Year-End Report

2013-2014

Department: Physical Sciences

Document Prepared By:

Jennifer Batten, Ph.D.
Department Information

Annual Updates

Current year goals & outcomes

Current Year Activities (that were not planned for this year)

The Essential Abilities Documents- Our Department created five Essential Skills Documents – Chemistry, Physical Science, Astronomy, Geology and Physics -for Dominic Dorsey, Director of Accessibility. The documents have been approved and will let the DSS office and students know the required skills to be successful in our courses. Thank you to Elaine Kampmueller, Bob Cebelak, Joe Hesse, and Will Millar for their work on this project.

Instrument Repairs and Upkeep- The IR was repaired in December and is now working. The pump oil was changed on the GC-MS, which is the first time this instrument was brought down and up. This instrument is working well. The AAS was repaired in April. Thank you to Pam Scott for her work on maintaining these instruments and to Janis Qualls for her work in preparing the purchase orders.

100 Year Celebration- Joe Hesse has done a wonderful job in planning and finishing our Department banner. Other plans for next year include having 100 6th-8th grade girls come on campus to complete science experiments and preparing 100 bagged science experiments for Godwin Hts. Schools.

Wyoming Middle College- Our Department has worked with Dan Clark to offer a lab science course to Wyoming Middle College. The online AS 103 and/or PH 115 may become part of that curriculum.

CHM Pre-Program- Tom Neils recently worked with Katie Daniels on developing a chemistry pre-program for the upcoming catalog. This pre-program is a great way to help our STEM students plan their educational pathway. Tom also completed work on updating the CHEM Tech. Program which is related to the previous year’s goal of working to improve and advertise this program.

Safety Rules Update- The Department’s Lab Safety Rules were updated and made available on Blackboard. The new rules clamp down on several new fashion trends that are incompatible with working safely in the lab.

ACS Self-Assessment- Tom Neils and Pam Scott completed an American Chemical Society two year program self study. The results showed that while the Department is generally in good shape, we could benefit from more full time employees and better engagement at conferences.

Computers on the Cart- Mice were purchased for the cart computers making these computers much easier to use. The GC/MS software has been installed on the laptop computers. Thanks to Bryan and Ian in IT for this work.

Geology Field Trips- In April, students in geology classes had two opportunities to go on field trips. Students from Tari Mattox’s GL 105 class travelled to visit two different seas that existed million years ago. They saw rocks exposed in Southern Indiana that record a time when the North American Continent was covered by shallow inland seas. The students described and collected fossilized remains
of marine organisms that lived in these seas. It was a wonderful opportunity for GRCC students to study the fossil record. Students from Judith Froot’s GL 104 course went on a 2.5 hour trip in the Grand River and out into Lake Michigan on one of GVSU's Annis Water Research Institute vessels. The students learned about dune formation, sand mining, water quality, sediment sampling, and discussed the effects of climate change.

Planned Activities (activities that were proposed last year)

Increased Instrumentation Use- Tom Neils worked toward increasing instrumentation use in the General Chemistry and Honors General Chemistry labs. As part of the recent NSF Grant, Bernard Liburd incorporated GC-MS experiments into the General Chemistry I and II laboratory experiments. Jennifer Batten and Tom Neils incorporated using the GC-MS into the Organic Chemistry I and II lab courses and into the Instrumental Analysis Lab.

New Faculty Member in Physical Sciences- The Physical Sciences Department will welcome new faculty member in the Fall of 2015. Bernard Liburd, Robert Cebelak and Jennifer Batten served on the hiring committee. The Department will welcome Dr. Dan Groh as a new FT faculty member in the Fall.

Geology Supply Organization- Elaine Kampmueller planned to organize the Geology storage area using recently purchased storage bins for her samples. This work is on-going.

Online Courses- Elaine Kampmueller (GL 101) and Bernard Liburd (CHM 140) planned to develop hybrid/online versions of the listed courses. Tom Neils and Jennifer planned to develop CHM 290 in hybrid format. This work is on hold due to issues in the ISIS area.

Community Science- The Department continued to support science in the community by offering activities to area students and supporting other community groups with similar goals. See External Collaborations and Partnerships for more details.

Forensic Chemistry Summer Camp- Bernard Liburd and Jennifer Batten developed and offered two week long summer camps as part of the Department’s NSF Grant. Details follow.

The Physical Sciences Department hosted two week long summer camps that taught 39 West Michigan high school students the basics of forensic chemistry and how it is used to solve an arson crime. The camps, which were in part sponsored by the National Science Foundation under TUES Grant number 1140509, allowed the students to use GRCC’s advanced instrumentation to carry out the analysis of different types of evidence and then use the evidence to solve a simulated arson crime. Along with using the College’s atomic absorption spectrophotometer to analyze soil samples and gel electrophoresis equipment to analyze DNA, the students used the newly acquired gas chromatograph–mass spectrometer to analyze materials that could be used to accelerate a fire. In addition to the hands on experience, Officer Dale Dekorte and his canine partner, Ritzey, from the Kent County Sheriff’s Office showed the students how canines are used to help investigators and scientists solve arson crimes. A number of staff and faculty worked to make the camp a success including Pam Scott, Leah VanHartesveldt, E. Yasmine Walton-Durst, David Greening, Wayne Bickel (Ottawa Hills HS), Eric Pilko, Julie Henderleiter (GVSU), Tom Neils, Bernard Liburd and Jennifer Batten.

Repairs and Purchases of Physics Equipment- During the summer 2013 semester, Jared Johnson spent weeks repairing and replacing broken items and equipment that is used in our physics courses. This work saved a lot of Department funds and makes the physics labs better for the students.
Website Maintenance- Physical Sciences has continued to improve our Department website so that the community knows the high quality education that is offered at GRCC. The website was updated and reviewed in March 2013.

Assessment Projects- Through the Assessment Projects, the Department members have and will continue to evaluate our course content and quality so that we are always enhancing the courses that we deliver. This work is ongoing and will continue. Each project is described in more detail later in this report.

Department Cleanup- Clean Storage space in the Department’s area has been getting full. We have begun disposing items that are no longer useful to free up space. This is a very large task as there is a lot of very old and out dated equipment in storage. Pam Scott and Leah Van Hartesveldt have cleaned up SCIE 504 and Jared Johnson and Bob Cebelak reorganized the Physics prep room space. This work will continue during the 2014/2015 school year.

Department Scholarships- The Department reviewed scholarship applications and made recommendations for the award of five different STEM based GRCC scholarships, including the first Physical Sciences Faculty Scholarship. Bernard Liburd heads this effort.

Demonstration Kits- These kits that are used by the faculty in their classrooms for demonstrations were repaired and rejuvenated by Pam Scott and Leah Van Hartesveldt.

Geology Pre-major- Elaine Kampmueller planned to work toward the development of a pre-major program in Geology that will lead to an AS degree. This work is ongoing.

New Position- The Lab Assistant position in the Department held by Leah VanHartesveldt has been moved from part-time-contingent to full-time(48 weeks) -permanent. We greatly appreciate Mike Vargo for all of his hard work in making this much needed position happen.

CARP Documents- The following CARP documents were completed and approved this year. Elaine Kampmueller was very helpful in providing feedback during the process.

| AS 103, AS 106, AS 108, PC 141 / Millar |
| GL 104, GL 105 / Kampmueller |
| PC 151, PC 111, PH 125 and PH 126/ Cebelak |
| PH 115 / Wang |
| PH 245, PH 246/ Johnson |
| EG 208, EG 212, EG 215 /Johnson |

Quick Start Guide Updated- The Department’s Quick Start Guide, which contains all of the directions to operate the instrumentation, was updated to include the GC-MS, updated NMR software, and the newer Varian AAS. The Guide can be found at: http://grcc.edu/physicalscience/instrumentdocumentation.

Physical Science Student of the Year Award- The Department members agree that it would be a good idea to develop this award, but no one took on this task this year so it will be moved to next year’s goals.
**Internal collaborations and partnerships**

The Physical Sciences Department collaborates with internal departments in the following ways:

- with Biological Sciences and Mathematics on Science and Math Advising days
- with the Dean’s office on scheduling, hiring, and student issues
- with Facilities on building maintenance and special improvement projects
- with IT on maintaining and upgrading the department laptops and other department owned equipment
- with Job Placement to hire student workers
- with Purchasing to secure equipment, reconcile purchases and maintain department credit cards
- with Print Services to maintain copiers and handle printing
- with the College Bookstore to secure books and classroom supplies
- with the Grants Office to prepare grant applications
- with the Institutional Research and Planning office to obtain data for grant and report writing
- with the Foundation to develop and award scholarships

**External collaborations and partnerships**

**STEM For Girls** - The STEM for Girls Event is a partnership between the Catholic Secondary School Foundation, 5th/3rd Bank, Kettering University and GRCC. The SAS Dean’s office and Physical Sciences are actively involved in organizing this annual event. Details follow.

*On Saturday, November 2nd Grand Rapids Community College hosted 205 5th to 8th grade girls from all over Michigan to participate in an experiential Science+ Technology + Engineering + Math (STEM) Girl Genius Conference. The day-long conference was designed to encourage young women to seek careers in the fields of science, technology, engineering and math. Provost Gilda Gely began the event by welcoming the participants to Grand Rapids Community College and introducing Elyse Kleifgen, Optometry Student at Ferris State University, who gave the opening address. Throughout the day, participants had the opportunity to carry out hands-on engineering activities and engage with women in STEM field careers, including Dr. Julie Davis Turner, Assistant Dean at the Van Andel Institute Graduate School, Leigh Kleinert, GRCC Biology Professor, Linda Bramble, GRCC Chemistry Professor and Leigh Eriks, Catholic Central HS Chemistry Teacher. The participants also had the opportunity to have lunch with women who are engineering and science professionals who work at companies including GE Aviation, Gentex Corporation and the Van Andel Institute. Many professional women from GRCC also participated including Kathy Roberts, Tari Mattox, Patricia Dockham, Amy Kudrna, Laurie Chesley, Jodi Dickerson, Laurie Foster, Kate Kryger, and Jan Colvin. Pam Scott, Leah VanHartesveldt and Jennifer Batten worked with the community partners to prepare for the event. The STEM Girl Genius Conference is in its third year and is a collaborative effort between Fifth Third Bank, Kettering University, the Catholic Secondary School Foundation and Grand Rapids Community College.*

**MAS 4 STEM Scholarships** - MAS4 S-STEM Scholarship is a NSF Funded partnership between GRCC and GVSU that provides substantial scholarships to five STEM transfer students. Physical Sciences promotes this program and recruits student scholars. This year 3 GRCC students were awarded scholarships.

**Hope College REU Collaboration** - The Hope College REU and S-STEM programs are partnerships between GRCC and Hope College. The REU allows students to carry out Independent Study
Projects at GRCC and then work at Hope College during the summer. The S-STEM program provides substantial scholarships to GRCC transfer students. Tom Neils and Jennifer Batten supervised the independent studies at GRCC and promoted the scholarship program. Four GRCC students will conduct research at Hope College this summer as a result of this partnership.

Science Club at City Middle- Tom Neils has been working in partnership with several science faculty from GVSU to create and operate a Science Club at City Middle school. The after school club meets weekly at the middle school to work on projects based in biology, geology, chemistry and physics. About 30 middle school students participate.

Chemistry in the Mall- GRCC faculty and students participated in Chemistry in the Mall which is a National Chemistry Week Activity. More details follow.

The annual Chemistry in the Mall activity was held on Saturday, October 12th in Muskegon. The event was sponsored by the West Michigan division of the American Chemical Society (WMACS). The Physical Sciences Department hosted two activity tables that included making slime and silly putty, doing magic-marker chromatography and assembling fruit batteries. Thirty GRCC students, who are enrolled in courses taught by Linda Bramble, Tom Neils and Bernard Liburd, showed off their knowledge of chemistry to hundreds of children and adults in the community and many earned Academic Service Learning credit. Adjunct faculty members Jim Krikke and Duane VandenBrink and former GRCC student Kat Wirth demonstrated how much fun chemistry can be by putting on Chemistry Shows on the event main stage. Bernard Liburd and Jennifer Batten coordinated the Physical Sciences Department role in the event. Thank you to Pam Scott and Leah VanHartesveldt for all of their help in readying the supplies and materials for the tables.

The Biennial Conference on Chemical Education (BCCE) - The BCCE will be held at Grand Valley State University, August 3-7, 2014. Tom Neils is very involved with conference organization through Y2C3 and Bernard Liburd and Jennifer Batten will be co-hosting the following symposium:

Instrumentation in the Chemistry Laboratory Classroom: Lessons from Community Colleges
Incorporating technology and instrumentation into the chemistry laboratory classroom is now the norm at many colleges and universities as faculty seek ways to engage students in course material, improve critical thinking skills and prepare students for research experiences and the workforce. However, with the current constraints in education, such as limited budgets, large and many course sections and fewer tenured/tenure track positions, the challenge to continue to acquire, incorporate and maintain instrumentation can be daunting. As a result, faculty must seek innovative ways to include relevant technology and instrumentation in their courses. During this symposium, presenters will describe and discuss methods to best deliver hands on use of and understanding of instrumentation in the laboratory classroom.

WMACS Presentation at GRCC- On April 24, 2014 the Physical Sciences Department and the West Michigan section of the American Chemical Society hosted Dr. Katherine Helmetage from Henkel Corporation. Kathy gave a presentation titled “Tribology; The Intersection of Chemistry and Mechanics.” The presentation was very attended by GRCC students. Thank you to Janis Qualls for working with WMACS to coordinate the event.
Fruitport Middle school - Brit Price worked with 7th graders at Fruitport Middle School on a hands-on chemistry experiment. The students carried out an analysis of several commercial products to learn more about the chemical properties of the substances.

Big Brower Lake Improvement Association - Joe Hesse serves as the water quality consultant to the Big Brower Lake Improvement Association (BBLIA) for 2013 – 2014 and serve as representative from the BBLIA to the Courtland Township Lakes Board. In this role, Joe provides information to the BBLIA Board and Courtland Township Lakes Board on the water quality of Big Brower Lake. Doing so will allow these organizations to make informed decisions that will impact the sustainability of this natural resource.

WEBELOS Cub Scout pack - Randy Creswell worked with the WEBELOS Cub Scout pack on physical science lessons with experiments for their "Scientist" merit badge. Topics/experiments included: Newton's laws of Motion, Pascal's Principle, optics and circuits. Randy also taught a series of integrated math/science lessons with experiments to the fourth grade at Knapp Charter Academy.

Departmental needs for support from other departments within the college - NA

Program accreditation Updates - NA

Description of departmental advising plan and outcomes

The Physical Sciences has four avenues for student academic advising. These avenues are:

- Science Advising Days- In collaboration with the Mathematics and Biological Sciences, we hold two science advising events, one in the Fall and one in the Winter. These events are advertised and students are encouraged to attend. The success of the events has been modest as most often only between 15 and 20 students participate per department. Full-time faculty participation is high and most assist with event. Linda Bramble is the Department Event Coordinator.
- Several faculty members are participating in the pilot program that assigns students with a specific course code to a faculty member. The success has been less than what was hoped as few students have responded to offers of assistance.
- The Department webpage has an “advising” tab that links to the Physical Sciences faculty and the areas in which they advise. Students can find information about faculty advising here.
- Students often just drop in during office hours or send emails to faculty regarding questions that they may have about careers and coursework. Students may be using the webpage to get faculty information on advising. The route to advising seems to be most favored by the students.

Departmental professional development activities

Assessment in the Sciences - Dr. Tom Pentecost and Dr. Julie Henderleiter from GVSU presented at our Department’s Learning Activity. They conveyed information on Program and Student Assessment in the Sciences including:
- Reasons for doing assessment
• Writing reasonable goals/objectives
• Choosing sources for data
• Collecting/organizing data
• Analyzing/reporting results

**GC-MS Training** - Bernard Liburd developed a GC-MS training video for the Department that can be accessed through the CTE. Watching this video is an important start to understanding how the GC-MS operates. This video is done very well and all were faculty are encouraged to watch and participate. It was very well received and all faculty teaching General and Organic Chemistry have viewed the video and used the instrument in their laboratory classrooms. This video is also available for students to view on the Department Webpage.

**Emergency Training** - The GRCC Police Department presented information on how to respond to an on campus shooter to the Physical Sciences Department on March 14, 2014.

**Student Awards**

**Physical Science Scholarships** - The following Physical Science Scholarships were awarded:

1. Joseph Duley—Wherity
2. Juan Romero—Physics & Engineering
3. Mitchel Vannette—Elve
4. Sarah Jernigan—Physical Sciences Faculty
5. Thaovy Tran—LJK Stem

**MAS4 Scholarships** - Kayla Lombardo, Jared Sweet, and Ernesto Duran were selected by GRCC faculty to receive the MAS4 STEM scholarship at GVSU.

**Hope REU** - John Cooper, Sarah Jernigan, Connor McNeely and Josh Vandenburgh were selected to do summer research at Hope College after working with Tom Neils and Jennifer Batten on Independent Study Projects. Bethany Beelen was selected to conduct summer research at GVSU.

**Other department updates** - NA

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**Faculty & Staff**

**Faculty & Staff Annual Updates**

**Professional Development Activities**

• Matt Wang attended the American Association of Physics Teachers meeting
• The Physical Sciences faculty participated in numerous offerings from the CTE
• Joe Hesse attended the Teacher Education Seminar and Transfer Fair
EOL/Release Time Work

- Jennifer Batten was given 0.5 hours of overload to Chair the Search Committee for Chemistry position #515. The Committee completed this work.

Faculty & Staff Accomplishments/Awards

Ron Mallet Interview- Dr. Ron Mallet, physicist from the University of Connecticut, visited GRCC on February 26 and gave a presentation on his work with time travel. Bob Cebelak interviewed the Professor for GRCC TV. Klaas Kwant sent the following:

We were very fortunate to have Bob do this interview; as it turned out, we weren't allowed to record the lecture, and I personally think that Bob's interview was more revealing than the formal presentation. Thanks again for doing this; Bob was the perfect choice, as you'll see: http://www.youtube.com/watch?v=OihObAeTa8k&feature=youtu.be

GRCC and Tom Receive Acknowledgement- Dr. Shihong Li of the Van Andel Institute recently published a paper on PLOS ONE. Dr. Li acknowledged Tom and GRCC which read “We would like to thank Dr. Tom Neils for assistance with helpful discussions and comments on the manuscript and with the FT-IR measurements at Grand Rapids Community College.” The paper can be found at http://dx.plos.org/10.1371/journal.pone.0088648. This is another great community partnership.

New I grade and W policies- Jennifer Batten co-chaired the team that moved proposed changes to the I and W grades through AGC. The changes offered clarity to the I grade policy and created a more student friendly W grade policy.

Mathematics Seminar- On Wednesday, November 13th, Tom Neils gave a presentation titled “What’s My Line?” at the monthly Mathematics Seminar at GRCC. The presentation well attended and well received. The abstract of Tom’s seminar follows:

Many scientific experiments are carried out to determine the mathematical relationship between two or more variables. Graphing the experimental data is often the most effective way of finding this mathematical relationship, because one can determine a curve of best fit for the trend in the data and also obtain a visual of the relationship between the variables. During this interactive seminar we will discuss the extent to which chemists will go to obtain a linear fit for their data and get some practice fitting the slope-intercept formula to various data sets.

Teachers of Tomorrow Scholarship Luncheon- Joe Hesse planned and organized the Teachers of Tomorrow Scholarship Luncheon that was held on August 26th. The luncheon served to honor 10 students for their academic achievements. Joe, who is the TOTs Scholarship Coordinator, gave a presentation on the history and status of the program. Way to go Joe!

Y2C3 Presentation - Jennifer Batten presented The Development and Implementation of a Summer Camp for High School Students Based on the Applications of Analytical Instrumentation in Forensic Chemistry at the 2YC3 conference that was held at Delta College on September 27th and 28th. The presentation can be found at:

http://www.grcc.edu/physicalscience/forensicchemistrysummercamp

Faculty Development for Upcoming Year -NA at this time.
**Assessment of Student Learning**  
**Physical Sciences**

**Program Outcomes:**
- To develop scientific literacy for general education requirements
- To prepare students for upper- and transfer-level science courses
- To train students for jobs in science and related disciplines
- To support other department/programs
- To provide continuing education and/or retraining/certification
- To help students complete the Lab Science requirement

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<tr>
<th>Program Learning Outcomes</th>
<th>ILO</th>
<th>Measure</th>
<th>Findings/ Improvements/Impact (For more detail, see the full reports at the end of this document.)</th>
<th>Status, Winter 14</th>
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</table>
| Apply mathematical concepts to find solutions to scientific problems | Critical Thinking | Comparison of pre- and post test questions (CHM 100) | • More story problems with extra information need to be incorporated into the course material.  
• It was decided that there needed to be accountability for the work done in groups. So the group work was followed by a quiz taken individually after each group assignment and turned in for a grade.  
• Students were also not doing their homework. This semester, I added a stamp on a homework sheet that each student is responsible to bring to class with the completed homework.  
• The post-test questions were inserted in to the final exam, as part of the exam.                                                                 | Changes made/impact to be assessed |
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<td></td>
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<td>Survey and test questions, and for those students taking the lab component, lab assignments and reports (CHM 130/131)</td>
<td>There were improvements in individual student scores compared to the previous semester (Fall 2013). More students scored higher on the lab report increasing the average score slightly above that of the previous average (12.4 pts vs. 12.2 pts). There was also a slight increase in the average post quiz score (3.5 pts vs. 3.3 pts) over the previous semester. Overall, the changes made to the experiment still positively impacted student learning and understanding of GC-MS. The modifications also allowed students to utilize more of the instrument's capabilities to analyze experimental data.</td>
<td>Changes made/impact assessed</td>
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<td>Exam questions (PC 141)</td>
<td>While these non-science major (mainly musicians) students were unable to regurgitate definitions from a difficult subject outside of their major, they were at least able to cite examples of the type of motion involved with the production of musical sound. Changes to be implemented include a new emphasis on the importance of this concept, and an exercise to teach students how to write out definitions as opposed to examples, using their own words.</td>
<td>Data collection/implementing changes</td>
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<td>Demonstrate the ability to write for scientific purposes</td>
<td>Communications</td>
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<td>Demonstrate competency in appropriate lab skills.</td>
<td>Critical Thinking</td>
<td>Lab final exam (PH125)</td>
<td>The data shows that the lack of prerequisite math skills seems to be preventing success for some students in PH 125. A practice problem system will be put in place in hopes of developing math skill.</td>
<td>Changes implemented/impact assessed</td>
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<td>Program Learning Outcomes</td>
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<td>Describe the basic principles of science and apply them to problem solving</td>
<td>Critical Thinking</td>
<td>Test or quiz questions (PH 245)</td>
<td>The number of generator examples on the practice sheet was increased from 1 to 4. The students were told that they probably would get a generator right hand rule problem since I had to do this study. So they got one along with 4 or 5 other right hand rule problems on a quiz and on a hour test. 75% of the students got the generator right hand rule problem on the quiz and a similar 75% on the hour test, which means 50% knew how to do it. The other 50% guessed and 50% of them got it right. On another magnet being shoved into a solenoid problem that has many permutations and multiple steps, I had 90% correct responses, meaning 80% knew how to do it. Previously, before the worksheet was changed, only 43% correctly responded on the generator problems.</td>
<td>Changes implemented and assessed</td>
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<td>Analysis of selected problems on lab reports or exams (CHM 261)</td>
<td>In order to address learning deficiencies, the lab manual will be reorganized and new material added. The new material will reinforce the concepts of IMFs that should have been taught in General Chemistry and will delve deeper into the theories that govern IMFs and solubility. This work has begun by making changes to the experiments conducted in CHM 261. Data will be collected from students taking CHM 261 during the summer 2014 semester to determine if there is improvement.</td>
<td>Data collection/implementing changes</td>
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<td>Analysis of selected problems on quizzes or exams (GL 101/111)</td>
<td>There was no meaningful change in students’ ability to connect multiple features to the correct plate boundaries; however, students did improve slightly in connecting single features to plate boundaries. It is too soon to say that sharing expectations was the reason for the change.</td>
<td>Data collection/implementing changes</td>
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<td>Action Needed?</td>
<td>Brief Action Statement</td>
<td>Resources Needed</td>
<td>Academic Year for Work</td>
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<td>YES</td>
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**DEPARTMENT**
- External Collaborations & Partnerships | X |
- Internal Collaborations & Partnerships | X |
- Accreditation | X |
- Departmental Advising | X |

**FACULTY/STAFF**
- Faculty credentialing | X |
- Faculty online certification | X |
- Academic Service Learning | X |
- Ratio Fulltime/Adjunct faculty | X |
- Faculty professional development | X |
- Resources | X |

**MISSION/PURPOSE**
- Mission/Purpose | X |
- Target Audience | X |
- Program Admissions Requirements | X |

**DATA**
- New Student Enrollment | X |
- Total Student Enrollment | X |
- Student Progress | X |
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<th>Student Participation in Nontraditional Fields</th>
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<td>Credential, Certificate, or Degree Attainment</td>
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<td>Student Completion in Nontraditional Fields</td>
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<td>Technical Skills Attainment</td>
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<td>Course Enrollment by Semester</td>
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<td>Course Success Rates</td>
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<td>Course Grade Distributions</td>
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**CURRICULUM**

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<td>Curriculum Alignment K-12</td>
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<td>Program Outcomes</td>
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<td>Program Learning Outcomes</td>
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<td>Preparing students for change</td>
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<td><strong>ASSESSMENT OF STUDENT LEARNING</strong></td>
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<tr>
<td>Identifying Measures for each Program Learning Outcome</td>
<td>x</td>
</tr>
<tr>
<td>Reporting out longitudinal data in a meaningful format</td>
<td>x</td>
</tr>
<tr>
<td>Creating meaningful improvement projects</td>
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<tr>
<td><strong>PREPARING FOR THE FUTURE</strong></td>
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<tr>
<td>Program Planning</td>
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<tr>
<td>Securing resources for course/program development/administration</td>
<td>x</td>
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<tr>
<td>Facilities/equipment upgrades</td>
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<tr>
<td><strong>OTHER</strong></td>
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<td>Other:</td>
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<td>Other:</td>
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</table>
Project Title: Determining the Direction of Induced Current in the Generator Coil or the Correct Direction of the Torque on the Coil in the Motor: A Calculus Based Physics Problem

Outcome Assessed: Given a 3D and a 2D picture of an idealized motor or generator can the student reason using Faraday's Law and correctly deduce the correct clockwise or counterclockwise direction of the induced current in the generator coil or the correct direction of the torque on the coil in the motor.

Program Outcome Assessed: Describe the basic principles of science and apply them to problem solving

Faculty Member: Jared Johnson

Description of Activity: I pass out in class 2 work sheets with 33 pictures of different physical situations involving charges, magnets, coils of wire, switches, magnetic fields, etc, and the student is asked to find the direction of the torque or current or force or something in the problem using the Right Hand Rule, or Faraday's Law. There are 12 completely different modeled situations. Some of these models have as many as 128 different permutations. My pictures usually show 3 permutations of each model. It is easy for the students to see that the direction of the asked for quantity is one of two directions, up or down, left or right, in or out of the page, etc. Thus the student has a 50-50 chance of guessing the answer correctly. (Of course, I subtract right from wrong.) So we go over these 33 Right Hand Rule problems in class. They are told they will get 20 points on their next hour test and the models the 20 points will be based on will be these 12 models we go over in class. The shocker is that over the years when I put the idealized generator on the test and ask for the direction induced current in the coil only about 43% get it right - even though they should have a 50-50 chance just from guessing. I hypothesize the problem is that I only have 1 example of a generator on my 33 problem practice sheet and 3 examples of motors with which the generator might be confused. The question is how many permutations of a problem do you need to see before you can solve all permutations of the problem. I hypothesize if I have 3 permutations of the generator problem on my practice sheet, the scores on the generator problem should rise. They probably have been confusing the motor and generator problems as they look a bit the same. A better project it would seem is to see if they have mastered 12 models could they do 3 or 4 models they have never seen before. The answer is no, only the 7% of the class that did not need the work sheet in the first place can do that. I do that experiment once a year. Overall, the students in the past master 11 of 12 models but except for the gifted few cannot then work almost any other new model. This type of problem is not stressed at Big Ten schools probably because it is well known that students can't do this. Thus I will put more generator examples on my practice sheet and see if the students can score higher than 50% on the generator question on the quiz or hour test.

Results: I increased the number of generator examples on the practice sheet from 1 to 4. I told the students they probably would get a generator right hand rule problem since I had to do this study. So they got one along with 4 or 5 other right hand rule problems on a quiz and on a hour test. 75 % of the students got the generator right hand rule problem on the quiz and a similar 75% on the hour test. This means 50% knew how to do it. The other 50% guessed and 50% of them got it right. Thus, 75 % correct responses, but only 50% really knew what they were doing. On another magnet being shoved into a solenoid problem that has many permutations and multiple steps, I had 90% correct responses, meaning 80 % knew how to do it. Previously, before I changed the worksheet, only 43%
correctly responded on the generator problems. Many students, knowing it would be on the test, asked me personally how to do such a problem. The students seem to have problems visualizing the problem in 4 dimensions.

**Project Title: Assessment of Student Understanding of Analog Scales, Number Lines, and Instrument Uncertainty**

Outcome Assessed: Use scientific equipment to collect data  
Program Level Outcome Assessed: Demonstrate competency in appropriate lab skills  
Faculty Member: Robert Cebelak

Description: Data has been collected and analyzed regarding the performance of students on individual questions from the Physics 125 lab final exam over the last two years. After adding some lab material and exercises to early Physics 125 lab work, there was a small improvement in the final exam results for those questions. But a strong correlation was found between overall Physics 125 course performance (as measured by final grades) and the possession of prerequisite number literacy skills measured by these lab questions. A large majority of students getting C grades and below in the course missed lab questions due to basic prerequisite knowledge gaps. During the Fall 2013 semester both lecture and lab sections of Physics 125 will add extra coverage to enlighten some deficiencies. This extra coverage will include a lecture quiz. Results of the Fall 2013 Physics 125 final lab exam will be compared to previous results to check for improvement.

Results: All students still in the Physics 125 course at the end of the fall semester take a lab quiz at their last lab session. For the last three years I have been monitoring results of their lab quiz, noting that students miss many things that I would have expected they would have known already, such as putting data points on a graph or on a number line, or reading a thermometer scale. We have increased the emphasis on those small points in our early semester lab work. I added several pages of examples and exercises on reading scales to the first lab. In the lecture portion of class I have added some additional handout problems including calculating the slopes of lines students draw on a graph. I have emphasized and over-penalized mistakes made because of misreading the location of the lines they draw. In the PH 125 lecture part of the course, the results of the line-slope quiz came out a little better this semester, only about 20% of students read the graph wrong as they calculated. But at the end of the semester, on the lab quiz, the point placement question still led to a 45% rate of mistakes, similar to the 65% rate of 2011 and 47% rate of 2012. The drop from 2011 to 2012 could very well be from judgment as to what is a mistake. I standardized that in 2012, if either one of two data points were placed one and a half boxes off its correct location, it was counted as a “mistake.” The data points/graphing emphasis was the only change in instructional technique for fall 2013, and it seems to have led to a negligible improvement. Other lab quiz question-check benchmarks from 2012 were essentially the same in fall 2013 to my ability to be consistent in assessing them.

A superficial check of 2012’s “breakthrough” observation is also consistent in 2013. If I break the students up by final grade result into 3 equal groups, the students in the highest group with A, A-, B+ type grades make mistakes at a low rate of perhaps 10%, while students in the lowest grade (but still attending) group make mistakes at roughly a 85-90% rate. That means a student getting a C in PH 125 is 90% likely to goof up at least once reading a collection of thermometers, or when putting a couple points on a graph, or when performing a small experiment with concluding calculation. The reaction as I add these up each year swings between two
poles. Are students doomed to do badly in physics if they lack prerequisite math abilities? Or can I train them such that they improve in math, and their physics results will follow? At the end of the season, when results are disappointing, I have doubts that I can erase what might be 15 years of low math practice. And it is the end of the season now. But I usually find a few students for whom a year’s worth of problem practice has made them more comfortable with numbers, who then score higher in the second semester of physics than they did in the first.

I suspect next year, likely even this summer because I have the data collected already, I will be looking at the relationship of the algebra review sheet mistakes from the start of the semester to the final physics grade results. I am convinced seeing my daughter do algebra at home that her skills were developed with the help of a self-tutoring program called Kumon that she worked with for only a couple years from about age 8 to 10. It simply involved practicing easy problems till you could do them very fast for about 10 minutes a day. The problems built up, the skills built up. I might not hope for a miracle, but maybe I can improve my student’s prerequisite math skills with a small blizzard of easy practice.

Project Title: Assessment of Student Understanding of the Relationship between Intermolecular Forces and Solvation

Outcome Assessed: Describe the processes of solvation, melting point, and boiling point.
Program Outcome Assessed: Describe the basic principles of science and apply them to problem solving
Faculty Members: Tom Neils/Jennifer Batten

Method: During the fall 2013 semester, data was collected to evaluate students’ understanding of intermolecular forces (IMFs) as they apply to solubility and eventually comprehending the “work up” portion of completing an organic based chemical reaction. It has long been thought that students with a poor understanding of IMFs will ultimately have a poor understanding of the procedures being carried out in the experiments. This data seems to show that a poor understanding of IMFs is related to a poor understanding of organic chemistry in general.

Points earned on targeted lab report and exam questions were tabulated. This study is a small sample set so additional, but slightly different, data was obtained from Tom Neils. The data is shown in Tables 1 and 2. Lab 2 Q2 and Exam 2 Q2 are questions based on understanding IMFs, while Exam 2 Q6 and Exam 2 Q9 are IMF application questions. The scores from Neils class are slightly lower because one less data point was used.

<table>
<thead>
<tr>
<th>Student</th>
<th>Lab 2 Q7 Raw Points</th>
<th>Exam 2 Q2 Raw Points</th>
<th>Exam 2 Q6 Raw Points</th>
<th>Exam 3 Q9 Raw Points</th>
<th>Points per Student (%)</th>
<th>$S_2$ = success in Organic II lecture</th>
<th>$R_I$ = repeating Organic I lecture</th>
<th>$P_2$ = poor performance in Org II Lecture</th>
</tr>
</thead>
</table>

Table 1: Points earned by students on IMF assignments in Organic Chemistry 1 Lab tabulated with overall success in Organic Chemistry II lecture. (Batten)
## Table 2: Points earned by students on IMF assignments in Organic Chemistry 1 Lab tabulated with overall success in Organic Chemistry II lecture. (Neils)

<table>
<thead>
<tr>
<th>Student</th>
<th>Exam 2 Q2 Raw Points</th>
<th>Exam 2 Q6 Raw Points</th>
<th>Exam 3 Q9 Raw Points</th>
<th>Percent of Points per Student (%)</th>
<th>S2 = success in Organic II lecture</th>
<th>RI = repeating Organic I lecture</th>
<th>P2= poor performance in Org II Lecture</th>
<th>RGC= repeating General Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (BB)</td>
<td>3</td>
<td>5.5</td>
<td>4.5</td>
<td>76</td>
<td>S2</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>2 (TB)</td>
<td>3</td>
<td>6</td>
<td>3.5</td>
<td>73</td>
<td>S2</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>3 (DB)</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>53</td>
<td>R1</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>4 (JB)</td>
<td>.5</td>
<td>1.5</td>
<td>1</td>
<td>18</td>
<td>R1</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>5 (AB)</td>
<td>2.5</td>
<td>3.5</td>
<td>2</td>
<td>47</td>
<td>R1</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>6 (JC)</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>65</td>
<td>S2</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>7 (ED)</td>
<td>3.5</td>
<td>5</td>
<td>2.75</td>
<td>66</td>
<td>S2</td>
<td>RI</td>
<td>P2</td>
<td>RGC</td>
</tr>
<tr>
<td>8 (MH)</td>
<td>2.5</td>
<td>3</td>
<td>1</td>
<td>38</td>
<td>P2</td>
<td>RI</td>
<td>S2</td>
<td>RGC</td>
</tr>
<tr>
<td>9 (CJ)</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>59</td>
<td>S2</td>
<td>RI</td>
<td>S2</td>
<td>RGC</td>
</tr>
<tr>
<td>10 (CM)</td>
<td>2.5</td>
<td>2.5</td>
<td>5</td>
<td>59</td>
<td>S2</td>
<td>RI</td>
<td>S2</td>
<td>RGC</td>
</tr>
</tbody>
</table>
Summary of Results: One clear result from this data is that students generally have a poor understanding of IMFs and have trouble applying this information. It is clear that work needs to be done to strengthen understanding early in the course. Further, the results do show that students who perform better on the IMF material tend to persist and do well in Organic Chemistry 2. The average score for student labeled S2 (Organic 2 success) was 71%, while the average score of those who are doing poorly in Organic 2 (P2) or repeating Organic 1 (R1) or General Chemistry (RGC) was 44%. While these concepts may seem unrelated, understanding IMFs is important to understanding bonding and reactivity, which are key to success in organic chemistry.

Future Work: In order to address these deficiencies, the lab manual will be reorganized and new material added. The new material will reinforce the concepts of IMFs that should have been taught in General Chemistry and will delve deeper into the theories that govern IMFs and solubility. This work has begun by making changes to the experiments conducted in CHM 261. Data will be collected from students taking CHM 261 during the summer 2014 semester to determine if there is improvement.

Project Title: Assessment of Students Increased Ability to Accurately Solve Mathematical Problems Commonly Encountered in a First Year Chemistry Course.

Outcome Assessed: Increased ability to solve typical chemistry mathematical problems.
Program Outcome Assessed: Apply mathematical concepts to find solutions to scientific problems
Faculty Member: Linda Bramble

Description: This project is a continuation of four semesters of evaluation in a Basic Chemistry (CHM 100) course which is a preparatory course for general chemistry. After observing a major deficit in mathematical ability among the majority of the students enrolled while teaching this course I had several discussions with general chemistry instructors. They confirmed that skills in mathematics are one of the main determiners for success in chemistry. I then decided to teach the course differently placing an emphasis on mathematical problem-solving and assessing effectiveness of the changes in student’s mathematical problem-solving ability. A five question math pre-test was developed that the students take at the beginning of the course and the questions are presented again at the end of the course embedded in the final exam. The pre-test was considered necessary to determine the level of mathematical skill before the class so an assessment could be made by comparison of the skill level demonstrated before the course work began and compared to the performance on the same questions at the completion of the course. The pre-test was shared at a departmental meeting and a few changes were made to improve the content; it was stated that if the students could do these problems presented on the pre-test that they could do any problem in the regular chemistry course. Several changes have
been incorporated into the format of this course from past results and the students have shown increased mathematical problem solving skills. A major problem still appears to be in the ability to select information that is required out of the presented problem and to understand how to use that information to arrive at a sensible solution. The next phase of this assessment project will focus in this area of mathematical problem-solving by incorporating more experiences for the students to practice this skill.

**Winter 2012**

All students were able to do the first question on the pre-test so it was removed from the pre-test. Because this is being compiled before the final exam is given for the winter 2014 semester the results from fall 2013 will be reported here. Question number three has information given in the problem that is not needed in order to answer the question. This was the most commonly missed question.

It was observed that the students were just rushing through the post-test or not even taking it because it was given with the final exam but separately. Most students just chose to skip it and few took it seriously. On reflection I believed that I was doing too much work on the board and that they needed to do more on their own but with guidance. It was decided that I would give a shorter lecture with examples, and then give them a worksheet to do in small groups.

**Results from Fall 2013**

- Only eighteen students turned in a post-test where they actually answered the questions, by the time they finished the final exam they were not interested at all in doing the post-test. The results below are form comparing the students pre-test to the post-test from students who turned one in.
  - 25% showed improvement in mathematical problem solving skills
  - 5% showed a decline in mathematical problem solving skills
  - 60% showed no change in mathematical problem solving skills

Conclusion: There was no shown improvement in mathematical problem solving skills from these tests.

Comments: Students who go on to general chemistry have come back to thank me and instructors have commented on how well those students are doing and that my students have told other students to go back and to take my class.

**Changes Made After Reflection on Fall 2013’s Results**

- Question number three remains out of reach for all but one or two students. It includes extra information that is not needed to solve the problem. Students are unable to determine what information would be needed to answer the question and try to fit every piece of information in the problem into the answer. More story problems with extra information need to be incorporated into the course material.
- It was decided that I had to place some accountability for the work done in groups. So the group work was followed by a quiz taken individually after each group assignment and turned in for a grade.
- Students were also not doing their homework. This semester I added a stamp on a homework sheet that each student is responsible to bring to class with the completed homework. A given percentage of stamps are required in order for
a student to obtain points for homework towards their grade, along with the quiz after each group assignment.

- The post-test questions were inserted into the final exam, as part of the exam.

Title: Assessment of PC 141 “Science of Sound” Student Knowledge and Understanding of Simple Harmonic Motion.

Brief Description: A survey of acoustics students’ understanding of vibrational motion and the role of simple harmonic (vibrational) motion in the production of musical sound. Three questions were asked in an essay format. The questions asked anonymously. The number of students taking part in the survey is 13, all male. The questions asked were: 1) “What is vibrational motion?” 2) “What is the definition of simple harmonic motion?” and 3) “What role does simple harmonic motion play in the production of music?”

Course Learning Outcome assessed: Demonstrate understanding of the role which simple harmonic motion plays in the production of musical sound.
Program Level Outcome Assessed: Describe the basic principles of science and apply them to problem solving
Faculty Member: Will Millar

Initial Data and Findings:

1) “What is vibrational motion?”
   Correct answer: “Any motion with a regular period of repetition.”
   Number of students responding = 12.
   Number of correct student responses = 0.
   The worst incorrect response: “Any motion that is vibrating.”
   Typical response is a description of a vibrating object: “… a side-to-side or up-and-down motion…”
   Remarks: Not a big surprise that students cannot recreate the definition in their own words – but disappointing because I thought I had students with promise – ones who could. Obviously need to make a bigger point of making sure they understand the difference between an example and a definition — and that they know the definition.

2) “What is the definition of simple harmonic motion?”
   Correct answer: “A vibrational motion with a restoring force which is linear with displacement from equilibrium with a single frequency of vibration.”
   Number of students responding = 12.
   Number of correct student responses = 0.
   The worst incorrect response: “Harmonic motion that is simple”
Typical incorrect response is either to site an example (a spring-mass system) or to confuse the concept with resonant frequency or resonant vibration.

Remarks: This is a far more technical definition. I’m not surprised they needed to resort to examples for which they have been told that the motion is simple harmonic. Students in general are not good at memorizing definitions – particularly when those definitions are outside of their major subject. Possible action is to spend much more time emphasizing the definition and the physical concept behind it.

3) “What role does simple harmonic motion play in the production of music?”

Correct answer: “Any musical instrument which creates a definite musical pitch does so by radiating the energy produced by a mechanical system vibrating in simple harmonic motion.”

Number of students responding = 13.
Number of correct student responses = 0.
The worst incorrect response: “It makes the harmonic motion more simple.”
Typically they realize that SHM is important to music but they are confusing the word harmonic in the term with the idea of harmonics or harmony in musical intervals.

Remarks: This confusion should be expected from music students but I admit I did not expect it. Although there actually is a relationship of this type (complex harmonic motion), it was not spoken of during lecture. I foresee a modification in the presentation of the connection between harmonic motion and musical sound to strengthen this connection and the role of HM in musical CHM.

Conclusions: It appears that my teaching effectiveness is only slightly above zero. While these non-science major (mainly musicians) students were unable to regurgitate definitions from a difficult subject outside of their major, they were at least able to cite examples of the type of motion involved with the production of musical sound.

Curricular or Pedagogical Changes Implemented: Because this course is offered only in the fall semester, no changes have been implemented. Changes to be implemented include a new emphasis on the importance of this concept, and an exercise to teach students how to write out definitions as opposed to examples, using their own words.

Title: Drawing Conclusions/Putting the Pieces Together

Outcomes Assessed: Describe the processes and features occurring at the three main types of plate boundaries.
Program Level Outcome Assessed: Describe the basic principles of science and apply them to problem solving
Faculty Member: Elaine Kampmueller
Initial Data and Findings

Fall 2013: The first test in 2 sections of GL 101 and 1 section of GL 111 included 4 multiple choice questions that gave students a feature or landform and asked for the appropriate plate boundary association. Another 3 questions gave students a list of three or four landforms (including those in the previous questions) and asked them to identify the plate boundary. I then kept track of which questions students answered correctly. Statistics based on the data for 63 students are below.

- Average number of feature questions answered correctly: $2.91/4 = 72.6\%$
- Average number of boundary questions answered correctly: $1.94/3 = 64.6\%$
- Percent of students getting all 7 questions correct: $33.3\%$ (21/63)
- Percent of students getting 6 of the 7 correct: $14.3\%$ (9/63)
- Percent of students getting less than 6 of 7 correct: $52.4\%$ (33/63)

Conclusion: Less than half of the students are able to use multiple features to correctly determine the plate boundary. This is about what I expected based on student performance in previous semesters.

Curricular or Pedagogical Changes Implemented

No major curricular or pedagogical changes were made for Winter 2014 on this specific content, except to tell students of my expectation that they would be able to place each feature or landform at the correct plate boundary. I did explicitly address other critical thinking and communication skills, such as how to properly answer essay questions about differences and/or similarities. That skill shows up on both lab exercises and on tests and will likely be an assessment project in the future.

Data and Findings (post improvement/change)

Winter 2014: The first test in 2 sections of GL 101 and 1 section of GL 111 included the same 7 questions as in the Fall 2013 semester. I kept track of the same data. Statistics based on the data for 68 students are below.

- Average number of feature questions answered correctly: $3.21/4 = 80.3\%$
- Average number of boundary questions answered correctly: $1.78/3 = 59.3\%$
- Percent of students getting all 7 questions correct: $22.1\%$ (15/68)
- Percent of students getting 6 of the 7 correct: $26.5\%$ (18/68)
- Percent of students getting less than 6 of 7 correct: $51.4\%$ (35/68)

Conclusion: There is no meaningful change in students’ ability to connect multiple features to the correct plate boundaries; however students did improve slightly in connecting single features to plate boundaries. It is too soon to say that sharing my expectations was the reason for the change.

Plans for next year: I will continue to be more transparent about my expectations for how students will use
Title: Assessing Student Understanding of GC-MS and its Accompanying Calculations

Purpose: To teach students the basics of gas chromatography - mass spectrometry (GC-MS) and how to perform GC-MS calculations.

Outcome Assessed: Describe the essential components of GC-MS instrumentation, basics of the GC-MS technique and the terminology used. (The CARP document will be updated to reflect this outcome.)

Program Level Outcome Assessed: Apply mathematical concepts to find solutions to scientific problems

Faculty Member: Bernard Liburd

Initial Data and Findings

A schematic of the GC-MS was illustrated to students in lecture. Its various parts and their functions, the basics of GC-MS, some of its applications and the terminology used were discussed. Students were coached on analyzing the data and performing related calculations. In lab, students worked collaboratively in preparing samples, making injections on the GC-MS, collecting data and performing relevant calculations. The emphasis was on GC-MS calculations.

On the lecture test there was a mandatory 20 pt GC-MS question and an optional GC question worth 5 pts. Students’ scores on both along with the average scores are shown below.

<table>
<thead>
<tr>
<th>GC-MS question (20 pts):</th>
<th>15</th>
<th>13</th>
<th>12.5</th>
<th>16</th>
<th>19</th>
<th>15.5</th>
<th>18</th>
<th>16.5</th>
<th>18</th>
<th>8.5</th>
<th>11</th>
<th>10</th>
<th>16</th>
<th>14</th>
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<tbody>
<tr>
<td>Average = <strong>14.6 pts</strong> /20</td>
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<table>
<thead>
<tr>
<th>GC question (5 pts):</th>
<th>4.5</th>
<th>5</th>
<th>4.5</th>
<th>5</th>
<th>5</th>
<th>4</th>
<th>4.5</th>
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<th>4.5</th>
<th>3.5</th>
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<tbody>
<tr>
<td>Average = <strong>4.6 pts</strong> /5</td>
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The lab report was graded out of 15 points and the quiz out of 5 pts. Students' scores and averages are shown below:

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<tr>
<td>Average = <strong>12.2 pts</strong> /15</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Post quiz (5 pts):</th>
<th>3.75</th>
<th>3.25</th>
<th>4.75</th>
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<th>1.75</th>
<th>2.25</th>
<th>2</th>
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<th>4.75</th>
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The lecture data shows a good bit of student understanding of the technique of GC-MS. Students scored well on the 20 pt test question (average > 70%) and very well on the 5 pt question (average > 90%).

To prepare students for the lab, all lecture instructors were directed to coach students on relevant GC-MS calculations. With the variation in coaching between lecture sections and the lab being composed of students from different lecture sections, overall the data shows good understanding of the technique and ability of students to perform GC-MS calculations. The collaborative learning style of the experiment seemed to enhance student understanding through the hands-on use of the instrument and helped develop their problem solving skills in the analysis of different types of experimental data.

Students were also interviewed by an outside evaluator about their experiences with the instrument and technique. The many responses below indicate that overall they see real value in the GC-MS and have a great grasp of its capabilities and how it helps them in the lab.

**EVALUATOR**--And to start out, GC-Mass Spec was one of the techniques that you learned about in class. What types of things did you learn about in class? So from the lecture, not necessarily from lab.

**STUDENT**--In general chemistry, that’s what we did. We went through a lot of the different parts of it and talked about what each part did, and how we use it.

**EVALUATOR**--Were there things about that that was helpful?

**STUDENT**--It was cool to see how we would use it in the real world experience, and the type of thing that you’d do with it. It was neat to see how it would apply.

**EVALUATOR**--What were things that you did, either in the lecture or in the lab, that helped you learn how to use and work with the GC-Mass Spec? Are there specific things that were done that you thought, “this was really effective”? Were there things, we’ll talk about what’s difficult next, but were there things that really helped with the way that the material was presented, or what you did, or the sequence of activities?

**STUDENT**--And you needed, we learned about it in lecture too, and then there was a lab video we had to watch in preparation for lab. And then there are some students that are taking lecture without lab, so that video, it’s like a 45 minute video or something, um, a student walked his sample through a GC-MS so that way people who weren’t in the lab were still able to see how a GC-MS worked.

**EVALUATOR**--Were there things that were difficult for you about using the GC-Mass Spec? Operating, interpreting, fragmentation patterns, what would you like to have had more time on, more information about?
STUDENTS--
-That’s right. The instructor did do a lot of handling of the machine and setting things up. So it was cool to see it, but it would have been nice to do a little bit more for ourselves.
-Well, most of that was due to the time constraints.
-Yeah.
-We, we were all present for the samplings.

EVALUATOR--All right. How has your thinking about GC Mass Spec changed from the first time you heard it, heard about it in lecture on until now?
STUDENT --All right, it didn’t really mean much at first because I didn’t know what it was capable of. And so now I see how they use it to test drugs or see what’s in certain substances, so to see how it’s used and what it’s capable of.

Curricular or Pedagogical Changes Implemented
The lab experiment was revised/re-written for Winter 2014 to emphasize the qualitative aspects of the technique and for students to use more of the instrument’s capabilities. Specifically, students were asked to use the instrument’s library to identify the components in a mixture and then as before to perform some calculations (not as much as in the previous semester) on the collected data.

Data and Findings (post improvement/change)
The lab report, quiz scores, and their averages are shown below:

Report (15 pts):

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Average = **12.4 pts /15**

Post quiz (5 pts):

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Average = **3.5 pts /5**

There were improvements in individual student scores compared to the previous semester (Fall 2013). More students scored higher on the lab report increasing the average score slightly above that of the previous average (12.4 pts vs. 12.2 pts). There was also a slight increase in the average post quiz score (3.5 pts vs. 3.3 pts) over the previous semester. Overall, the changes made to the experiment still positively impacted student learning and understanding of GC-MS. The modifications also allowed students to utilize more of the instrument’s capabilities to analyze experimental data.