

Spring 2016

Principles of Chemistry I (University of North Georgia)

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Grants Collection

University of North Georgia



UNIVERSITY SYSTEM
OF GEORGIA

Jim Konzelman and Greta Giles

Principles of Chemistry I





Grants Collection

Affordable Learning Georgia Grants Collections are intended to provide faculty with the frameworks to quickly implement or revise the same materials as a Textbook Transformation Grants team, along with the aims and lessons learned from project teams during the implementation process.

Each collection contains the following materials:

- **Linked Syllabus**
 - The syllabus should provide the framework for both direct implementation of the grant team's selected and created materials and the adaptation/transformation of these materials.
- **Initial Proposal**
 - The initial proposal describes the grant project's aims in detail.
- **Final Report**
 - The final report describes the outcomes of the project and any lessons learned.



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Syllabus

CHEM 1211 SCHEDULE

<u>Chapter Text / Topic Reference</u>	
Textbook website: https://openstaxcollege.org/textbooks/chemistry	
<u>Week 1</u> Introduction: Matter and Measurement	https://web.ung.edu/media/chemistry
<u>Week 1 – 2</u> Atoms, Molecules and Ions	https://web.ung.edu/media/chemistry
<u>Week 3 – 4</u> Stoichiometry: Calculations with Chemical Formulas and Equations	https://web.ung.edu/media/chemistry
Exam I: Ch. 1 – 3	
<u>Week 5 – 6</u> Aqueous Reactions and Solution Stoichiom.	https://web.ung.edu/media/chemistry
<u>Week 7 – 8</u> Thermochemistry	https://web.ung.edu/media/chemistry
Exam II: Ch. 1 – 5	
<u>Week 9-10</u> Electronic Structure of Atoms	https://web.ung.edu/media/chemistry
<u>Week 11</u> Periodic Trends of the Elements	https://web.ung.edu/media/chemistry
<u>Week 12</u> Basic Concepts of Chemical bonding	https://web.ung.edu/media/chemistry
Exam III: Ch. 1 – 8	
<u>Week 13 – 14</u> Molecular Geometry and Bonding Theories	https://web.ung.edu/media/chemistry
<u>Week 15</u> Gases	https://web.ung.edu/media/chemistry
Exam IV: Ch. 9 – 10	https://web.ung.edu/media/chemistry
Final Exam: Chapters 1-10	

Initial Proposal

**Affordable Learning Georgia Textbook Transformation Grants
Round 2
Summer 2015, Fall 2015, Spring 2016
Proposal Form and Narrative**

Institution Name(s)	University of North Georgia- Dahlonega and Oconee campuses				
Team Members (Name, Title, Department, Institutions if different, and email address for each)	Jim Konzelman, Professor of Chemistry, UNG-Oconee, Jim.Konzelman@ung.edu Greta Giles, Assistant Professor of Chemistry, UNG-Dahlonega, Greta.Giles@ung.edu				
Sponsor, Title, Department, Institution	John Leyba, Department of Chemistry and Biochemistry Chairman, University of North Georgia				
Course Names, Course Numbers and Semesters Offered (Summer 2015, Fall 2015, or Spring 2016)	Principles of Chemistry I, CHEM 1211, offered all three semesters Principles of Chemistry II, CHEM 1212, offered all three semesters				
Average Number of Students Per Course Section	40	Number of Course Sections Affected by Implementation in Academic Year 2016	15	Total Number of Students Affected by Implementation in Academic Year 2016	600
Award Category (pick one)	<input checked="" type="checkbox"/> No-Cost-to-Students Learning Materials <input type="checkbox"/> OpenStax Textbooks <input type="checkbox"/> Course Pack Pilots <input type="checkbox"/> Transformations-at-Scale				
List the original course materials for students	Chemistry Plus Mastering Chemistry with eText -- Access Card Package (6th Edition) Required		[Cost] \$279.60 + tax / student		

(including title, whether optional or required, & cost for each item)		Total Cost: \$279.60 + tax/ student	
Plan for Hosting Materials	<input type="checkbox"/> OpenStax CNX <input type="checkbox"/> D2L <input type="checkbox"/> LibGuides <input checked="" type="checkbox"/> Other __Open Access website at UNG		
Projected Per Student Cost	\$0.00	Projected Per Student Savings (%)	\$279.60 + tax (100%)

1. PROJECT GOALS

- Reduce student expenses related to textbooks while enhancing the learning environment.
- Provide a free resource for college students taking chemistry for science majors that is superior to a textbook.
- Develop materials that will take advantage of digital media and be dynamic in nature, including video presentations, demonstrations, examples, quizzes, homework, text and additional resources.
- Develop content that is geared toward different learning styles.
- Provide a resource that will be organized into content areas to allow for flexible delivery sequences as desired by various instructors.
- Provide content geared toward the specific areas of study for all science majors, not just chemists.

1.1 STATEMENT OF TRANSFORMATION

Often times, students need additional help to master the abstract nature of chemistry, which is evident in the traditionally high DWF rates for this sequence. The textbook is an essential resource that can lead to student success if utilized properly, but can be difficult for some to decipher on their own. Students are known to turn to the internet for the additional help they need, spending valuable time searching, and watching videos on sites such as YouTube and Khan Academy.¹ The instructor has no control or input into the information presented to the students in this open forum, which often times is incomplete, inaccurate, or even wrong, causing more harm than good. In addition, the students can spend too much time searching instead of studying, and many actually think they are studying when they are not. A more efficient system is needed.²

Our transformation will begin in the spring of 2015 with the use of Open Stax materials in lieu of a physical textbook. During this time we will focus on developing our own digital media to compile on a free access website that goes beyond where a textbook ends. With comprehensive content, video, and assessments in one location, the students will no longer need to search the web to find the resources they need, and the instructors will have control over the content, which can be amended as needed. The content will replace the textbook for the two semester chemistry sequence for science majors. The website will be developed during the spring and summer of 2015, and implemented in the fall of 2015 for CHEM 1211, and for CHEM 1212 the materials developed in fall 2015 and launched in the spring of 2016, with continual updates and improvements. The materials will be available for adoption by all instructors, and for use by all students at UNG.

The stakeholders that will be affected are predominately freshman and sophomore science majors at both the Oconee and Dahlonega campuses of UNG. In addition, some non-traditional students returning to college seeking a career change will likely be enrolled.

Providing a website for the instructors to compile all of their teaching resources will greatly enhance the general chemistry sequence for all involved. The students will have 24/7 unlimited access to video lectures that can be watched and referred to as many times as needed, instead of relying solely on lecture notes. Students will no longer need to search the internet for

information, they can request additional information be placed on the website. Thus, a more efficient learning environment will be created, and should increase student success.

Unlike using a textbook, the instructors will have total control over the content, which can be continually improved and expanded upon, creating a customizable course, which can be delivered in varying order according to instructor preference. The website can include interactive features that a textbook lacks, such as video demonstrations, recorded lectures, and instantaneous feedback on homework and quizzes. The website can compile frequently asked questions to monitor areas where students have difficulty, which can then provide valuable feedback to the instructors, as well as answers to the students. The instructors' answers can remain posted indefinitely, creating an increasingly comprehensive and searchable resource. The website will become an essential resource that will free up class time and utilize student and instructor time more efficiently, while providing a more dynamic learning environment that should result in greater student retention and success.

1.2 TRANSFORMATION ACTION PLAN

The course materials for CHEM 1211 will be identified and developed during the spring and summer of 2015. Those items for CHEM 1212 will be identified and developed during the fall 2015.

The website will be populated with these materials with the assistance of an experienced web programmer in time to implement its use in the Fall 2015 for CHEM 1211, and Spring 2016 for CHEM 1212.

Drs. Giles and Konzelman, as the lead chemistry educators, will provide content and organizational structure, including course syllabi. Each topic will include slide show presentations with added audio, outlines, study guides, sequentially solved examples with audio explanations, formative assessments with instantaneous feedback, summative assessment with instantaneous feedback, video demonstrations, links to useful resources and additional information as deemed appropriate.

Working with direction from the instructors, the subcontracted web designer will be responsible for inserting the content on, and maintaining the website, and ensuring it will function on computers and portable devices.

All materials will be freely accessible for all instructors at UNG, and on the internet starting Fall semester 2015, with open access provided through Merlot.org.

1.3 QUANTITATIVE AND QUALITATIVE MEASURES

Quantitative Measures: *DWF rates for the past five years will be compared to those for the 8 sections employed for this transformation. Ideally, one would hope for a lower number of DWFs that is statistically significant, but any result that does not increase the DWF rate will be considered an improvement based upon cost savings to the students. It may be necessary to collect data beyond the one year introductory phase.*

Students will be given pre /post- quizzes on selected content to gauge their grasp of the material before and after accessing the website, and prior to covering the material in class. This data will be used to measure the effectiveness of the website to foster independent learning.

Qualitative Measures:

Student satisfaction with the transformation is an important factor that will be measured with opinion surveys. Data will be collected that will allow for improvement of the website, and a measure of value as compared to a traditional text.

1.4 TIMELINE

- 2015** May- Aug Instructors select and develop course content for CHEM 1211
 June-Aug Instructors work with web designer to add CHEM 1211 content to website
 Aug – Dec. Implement use of website in CHEM 1211, administer pre-post tests for each section, develop content for CHEM 1212, instructors work with web designer on CHEM 1212 content
 Dec Compile data, and submit mid-term report
 Dec Administer student opinion survey for CHEM 1211
- 2016** Jan-May Implement use of website in CHEM 1212, administer pre-post tests for each section
 May Administer student opinion survey for CHEM 1212, compile data and submit final report

1.5 BUDGET

<i>Item</i>	<i>Justification</i>	<i>Amount</i>
<i>Release time for Dr. Greta Giles</i>	<i>Dr. Giles will need time to develop web content, assessments, attend meetings, and coordinate with the web designer</i>	<i>\$3000</i>
<i>Release time for Dr. Jim Konzelman</i>	<i>Dr. Konzelman will need time to develop web content, assessments, attend meetings, and coordinate with the web designer</i>	<i>\$3000</i>
<i>Web designer/programmer</i>	<i>Hire an experienced web designer to facilitate posting of content</i>	<i>\$3000</i>

<i>Travel for Drs. Giles and Konzelman</i>	<i>USG grant kick-off training/implementation meeting</i>	<i>\$800</i>
<i>Computer Hardware/software</i>	<i>Wacom USB tablet and software for creating hand-drawn digital input, one each for Drs. Konzelman and Giles</i>	<i>\$1000</i>
	<i>Total</i>	<i>\$10,800</i>

1.6 SUSTAINABILITY PLAN

The initial website content is only the foundation of this project. Once established, the instructors will be able to maintain and update the content as needed. Ideally, there will be no reason to ever go back to using a textbook. As student use of the website proves successful, adoption of its use will increase and additional faculty will join in the process of maintaining and improving the content and effectiveness of the site. With some planning, the site can become useful in perpetuity, as younger faculty take over leadership of this project, with the only cost being the investment of time.

1.7 REFERENCES & ATTACHMENTS

1. Kay, Robin H. "Exploring the Use of Video Podcasts in Education: A Comprehensive Review of the Literature." *Computers in Human Behavior* 28.3 (2012): 820-31.
2. Allen, Nicole. "The Future of Digital Textbooks." *Public Purpose* 1 Dec. 2013: n. pag. [Http://www.aascu.org/](http://www.aascu.org/). [Http://www.aascu.org/](http://www.aascu.org/), 1 Dec. 2013. Web. 12 Nov. 2014.

PROPOSAL SUBMISSION: ALL PROPOSAL DOCUMENTS, REFERENCES, AND ATTACHMENTS MUST BE SUBMITTED IN A SINGLE EMAIL TO ALG@GATECH.EDU.

DEADLINE FOR CATEGORIES 1-3: 5:00 PM, NOVEMBER 30, 2014

DEADLINE FOR CATEGORY 4: 5:00 PM, DECEMBER 8, 2014



UNG UNIVERSITY of
NORTH GEORGIA™
COLLEGE OF SCIENCE & MATHEMATICS

Department of Chemistry & Biochemistry

November 18, 2014

To Whom It May Concern:

It is with great pleasure that I write this letter in support Dr. Jim Konzelman, Professor of Chemistry, and Dr. Greta Giles, Assistant Professor of Biochemistry. These two faculty members are teaming up to develop learning materials that will replace the textbooks that are currently being used. The newly developed learning materials will be supplied at no cost to students and will be used in Principles of Chemistry I and Principles of Chemistry II at the University of North Georgia. The efforts of Dr. Konzelman and Dr. Giles will result in the typical STEM student saving more than \$280 in textbook costs.

In order to complete this ambitious project, the two faculty members will need time and resources. Through funding obtained from an Affordable Learning Georgia Textbook Transformation Grant, the Department of Chemistry & Biochemistry will cover the faculty members' time through a combination of release time/replacement coverage and/or release time/overload pay. Funding obtained from this grant will also be used to cover required faculty travel, necessary computer equipment, and a programmer's time. Once this project is completed, the Department of Chemistry & Biochemistry will sustain on-going improvements to the developed website through release time for Dr. Konzelman and/or Dr. Giles. Pending future funding/budgetary availability, the Department of Chemistry & Biochemistry will support the development of a similar site for Survey of Chemistry I and Survey of Chemistry II. In summary, the Department of Chemistry & Biochemistry at the University of North Georgia enthusiastically supports Dr. Konzelman and Dr. Giles in their collaborative effort to develop and use free learning materials that will replace the traditional textbooks that are currently in use.

Sincerely,

John D. Leyba, Ph.D.
Professor of Chemistry
Department Head
Department of Chemistry & Biochemistry
(706) 864-1504
john.leyba@ung.edu

Cumming Dahlonega Gainesville Oconee

82 College Circle | Dahlonega, Georgia 30597 | 706.864.1505 | Fax 706.867.2972 | ung.edu
The University of North Georgia is designated as The Military College of Georgia and as a State Leadership Institution.

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Final Report

Affordable Learning Georgia Textbook Transformation Grants

Date: 25 May 2016

Grant Number: 81

Institution Name(s): University of North Georgia

Team Members:

Jim Konzelman, Professor of Chemistry, Dept. of Chemistry Jim.Konzelman@ung.edu;

Greta Giles, Assistant Professor of Chemistry, Dept. of Chemistry Greta.Giles@ung.edu

John Williams, eLearning & IT Training Admin, John.Williams@ung.edu

Project Lead: Jim Konzelman

Course Name(s) and Course Numbers: Principles of Chemistry I & II, CHEM 1211 and 1212

Semester Project Began: Fall 2015

Semester(s) of Implementation: Fall 2015 and Spring 2016

Average Number of Students Per Course Section:

Number of Course Sections Affected by Implementation: 8

Total Number of Students Affected by Implementation: 321

1. Narrative

A. The main goal of our project was to introduce a free and open access chemistry textbook into the two semester freshman chemistry sequence. Traditionally, students must purchase a textbook which is good for both semesters, two lab manuals, safety glasses, a calculator, and online homework access. The costs for all of these items places chemistry as one of the most expensive courses taken by freshmen, especially since the textbook cost is incurred the first semester.

We adopted the Openstax chemistry textbook available free online, and as printable version for a nominal fee. Since this text is free to edit and disseminate, we were able to modify it for to fit our purpose. The link to the text was provided in the course syllabi, so students had free access from the first day of class. In addition, our course website provided smaller portions of the text organized into units that paralleled the courses progress.

The students applauded the fact that the textbook was free, as expected. A surprising number expressed a preference for a physical textbook over the online version, even if they were required to pay for it. So the second semester, we emphasized the option to order the printed text. In the future, we intend to have the bookstore carry the printed version to meet the needs of these students. It is worth noting that the printed version of this open

access textbook is significantly less expensive than those provided by publishers, making the switch worthwhile.

The secondary goal of this project was to build a website to support the open access mission. The concept was to build a website to organize and deliver the course content in one online location. This goal was significantly more challenging and time consuming. First, it involved coordination from two different campuses between two professors to agree on content and delivery. Second, this material had to be developed in a timely fashion into the appropriate media, delivered to our computer expert, and formatted and published to the internet site in the appropriate format. The main challenge was time, as we wanted to create the 'perfect' product, yet had to stay on schedule as we developed materials the same semester as they were used. The great part is we now have an excellent website that is completely under our control, and can be edited and improved upon at any time. We are no longer reliant upon the publishers for our content. In addition, the students can access the course content 24/7 which includes lecture videos, notes, homework, and the text. We are grateful to ALG for providing the resources and opportunity for us to create this website and plan to build upon it each semester. We now have true academic freedom over the course content and delivery, and that is a real transformation.

Lastly, we decided to use the development of this website to 'flip' the classroom, as is a current trend in education. The idea was to have students access all of the course materials on the website. As lectures were pre-recorded and posted, along with the text, there was no longer a need for a traditional lecture. If students were to watch the lectures online, read the text prior to attending class, then the precious and limited class time could be used to address particular questions, and actively practice applying the concepts rather than passively listening to a lecture. This experiment was an uncomfortable experience for a professor who has been lecturing for over 20 years. It was quickly apparent that the students were not ready for this format either. The performance on the first exam was the lowest exam average of this professor's career! The format of the class was flipped back to a more traditional style, with the online materials playing a supportive role than a primary one. Interviews with students revealed that the more mature students tended to prefer the flipped classroom, while the younger and less responsible students relied on lecture to learn and rarely took the initiative to access the online materials. This experiment is worthy of being revisited, but will require more structure to motivate students to prepare.

Overall the students benefited from the free and open access chemistry textbook. We no longer had the few students who did not buy the text because of financial burden, nor did we have those students who were waiting on their text to arrive having purchased it online, nor did we have those waiting on the bookstore to restock their supply. There was an expressed preference for the printed version of the text, so we will be making that available in the future through our bookstore.

The supporting website received overwhelmingly positive reviews. Students appreciated having access to the materials at their disposal, and being able to revisit the lectures multiple times. In the past we have experienced students referring to information

they accessed on other websites, but with the implementation of our supporting website the students seem more focused on the materials being presented within the course structure, and therefore, less distracted. This increased focus is exactly what we hoped to accomplish; creating an environment that is efficient for learning.

In breaking with tradition, and adopting a free and open access chemistry textbook, we expected some resistance from our colleagues. The opportunity to participate in this pilot project was open to all chemistry faculty at UNG, and yet only two chose to participate. Our goal was to demonstrate that the student learning with a free and open access textbook would be at the same level as those with a traditional textbook; that we would have done no harm. We did not expect students to suddenly outperform their counterparts simply because the textbook was cheaper, or the information was presented in a different format, but we did need to ensure that the free textbook was effective enough for student to perform as well as expected. So in many ways, our project was an evaluation of the textbook and its content.

The CHEM 1211 fall semester courses were given a survey at the end of the semester to evaluate student opinions of using a free online textbook. Whereas the responses were overwhelmingly positive for the supplementary materials, the textbook received mixed reviews (38% positive, 38% neutral, 11% negative, with the balance abstaining) We were surprised to learn that there was a preference for a printed version of the textbook over the online only. To accommodate this request, the printed version of the text will be carried in the bookstore in future semesters. As the CHEM 1212 courses were populated by many of the same students, we chose not to administer the survey to these courses.

This project was quite an ambitious undertaking, and perhaps the best lesson learned from this experience would be to include more people in the task to share the workload, or try to make fewer changes at one time. There was a need for the two professors to teach enough sections to collect the data, and this prevented the use of reassigned time to accomplish the necessary workload. It was a great experience, and a worthwhile endeavor; we thank ALG for the opportunity.

2. Quotes

“it was really nice to get everything you needed so quickly”

“having lectures at my personal disposal was great I think it was very effective”

“the textbook was excellent because it was free! And easy to read”

3. Quantitative and Qualitative Measures

3a. Overall Measurements

Was the overall student opinion about the materials used in the course positive, neutral, or negative?

Total number of students affected in this project: 321

- Positive: 85 % of 50 number of respondents
- Neutral: % of number of respondents
- Negative: 15 % of 50 number of respondents

Student Learning

Outcomes and Grades

To measure the learning outcomes we had the students in each section take the American Chemical Society's standardized final exam. Two courses, one each for CHEM 1211 and 1212, were used as controls. The raw scores for the CHEM 1211 courses in this study were pooled together and compared to the control group. The same analysis was performed with the CHEM 1212 data. The data was analyzed for differences using the Student t-test, with our null hypothesis being the same for both sets of data: "the means on the ACS exam for the control and test groups are the same, and any differences are random, and therefore not a result of our use of the online textbook."

The analyses were done at the 95% confidence level, and in both cases, our null hypothesis was rejected. We cannot state with confidence that any differences in the data are random. However, the means for the controls and test groups are extremely close, so that no real differences are apparent. It is likely that with collection of more data in the future we will be able to demonstrate a correlation between the two controls and the test subject's performance on the ACS exam. The standard deviations in both the control and test groups are quite high, which lowers the confidence level in the data.

Choose One:

- Positive: Higher performance outcomes measured over previous semester(s)
- X Neutral: Same performance outcomes over previous semester(s)
- Negative: Lower performance outcomes over previous semester(s)

Student Drop/Fail/Withdraw (DFW) Rates

Drop/Fail/Withdraw Rate:

25% of the students, out of a total 321 students affected, dropped/failed/withdrew from the course in the final semester of implementation. As compared to 34% in the control groups.

Choose One:

- **X** Positive: This is a lower percentage of students with D/F/W than previous semester(s), as compared to the 34% in the control group.
- Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- Negative: This is a higher percentage of students with D/F/W than previous semester(s)

4. Sustainability Plan

Our data supports the continued use of the OpenStax chemistry textbook in our freshman chemistry sequence. Our goal is to continue to collect data on its effectiveness in an effort to convince our colleagues to implement the text in their courses, to benefit even more students.

The supporting website will be edited, updated, improved and built upon as a collaborative effort for the foreseeable future.

5. Future Plans

Participation in this project has led both investigators to pursue development of additional instructional materials to support their courses. We no longer see the need to adopt materials provided at high cost from the traditional publishers. We intend to develop lower cost materials that are more course specific.

We presented our findings at the USG Teaching and Learning Conference in Athens Ga in April 2016.

6. Description of Photograph

From left to right: John Williams, computer guru; Dr. Greta Giles, instructor; Dr. Jim Konzelman, instructor