Harris Teaching Workshop

Interdisciplinary Chemistry

University of Alberta, May 14-15, 2015

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Participants at the Harris Workshop used Google Docs to produce real time reports of the discussions. The following captures the “real-time” conversations between passionate teachers. For those that participated in the Harris Workshop, this will serve as reminders of what was discussed. For those who were not able to participate, this document provides a sense of the discussions. 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.

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

Thanks to our Sponsors !

McGraw-Hill Ryerson: Contact Leo Fong <Leo.Fong@mheducation.com>

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

Nelson: Contact Alexis Andres <alexis.andres@Nelson.com>

Pearson: Contact Alexandra Kramer <alexandra.kramer@pearsoned.com>

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Department of Chemistry at the University of Alberta

Faculty of Science at the University of Alberta

Centre for Teaching and Learning at the University of Alberta

Schedule

Thursday, May 14 E3-25 Chemistry (Gunning-Lemieux) Centre

9:00-9:30 am Introduction and Welcome by organizers
Discussion of Workshop Goals

9:30-10:30 am Discussion Groups (Session 1)
10:30-11:00 am Coffee and Displays (E4-43)
11:00-12:00 Discussion Groups (Session 2)

12:00-1:00 pm Lunch and Displays (E4-43)

1:00-2:30 pm Reports from Discussion Groups
2:30-3:00 pm Coffee (Outside CAB 265)
3:00-4:30 pm Brian P. Coppola presentation and discussion (CAB 265)

5:00-7:00 pm Reception (Devaney's Irish Pub (Downstairs), 11113 87 Ave NW)
Finger (bar) food will be served

Brian P. Coppola

Arthur F Thurnau Professor
Associate Chair, Educational Development and Practice
Professor of Chemistry
College of Literature, Science, and the Arts
University of Michigan

Title: Real Work is Better than Homework
Date: Thursday May 14
Time: 3:00-4:30 pm
Location: CAB 265

Schedule

Friday, May 15 E3-25 Chemistry (Gunning-Lemieux) Centre

9:00-9:30 am Convene in E3-25
9:30-10:30 am Discussion Groups (Session 3)
10:30-11:00 am Coffee (E4-43)
11:00 -12:00 Discussion Groups (Session 4)

12:00-1:00 pm Lunch and Displays (E4-43)

1:00-2:30 pm Reports from Discussion Groups
2:30-2:45 pm Coffee (E3-25)
2:45-3:30 pm General discussion, Conclusions, and Follow-up Planning

4:00 pm Adjourn

Internet

All rooms will have wireless internet access

- UWS, eduroam, or Guest access

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 2015 Summary" in Google Drive is a living record of the workshop. http://tinyurl.com/l6mwdhv
5. If discussion strays from topic, GREAT!!!

Breakout Discussion Groups (Session 1): Thursday, May 14, 9:30-10:30 am	
Topic: What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?	**Location:** E3-25
Topic: Introductory Organic Chemistry: Is there a place for interdisciplinarity? If so, how?	**Location:** E3-49
Topic: Introductory General Chemistry: Is there a place for interdisciplinarity? If so, how?	**Location:** W4-44
Topic: Bio-analytical chemistry: Detection and diagnostics	**Location:** W4-46
Topic: Where should we incorporate interdisciplinary chemistry?	**Location:** W5-58

Breakout Discussion Groups (Session 2): Thursday, May 14, 11:00 am-12:00 pm	
Topic: Chemistry and Society	**Location:** E3-25
Topic: Chemical Biology	**Location:** E3-49
Topic: Interdisciplinary Labs: Who? What? Where? When? Why?	**Location:** W4-44
Topic: Materials Chemistry	**Location:** W4-46
Topic: Pearson Education: Learning Catalytics, MasteringChemistry and more	**Location:** W1-50

Breakout Discussion Groups (Session 3): Friday, May 15, 9:30-10:30 am	
Topic: Chemistry at the edges	**Location:** E3-25
Topic: Green Chemistry	**Location:** E3-49
Topic: Nanoscience	**Location:** W4-44
Topic: Chemistry and Education	**Location:** W4-46
Topic: McGraw-Hill Ryerson: SmartBook, the Adaptive Reading Experience	**Location:** W1-50

Breakout Discussion Groups (Session 4): Friday, May 15, 11:00-12:00 pm	
Topic: Interdisciplinary chemistry and the traditional curriculum	**Location:** E3-25
Topic: Medicinal/Pharmaceutical Chemistry	**Location:** E3-49
Topic: Environmental Chemistry	**Location:** W4-44
Topic: Chemistry and Industry	**Location:** W4-46
Topic: Resources for interdisciplinary Chemistry	**Location:** W5-58

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

Connection of chemistry with

- biology, physics, materials, computing, ...
- itself

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

UBC: Integrated laboratory program

- students self-select labs within framework
- decoupled, so students have to learn again (a pedagogical benefit)
- students admit learning better/more if they learn in lab first
- still silo'd by discipline working on this

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

UBC Science 1

- 75 students
- designed as a top-student program
- integrates biology, chemistry, math, physics, computer science, ???
- underlying concept: “if you know something about a lot of different sciences, you are better of that someone who is highly specialized in one area”
- can get individual credit for courses

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

UofA Science 100

- 30 - 60 students
- integrates biology, chemistry, math, physics, eas, psychology, computer science, writing
- high-risk: 27 credits, all or nothing for the year
  - one grade

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

MacEwan

- endeavors to integrate real-world examples
-

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

NAIT: interdisciplinary in that they have to integrate applications to defined programs:

- alternate energy, materials science, heavy-equipment, nanotechology
- project-based courses that integrate different specializations

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

benefits

- build independent learning skills
-
- increase student motivation (real-world case studies)
-
- students see links between all of sciences
  - same concepts, different contexts
-
- link to current research trends
-

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

benefits

- getting student buy-in is critical
  - milestones are good
-
- teamwork skills with interdisciplinary projects
-
- helps science progress
-

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

challenges, solutions (?)

- students are limited by existing knowledge
- instructors are limited by training
-
- team teaching (within and beyond dept)
-
- first-year students have broad spectrum of interests
-

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

challenges (and solutions)

- idea: less structured program that allows students to build their own interdisciplinary programs
-
- students have greater focused interest in senior course
-
- Q: what knowledge should a person with a chemistry degree have?

1.1 What is interdisciplinary chemistry? And why should we try incorporate it into our curriculum?

Helping each other

- sharing laboratory exercises
- sharing examples

1.2 Introductory Organic Chemistry: Is there a place for interdisciplinarity? If so, how?

Interdisciplinarity: Topics?

- -Biochemistry/pharma
- -Nano and materials
- -Environmental, “green chemistry”, food safety
- -Engineering

Making room for new content in Intro courses/lecture
“Tyranny of the curriculum”

“Hand-off” or linking of courses and topics

1.2 Introductory Organic Chemistry: Is there a place for interdisciplinarity? If so, how?

Laboratories - focus on techniques?

Designing experiments for learning, reduce emphasis on rote procedures? dealing with “controlled chaos”

Process chemistry, “greening” a lab

Combinatorial labs for limiting in lab-chaos; introduce systematic problem solving

1.3 Introductory General Chemistry: Is there a place for interdisciplinarity? If so, how?

Present: Brian Rempel, Les Rawluk, Frances Sutherland, Kin Wong, Cindy Slupsky, Danielle Vallee, Shuai Sun, Sarah Parke, Christie McDermott, Glen R. Loppnow, Lioudmila Badalova, Alex Brown, Norman Gee, Ratmir Derda.

SCI 100 @ UofA-all courses/students together. Easy to find interdisciplinary connections when background of students known. Can or cannot be difficult to bring in interdisc. examples when student backgrounds not known. Different instructors for different instructors. ***My puppy smiles with his tail.*** Labs are both disciplinary and inter-disciplinary, weighting is a difficult process to separate into disciplines. Labs in SCI 100 teach both chemistry skills as well as interdisciplinary ways of thinking. Had to be approved by all Science departments.

King's-smaller allows more flexibility. Instructors can do one-off lectures in different classes. Can do small projects in regular classes, since smaller than at bigger Univ/Polytechnics/Colleges.

Gen Chem-for citizens or for majors? Kings-examples are broad, but pre-req credit needs to be met. Has a chemistry course for non-majors (not a Pluto course, but taught with a different philosophy, 1 term, cannot transition to majors). UofA not actively discussing a non-majors chem course, but other Science departments going that way, so we might too. Augustana campus - also liberal arts and may develop a non-majors component in a more modular structure.

BC schools need to follow UBC's curriculum lead.

Should we show interfaces in 1st year? If so, what goes? - Augustana campus courses run in lock-step with main campus for transferability. No organic in 1st year at UofA, but is in Kings and TRU. Hard to know when topics are covered in other 1st year disciplinary courses, so hard to coordinate topics. Could pair courses between disciplines.

1.3 Introductory General Chemistry: Is there a place for interdisciplinarity? If so, how?

Students tend to identify with one department and can be resistant to interdisciplinary content in a disciplinary course. ***Teacher says my nose wouldn't bleed if I kept my fingers out of it.***

Pressure for content? Do we have to teach everything? Challenging to see department as a whole; easier to see individual courses. Don't know how pre-reqs are really tied to content in subsequent or previous courses unless same person teaches it. Same for lab - disconnect between what course instructors and lab coordinators teach. Leads to redundancies and holes. Can reduce teaching time, as long as outcomes, pedagogy and assessments clear and aligned.

Students expect material in lab at same time as lecture material, or before (Kings, UofA). Online components can mitigate this, as well as clear expectations about what the lab experience should be and will be. Students are grade motivated. Can think about using discovery labs to address the timing problem.

Interdisciplinary work can be brought in by projects, rather than through classroom teaching. Kings has done for over 25 years; students go out into community to collect data. Do a formal paper write-up and work done in lab, student-directed but mentored by lab coordinator, use grocery store chemicals, some projects include: air pollution measurements, Jell-O chemistry, GC-MS measurements; students get access to instrumentation but not use. Too hard for grad students to mentor at UofA in 1st year. UofA has 2nd year research course.

1.3 Introductory General Chemistry: Is there a place for interdisciplinarity? If so, how?

If you could reduce content, what would you talk about? - Do you emphasize the interface or do you integrate organically into content? SCI 100 - Profile of an Expert project, can flip and bring expert into group. UBCO-"What is life?" course with guest lecturers. Good for students. Good to bring in current research. Problems, labs and projects are natural ways to bring in this more interdisciplinary ways of thinking. Problems on exams can be the same way. I love Chemistry! Story-based approach (rich contexts) at King's to introduce background and context for a particular concept, usually big project.

Concluding statement - What do YOU think?

1.4 Bio-analytical chemistry: Detection and diagnostics

Nano-science class (U.Calgary) on applic of nano-science in medicine (capstone design a novel nano-biosensor).

Nano 502 - research lab course (pairs)

- challenge of difference background

Is need for prior knowledge different than the real world?

Cost of labs prohibitive - videos can demonstrate some techniques, but does not replace hands on experience

Sandbox lab on paper microfluidics (King's use www.mf20.org/); Don Ingver (Harvard Medical) overhead and printer microfluidics; Chuck Henry (Colorado) paper and parafilm

Bioanalytical courses UAlberta by Robert Campbell - covers bio basics, Western blot

1.4 Bio-analytical chemistry: Detection and diagnostics

Why bio-analytical?
-most interesting application of analytical

- bridge between chemistry and biological
- Med Lab does not have the instrumentation of anal chem

What is overlap with biochem, med lab, other programs?

Who should teach bio-analytical chemistry?

Use bio-inspired examples.

Balance content vs. doing vs. exploring

Presentation or teach lecture

TA evaluation of student conduct is a lab grade

1.5 Where should we incorporate interdisciplinary chemistry?

one participant… no discussion although 1.1 ended up dealing with some of these issues.

2.1 Chemistry and Society

Science and society courses

- SFU: breadth courses for non-chemists
  - chemistry in your home and work environment
  - science technology and society

- UofA
  - science citizenship course (science option)
  - science technology and society (arts option)

2.1 Chemistry and Society

Science and society courses

- UBC: multiminor science program
  - communicating science
  - communicating chemistry
  - global challenges and case studies
    - popular because rewarding
-

2.1 Chemistry and Society

Science and society courses

- Others
  - Utah: sex, drugs, and organic chemistry
  -

2.1 Chemistry and Society

Why are these courses not for chemists?

- the perception is that this is the only way to interest non-majors
- some programs require society-related courses
- possible bimodal distribution because of background knowledge
  - case study model might resolve
  - different expectations for different students
  - students find different aspects different

2.1 Chemistry and Society

Sharing resources

- Lon Capa
  - networks all institutions together(!)
  - instructors can share material between institutions
-

2.1 Chemistry and Society

Ideas

- writing intensive — SFU, Toronto, TrumanU
- society intensive
- _____ intensive
-

2.1 Chemistry and Society

Challenges

- diverse interests of students
- IB & AP students struggle if take first-year or if pass first-year
-

2.1 Chemistry and Society

Beyond students … science and society

- should we be educating the public? how?
- the public learns differently than students
  - focused interest
  - learning by association (friends share their interests)
-

2.1 Chemistry and Society

Beyond students … science and society

- How can we supplement public knowledge?
  - not from formal courses or MOOCs
  - Royal Society lectures (implement in Canada)
    - Nerd Night in Edmonton
  - Philosopher's Cafe, Cafe CIC
  - Edmonton life-long learning association
  - 3 minute thesis

2.2 Chemical Biology

-Sub-discipline or Division? This is a mature field, with many active researchers, shouldn't we have introductory courses? Are we missing students that want to work in this area?

-Introduced as part of Organic (special topics)

-Topics that could be taught:

- chemical genetics
- DNA/RNA synthesis & sequencing
- Protein/peptide synthesis
- Non-ribosomal synthesis
- Enzymology, protein engineering
- Cell biology, metabolic labeling
- Systems biology & Synthetic biology
- Glycomics

2.3 Interdisciplinary Labs

Michigan

1989 Curriculum change involving creation of interdisciplinary laboratories. Mostly 3rd year students take these labs but some 2nd year students. Two four hour periods spent in these labs.

NAIT

Some interdisciplinary projects. Students that do these projects have some foundational courses before attempting interdisciplinary projects.

UBC

- 2nd year physical/analytical laboratories. 2nd year organic/inorganic synthesis labs.
- 3rd year integrated labs (four core disciplines + integrated labs)
- 4th year integrated labs. Best students are expected to do thesis projects

Arthur Mar's (UofA) demo

Arthur had an interesting demo about using a thermoelectric material to power a fan. This demo would require students to discuss chemistry, physics, math, engineering.

One question, at what level can you use these demos?

Kings University

See below

When is a good time to have interdisciplinary labs?

- King's university starts at the first year level (2nd term). Students self-report this as a memorable but daunting experience. Students are able to pick a project and take it in a direction of their interest. One of the challenges is that students need to be reminded that the project is about CHEMISTRY rather than applications (USES). Students need to write a J. Chem. Ed. paper. This experience may be helpful in the 4th year thesis project.

- Other institutions said that it may be a challenge to write interdisciplinary labs that at the first year level.

Why design interdisciplinary labs?

- Do something that has more meaning and applications for students
- Expose students to new experimental or characterization techniques that are not find in traditional disciplines (XPS, XRD, SEM, enzyme kinetics)
- To expose students to real life, research-like experience. For example, make an OLED will require:

synthesize ligand " → make organometallic compound "→ use such compound to make an OLED.

What are the challenges of creating interdisciplinary labs?

- Cooperation. Within department, within faculty, within university. Mostly in the form of providing expertise for content and/or laboratory development.
- Instructors are hesitant to teach interdisciplinary labs. Instructors with breadth of knowledge is a must.
- Logistic issues (TA training), making sure teaching staff is up-to-date. Some TAs may not be interested in investing into teaching interdisciplinary labs. Other TAs may already have the expertise if they are working in interdisciplinary fields.
    - Beneficial for the TA to learn about different fields of chemistry.

Are new TAs and graduates better trained to teach interdisciplinary courses?

If graduate student is already in an interdisciplinary field, TAs feel well-equipped to teach these type of courses.

2.4 Materials Chemistry

Materials chemists joined the discussion in 2.3 Interdisciplinary labs

2.5 Pearson Education: Learning Catalytics, MasteringChemistry and more

thanks to Pearson for the discussions. If you have questions, please contact the Pearson representative (see Slide 2)

3.1 Chemistry at the edges

what does it mean? chemistry to non-chemists

example from SFU (driven by university requirement)

- breadth requirement (non-science students) basic chemical literacy
- survey - food, polymers, atmospheric chem, energy, “chemical-free”

UoA, UBC - no equivalent for non-science students

- driven by funding (or lack thereof)?
- pedagogical imperative is strong, university investment is not

Creates new perspectives for the students and the faculty

- options are typically available for non-chem science students
- is that not also good for chemistry students? (chem students often prevented from taking)
- engineering - required courses on connection to society

Waterloo - program in knowledge integration (removes pre-reqs)

3.1 Chemistry ~~at the edges~~ on a precipice

requirement for ethics and best practices?

- UofA - discussions at faculty level (available for grad students)
- UBC - new honours chem courses (“research development”)
- SFU - new repository of academic integrity questions (in-class verification)
- NAIT - method validation in industry is *very* important
- current approach (workshops) don’t work?
- data verification in lab courses? (TA resources, student cross-checking)

Discussed poor science student writing skills

- interactions between science and arts students can help
- Roy has a book for that

3.2 Green Chemistry

- Why?
  - Waste reduction
  - teaching ideas/experiments
  - to counter pushback from faculty colleagues that green chem is a “social movement”
- When?
  - upper or lower level courses?
    - need to teach “traditional” techniques
    - some classes of techniques are broad - can we move away from hazardous materials
    - Change student mentality - start introducing ideas right away in first year - have students “audit” labs they perform to assess how green they are.

3.2 Green Chemistry

- How?
  - Introduce concepts early/”audit” conventional procedures
  - incorporate specific green chemistry experiments near end of course once traditional techniques are established
  - possible “greening” of existing techniques e.g. separations(solvents)
  - Field trips (land fill, composting facility, Olds college biodiesel facility)
  - Case studies (transparent compostable bags for waste)
- What? First hand experiences of participants:
  - dry ice to extract natural products (nutmeg, cloves, citrus peel)
    - too much plastic waste
  - microwave to assist reactions
    - capital investment required. Possibly very useful.
  - Suzuki-Miyarura cross-coupling in water
    - worked very well with, requires more than one lab period

3.3 Nanoscience

-Biology, physics, chemistry, engineering

-Requires many different skills:

synthesis, materials, programming, characterization (AFM, SEM, elipsom., lithography)

Where is training coming from?

-Grad school, hands-on in the group

-Undergrad 300/400 level courses (UofA), 300/400 level courses and labs (materials); at UBC, NAIT has nanotechnologist program (three courses) with some elements in other core courses, UofC 211/213 synthesis of Fe nanoparticles 1st year, introductory course 2nd year (150+ students) and 3/4/500 level

3.3 Nanoscience

-Probably best building on materials foundation, but maybe not mature enough for its own undergrad level course

-Very popular topic area with undergrads, intro courses attract many students to research

-Limitations with lab access for more advanced experiments. Provide students with data if oversubscribed

-UofA Engineering in Nanoscience has some dedicated lab equipment for undergrad

3.3 Nanoscience

-Outreach programs with Grade 11/12 students, microscopy with nanoparticles and insects

-Toxicity/environmental studies related to nanomaterials

-Experiments can be used to reinforce foundations of chemistry

-Data analysis - introduce students to methods for data analysis, statistics, programming, and image analysis

-Use excel as a stepping stone for teaching strategies for data analysis

-Large data sets for nanoscience

-Teach critical analysis of “nano”, limitations and expectations, professional ethics

3.4 Chemistry and Education

What do people think we talk about?

UBC- group exams

- exams are written individually first
- students then come back and write a group exam
- a study was done in 2013 to investigate several variables:
- 1) Would working in groups help learning
- 2) Would using resources help learning
- work is currently ongoing

3.4 Chemistry and Education

- Oral final exams (European model)
- students arrive in a room with 4-5 professors
- student pick up a card with a question on it (question bank known before)
- then go to back of room, think about the answer
- students then pick an evaluator and answer the question
- students do 4 questions - 4/4 = A, ¾ = B….etc
- regrading not an issue because European professors are terrifying and students don't bother

Downsides - no written record

UBC (Jose) does a 20 minute oral lab report. Students send the same total time on the report, but say they spend more of their time learning. Takes some time to train the TA's, but then the TA's can train new TAs.

-students like/appreciate the oral reports and immediate feedback

3.4 Chemistry and Education

- U of A online quizzes
- use Moodle
- students have their bottom two quizzes dropped
- scribe then engaged in discussion and didn’t take notes - feels great shame

Discussion around when/how to introduce Scifinder and Web of Science

- UWO has a stand alone course
- UBC thinking about putting this into a lab course
- U of A has it incorporated into certain courses

3.4 Chemistry and Education

- Flipped classroom
- U of A has used it. Short 5 minute videos, followed by quiz

students then have the option to come to a class (tutorial based)

- the following class will have a summative quiz for everyone
- blended model (mix between worksheets and mini-lecutres)

UBC has used flipped classroom as well for 2nd year ochem (non majors)

- online videos followed by quizzes
- in class worksheets

3.4 Chemistry and Education

- Increasing undergraduate, what are the roles/purpose of undergraduate volunteers

UofA has CHEM 299 - a four hour volunteer based course (for credit?)

- discussion of how to get ‘how to volunteer’ information to students

UBC has Imagine Day, where students who have selected chemistry as their major are provided mini seminars which explain funding agencies (RISE, URSA...etc)

- engages students in their newly selected field of study, introduces them to the teaching and research faculty

3.4 Chemistry and Education

Conclusions

“Exams and education are important”

3.5 McGraw-Hill Ryerson: SmartBook, the Adaptive Reading Experience

Thanks to McGraw-Hill Ryerson for the demonstration. If you'd like further information, please contact the representative (see Slide 2)

4.1 Interdisciplinary chemistry and the traditional curriculum

UBC Vancouver - 2015/16 curriculum overhaul rolls out

- drop from 3 to 2 core courses in each traditional discipline (anl, phs, org, ino)
- more thermo/kinetics into 1st year + move quantum & thermo/stat mech to 3XX
- CHEM 300 - communicating chemistry (required communication credit, taught by chemists)
- enriched honours courses (CHEM 319,329,419 - credit/no credit) “research development”
- students choose at least two interdisciplinary 3XX courses:
  - catalysis, biophysical chem, materials, synthesis, biological chem, computational chem
- change in combined (majors/honours) programs at interfaces
  - chem requirements tailored and balanced with courses in other discipline
  - lab hours modified to include labs in other discipline (CIC accreditation)
  - majors: chemical biology, chem & biochem, chem & oceanography
  - honours: chemical biology, chem & biochem, chemical physics, chem & math

4.1 Interdisciplinary chemistry and the traditional curriculum

interdisciplinarity is intimately linked to effective communication

- collaboration requires communication between experts in different fields
- simple, effective dissemination of information

peer-review, ethics, and the process of doing science

proposal writing, peer-review

communication course - learning how to write in regular labs can be challenging, dedicated course has advantages

lab reports - write not just fill-in blanks, ppt presentation, oral lab reports, different modes of communication

write lab report for baking cookies

give research paper - write abstract

4.1 Interdisciplinary chemistry and the traditional curriculum

classes including more and more presentation components

- including aspects of the mechanics of giving presentations
- discuss and make abstracts

Concerns about specific programs, e.g. “nanoscience”

- if the program is too general, graduates aren’t well prepared in anything

Connections to real jobs and professions - traditional disciplines being subsumed in society so students don’t recognize chemistry and where it is

Brian Coppola - 1st year students are asked to read a UM paper and are to formulate a good question about the paper to the faculty member, and then have the author come to class and answer the questions

4.2 Medicinal/Pharmaceutical Chemistry

- much general discussion of the organic curriculum and where these courses belong, e.g., senior options

4.3 Environmental Chemistry

Lecture and lab

Kings - field trips, overnight stays

Focii

- aqueous and soils
- atmospheric

Ideas

- teach risk assessment
    - is it safe to go down the drain

4.4 Chemistry and Industry

- Students want a job, but do not hear about industry
- Transition from academic research lab into industry - don't have enough training about industry but most will end up in industry
- Co-op, Tours, Career Forum, recruitment interview, list of companies that have hired students (NAIT), mentorship program
- Lack training on industry processes even at NAIT
- richness depends on instructor experience
- lack of communication between industry and academia
- engineers hired preferentially versus chemists (P. Chem)
- grad student finish and then start looking for a job
- lot of profs aren't on LinkedIN (profs need to improve network)
    - companies look at student profiles … what should we do?
- conferences are for networking and learning about industry
- courses about industry and business

4.4 Chemistry and Industry

- CHEM 300 (U Alberta) Introduction to Industrial Chemistry
- U Waterloo Co-op had online credit courses, but are on top of regular (full) program and so students skim through
- CAPS workshops are not directed to science/chemistry students
- balance of professional development within program
- networking not with company but with alumni (student initiated or department inititated?)
- consider smaller companies as well (harder to find)
- balance of entry position vs. being over qualified
- how do students even find a position? Passive or pro-active?
- how do you effectively search for a job?
- department bulletin board or Moodle site
- undergraduate: awareness of possibilities for careers