Making the General Chemistry Laboratory Affordable

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Background and Motivation

About the Course
- General Chemistry I & II (CHEM 111 & 112) are the foundational courses in chemistry for science and engineering students.
- Courses are in excessively high demand because they are introductory pre-requisites for many different courses among numerous majors of study.
- The only mandated pre-requisite for enrollment in CHEM 111 is completion of the Entry Level Mathematics (ELM) requirement.

About the Students
- 50% First Gen, 45% Pell Eligible, 35% Underrepresented Minorities
- Juniors 28%, Sophomores 47%, Freshmen 25%
- Chemistry 15%, Physical & Animal Sciences 7%, Health Sciences 7%, Biology 7%, Engineering 15%

The Need for Change
- A consistent DFW rate of around 30%
- Distinct and bleak achievement gap for underrepresented minorities

Creating a New CHEM 111 Lab Manual
- Manual needed to contain 15 laboratory experiments similar to those in the old manual so as to not over burden support staff
  - 9 experiments were completely developed in-house and are available for use through Creative Commons 4.0 License
  - Remaining 6 experiments resulted from extensive editing of copyrighted labs with permission
- Every experiment in the newly developed lab manual was then:
  - Executed by two undergraduate students and a laboratory instructor who provided feedback
  - After editing, experiments were run through a second time
- The Macmillan Learning Curriculum Solutions publishing team produced a professional product with excellent figures

Savings for Students
(Projected based on previous and current course enrollments)

<table>
<thead>
<tr>
<th>Students Who Only Take CHEM 111</th>
<th>Students Who Take CHEM 111 &amp; 112</th>
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<tbody>
<tr>
<td>Previously paid $133 for lab manual</td>
<td>Previously paid $133 for lab manual</td>
</tr>
<tr>
<td>Now pay $30 for lab manual</td>
<td>Now pay $77 for lab manuals</td>
</tr>
<tr>
<td>EACH STUDENT SAVES $103</td>
<td>EACH STUDENT SAVES $56</td>
</tr>
<tr>
<td>YEARLY SAVINGS: 467 STUDENTS × $103 = $48,101 SAVED</td>
<td>YEARLY SAVINGS: 320 STUDENTS × $56 = $17,920 SAVED</td>
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What Changed?

Required Materials
- ALL CHEM 111 students required to purchase full lab manual
- 60% of students purchased the two-semester manual for only one semester of lab
- CHEM 111 students purchase the new lab manual developed in-house
- CHEM 112 students purchase the custom-published manual with selected experiments

Lab Manual Improvements
- Originally published in 1977 by external authors
- Required multiple announced changes to fit our needs
- Experiments had not been updated in nearly 10 years
- Replaced several experiments with ones developed in-house
- Contributors adapted experiments for our needs
- Added experiment with analysis of Alka-Seltzer® to add relevance and real-world application

Preliminary Findings

Lab Manual Purchases

<table>
<thead>
<tr>
<th>Laboratory Affordable</th>
<th>Fall 2017</th>
<th>Spring 2018</th>
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<tbody>
<tr>
<td>Students who Purchased Manual</td>
<td>85%</td>
<td>100%</td>
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<tr>
<td>Average Manual Cost</td>
<td>$122</td>
<td>$30</td>
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Lab Scores
- In addition to the manual, other new pre-lab preparation materials were developed:
  - Virtual Labs
  - Submission of pre-lab questions online
  - Instructional Videos
  - Student pre-lab presentations

Initial Feedback
- Positive comments regarding the improvement in manual's writing and adaptations to fit our needs
- Suggestions for future edits; manual will be updated annually

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