More Options, Fewer Students: Joint Physics and Chemistry Courses at Mount Royal University

Western Conference 2013
Christopher Lovallo and Brett M. McCollum
Department of Chemistry
Mount Royal University

MRU Science

- No dedicated Chemistry or Physics degree
- BSc in General Science, Health Science, Molecular Biology, and Geology
- Limited student population past 2nd year in Chemistry and Physics
- Cross-discipline 3rd year courses

Cross-Discipline Courses

- Thermodynamics (CHEM / PHYS 3601)
- Elementary Quantum Mechanics (CHEM / PHYS 3602) – not running
- Solid State (CHEM / PHYS 3401)
- The Science and Politics of Nuclear Energy (CHEM 3802)

Most of the work still to be done in science and the useful arts is precisely that which needs knowledge and cooperation of many scientists and disciplines.

That is why it is necessary for scientists and technologists in different disciplines to meet and work together, even those in branches of knowledge which seem to have least relation and connection with one another.

- Antoine Lavoisier (1793)

Warning for Developers

The compromise will always be more expensive than either of the suggestions it is compromising.

- Arthur Bloch

Fall 2010 – First Offering

	Total Number of Students	Chemistry enrolment	Physics enrolment
Thermodynamics	7	5	2
Solid State	4	4	0

- Instructors to alternate between CHEM and PHYS each year.

Thermodynamics

- Traditional difference: amount of math (partial differential equations, multiple integrals, and statistical reasoning), but most of the topics are common

A Modern Approach to Thermo?

- Focus on thermodynamic changes such as energy flow in a chemical reaction
- Objective: cover the topics as one whole; not divided into “chemistry” and “physics” parts

Instructor's Opinions (Thermo)

- Insufficient time to get to most applicable material (how chemical potentials cause chemical reactions)
- Very much a physics and math-heavy course – I would feel comfortable calling this a PHYS course
- Long, heavy lectures
- Labs were relevant but not the most interesting… melting ice for example

SoTL Study

- Students interviewed 1-on-1
- 15 open-ended questions:
  - 4 demographics
  - 8 student opinions on current course design
  - 3 student suggestions for future design

Student Opinions (Thermo)

- Difficulty of course where 5 is average difficulty: 8.2 / 10
- Importance of Lecture: 8.0 / 10
- Importance of Laboratory: 7.6 / 10
  - 2 rated lectures more important; 3 said lab

CHEM < PHYS	CHEM > PHYS	CHEM = PHYS
2	1	2

Shared Opinions (Thermo)

- Level of chemistry versus physics seems ok (since no one seems happy)
- Need to review math more since they are very rusty (2+ years since last course)
- Usefulness of another prerequisite at the second year level? (currently Chem II, Phys II and Calculus II)

Moving Forward (Thermo)

- Thermodynamics:
  - Reconfigure topics?
  - Add more applications into the course and labs (bubbles, hand warmers, hurricanes)
  - More math tutorials / assignments to help students catch up
  - Less assignments overall
  - Convert into an advanced thermo class? (with a second-year prerequisite)

Solid State

- Purpose of course:
  - Inorganic content for future degree
  - Solid State Chemistry and Condensed Matter Physics
- Less topics in common than Thermodynamics

Solid State

- Goal was:
  - 5 weeks chemistry topics
  - 5 weeks shared topics
  - 3 weeks physics topics
- Result (based on enrolment):
  - 6 weeks chemistry
  - 5 weeks shared
  - 2 weeks physics

Instructor's Opinions (Solid State)

- Insufficient time for physics material – what content should be cut?
- Chemistry students complained when materials was presented in a physics fashion
- No physics students, but would they be able to do the synthetic chemistry labs?

Student Opinions (Solid State)

- Difficulty of course where 5 is average difficulty: 6.3 / 10
- Importance of Lecture: 9.4 / 10
- Importance of Tutorial: 7.9 / 10
- Importance of Laboratory: 6.3 / 10

CHEM < PHYS	CHEM > PHYS	CHEM = PHYS
0	4	0

Shared Opinions (Solid State)

- Chemistry content worked "as is"
- Need to increase physics approach to some content (more math), but keep the audience in mind
- Labs ran overtime; tutorial was useful but was cut for an extra hour of lab
- 2nd yr prerequisite could help, but what to do about Chem vs Phys?

Moving Forward (Solid State)

- Move Inorganic content into its own 2nd year course. Focus on overlap between Solid State Chem and Condensed Matter Phys
- Replace textbook with course pack (prepared by faculty or content merged from two texts)
- Changes to lab?
- Additional resources to help less experienced students in lab
- Team teach?

Suggestions for Developers

- Craft “wishlist” of topics then find commonality
- For common topics, decide if they will be taught from one approach, or if time should be doubled to teach from both points of view
- Fewer topics is better; time to fill in foundational gaps in either population

Suggestions for Developers

- Importance and availability of learning materials
- Try to play to the strengths of the different disciplines
- Try to maximize group work, especially combining people from different discipline backgrounds
- Team-teach if possible

MOUNT ROYAL UNIVERSITY 1910