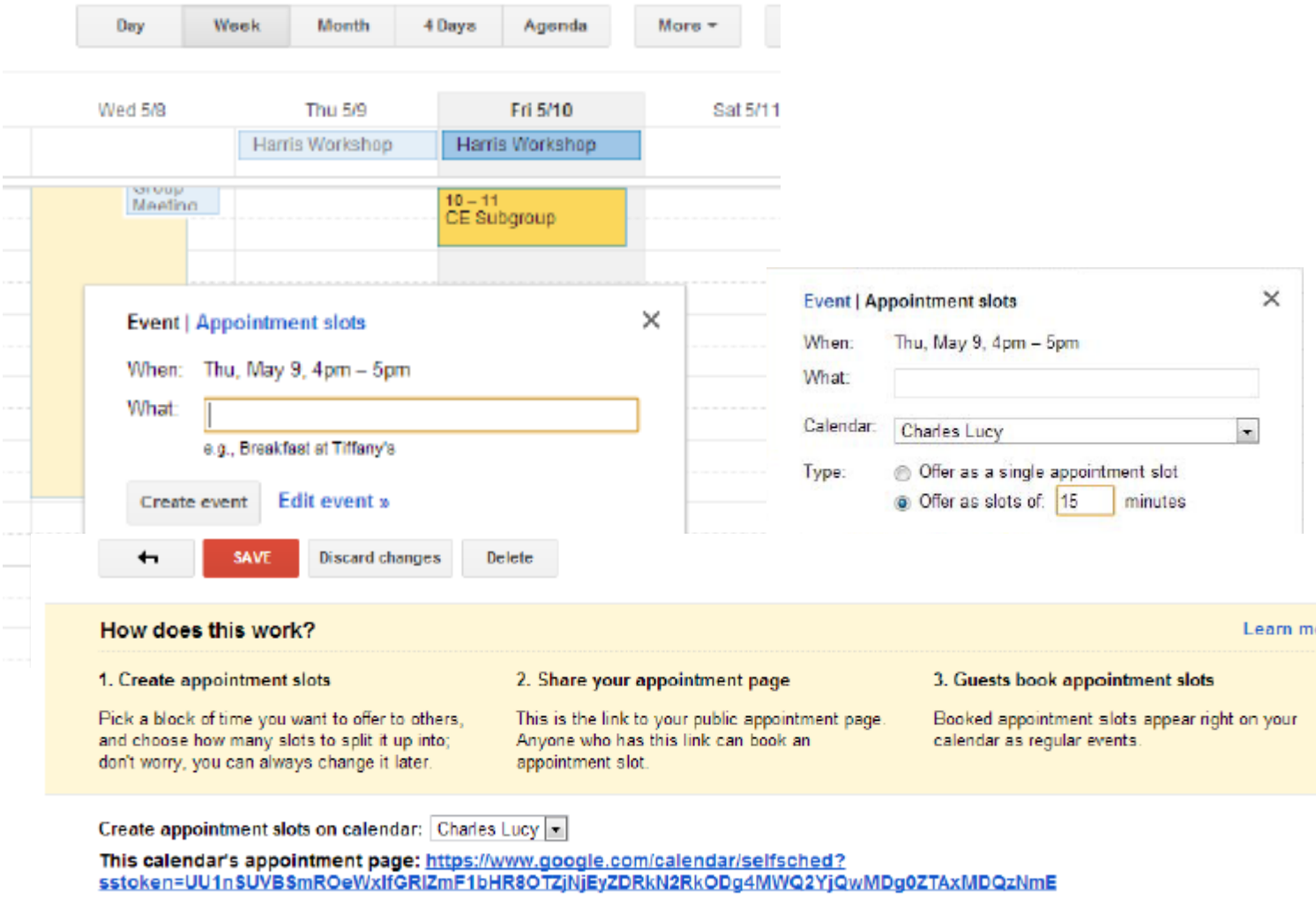
The instructor provided constructive feedback throughout this course.

Overall, this instructor was excellent.

Show and Share: Office Hours (Lucy)

Traditional office hours under-utilized

Use "appointment" function in Google Calendar (see note below)



Note that google has discontinued the appointment slots feature for general users (unless your institution is a 'google app for business' customer
See http://webapps.stackexchange.com/questions/39518/alternatives-to-discontinued-google-calendar-appointment-slots
for a potential workaround (not tested by me)
or
http://collaborative-tools-project.blogspot.ca/2013/01/an-alternative-to-google-calendars.html

Break-out 3: How in the class?

- Roy Jensen: Avogadro.
- Roy Jensen: orbitals.com (orbital viewer)
-

The take away

- We should have documented proof that the electronic resources used are useful for learning. We also need to define what is success.
- Putting lectures online is not as hard as we thought especially to take content out of the class because running out of time during in-class assignment.
- Technology should not be the problem. It is getting easier now with all the options.
- Technology should be a solution e.g. time problems, engagement, aid deep understanding.
- Nice perspective due to team effort i.e. you do not have to try all the options, just get testimonials from others.
- Educreations can be used to do customized feedback or for problem solving.
- Electronic resources should not be used to avoid student contact. Many times questions are better answered in person.

The take away (cont)

- We do not want to take all of the learning outside of the classroom. There must be a balance in the amount of electronic resources we use.
- Trying new methods is exciting though!
- We must be careful of forcing electronic resources on students as not every student will learn well from them.
- Electronic resources should be supplementary rather than replacing the traditional lecture.
- Students have other activities on their schedule so there should be a balance of how many out-of-class assignments that are required.
- Many students are not excited about Chemistry and may not be encouraged to learn on their own.
- We need to know who our students are before we decide their needs and how to fulfill those needs with electronic resources (course level learning objectives).

Home Work

"In my mind teaching is not merely a life work, a profession, an occupation, a struggle; it is a passion. I love to teach"
William Lyon Phelps

J. Chem Ed.1930, 7(5), 1140.

Do not be a slave to your text book!