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Application Summary

Competition Details

Competition Title:	Textbook Transformation Grants, Round Seventeen (Summer 2020 - Summer 2021)
Category:	University System of Georgia
Award Cycle:	Round 17
Submission Deadline:	04/20/2020 at 11:59 PM

Application Information

Submitted By:	Megumi Fujita
Appplication ID:	4771
Application Title:	537
Date Submitted:	04/21/2020 at 8:47 AM

Personal Details

Institution Name(s):	University of West Georgia
Applicant First Name:	Megumi
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Applicant Email Address:	mfujita@westga.edu
Applicant Phone Number:	7705464388
Primary Appointment Title:	Professor
Submitter First Name:	Dixie
Submitter Last Name:	Curley
Submitter Email Address:	dcurley@westga.edu
Submitter Phone Number:	678-839-5354
Submitter Title:	Pre-Award Coordinator, Office of Research and Sponsored Projects

Application Details

Proposal Title
537

Requested Amount of Funding
$10,800

Priority Category (if applicable)
None / N/A

Course Title(s)
Organic Chemistry I (lecture) and Organic Chemistry II (lecture)

Course Number(s)
CHEM2411 and CHEM3422

Team Member 1 Name
Megumi Fujita

Team Member 1 Email
mfujita@westga.edu

Team Member 2 Name
Partha Ray

Team Member 2 Email
psray@westga.edu

Team Member 3 Name
Victoria Geisler

Team Member 3 Email
vgeisler@westga.edu

Team Member 4 Name

Team Member 4 Email

Additional Team Members (Name and email address for each)

Sponsor Name
Denise Overfield, Ph.D.

Sponsor Title
Associate Vice President for Research & Dean of the Graduate School

Sponsor Department
University of West Georgia

Total Number of Student Section Enrollments Affected by Project in One Academic Year
225

Average Number of Student Section Enrollments Affected per Summer Semester
25

Average Number of Student Section Enrollments Affected per Fall Semester
100

Average Number of Student Section Enrollments Affected per Spring Semester
100

Original Required Commercial Materials (title, author, price, and bookstore or retailer URL showing price)

Organic Chemistry, 9th ed. McMurry ($287.88 UWG Bookstore)

To see the UWG Bookstore price,

(1) Go to bookstore.westga.edu

(2) Course Materials --> Buy Textbooks --> Scroll down

(3) Select Spring 2020, CHEM, 2411, 01. On the right, click GET BOOKS

Original Total Cost per Student

$287.88

Post-Project Cost per Student

$0

Post-Project Savings per Student

$287.88

Projected Total Annual Student Savings per Academic Year

Based on expected CHEM 2411 enrollment for AY2020-2021: $287.88 X 150= $43,182

Using OpenStax Textbook?

No

Project Goals

The team of three organic chemistry instructors at the University of West Georgia (UWG) are aiming to (i) **adopt a no-cost textbook for the Organic Chemistry I and II** sequence to replace the traditional textbook, (ii) create **no-cost online homework** on the existing D2L system, and (iii) actively promote weekly study habits to enhance student success.

Organic Chemistry is a required subject for chemistry majors as well as biology majors, typically taken in the sophomore year. It also is one of the prerequisites for medical schools. However, Organic Chemistry is deemed a challenging subject. One reason is that the nature of the subject is quite different from the Freshman (General) Chemistry, which is based on more quantitative thinking. Organic Chemistry is heavily conceptual, and the content is both broad and detailed. The central goal of the course is to understand how structures of organic molecules dictate their reactivity. In particular, this course emphasizes understanding mechanisms (how bonds are broken and formed) and how these mechanisms can be used to predict the outcome of an unfamiliar reaction and thus carry out functional group transformations. Another major part of organic chemistry is to use the above information to synthesize novel molecules with important chemical, physical and biological properties such as pharmaceuticals, cosmetics, and polymers. Finally, students need to be able to interpret spectral data to elucidate the structures of organic molecules. Learning Organic Chemistry is like learning a new language; to communicate one must learn the alphabet, basic grammar, and word structure. Organic chemists communicate by drawing and naming structures, showing mechanisms, and sharing spectral data.

To become reasonably fluent in Organic Chemistry, not unlike learning a new language, requires time, patience, and repetition. The main reason that students do not succeed in organic chemistry is that they do not spend sufficient time on trying to understand the concepts and rely too heavily on memorizing the material. While memorization is necessary for learning anything, in the physical sciences it is simply not enough.

We believe that reading a textbook is a vital part of student learning. A good textbook provides a structure and context to the concepts that they learn in class, and offers many practice problems for students to work on to test their own understanding. We have been using Organic Chemistry by McMurry for years, due to its high quality and depth of the content coverage, and due to a good number of practice problems provided. However, because of the high cost, many students do not buy the textbook. Knowing this reality, we have not fully implemented an active usage of the textbook, such as reading assignments and quizzes based directly on the reading and practice problems. We have looked into low-cost textbooks options from time to time, but in the past, we could not find any options that were better and/or substantially cheaper than McMurry.

Organic Chemistry: Structure, Mechanism, and Synthesis by Robert Ouellette and David Rawn (first edition, Elsevier, 2014) is the first no-cost textbook that we find suitable for our purpose, available as an ebook at no-cost to students through GALILEO. It takes a traditional textbook format (a hardcover book is actually sold, $175 from the publisher), with a comprehensive coverage of topics comparable to the published mainstream textbooks. What we like the most about the textbook is the number of practice problems at the end of each chapter as well as after each subsection. We have re-examined the latest LibreText options and OpenStax options (including Michigan State University's webpage-based textbook), but decided on the Ouellette and Rawn textbook for the organized presentation of the topics throughout the book, instead of hodge-podge gathering of contents.

The goal of this project is to adopt the Ouellette and Rawn Organic Chemistry textbook, available at no cost to students via GALILEO, for the Organic Chemistry I and II sequence (CHEM2411 and CHEM3422), and redesign the lecture courses. In addition, we will create no-cost online reading and homework assignments, actively incorporating the end-of-chapter problems to help create a weekly study routine to maximize the student learning and success in these courses. Instead of using commercial online homework systems such as Sapling, we plan to create our own online homework problems on the existing D2L systems (called "CourseDen" at UWG). All developed materials, including the lecture materials and D2L online homework, will be made available for sharing with other USG institutions.

Statement of Transformation

Current state

UWG is a comprehensive university serving over 13,000 students, of which 35% is African-American, and 7% Hispanic or Latino (doubled in the past 5 years). Approximately 60% of students are from the primary service area of 37 counties in the West Georgia area, and over 25% are from the Metro Atlanta area. Over 40% of the students received Pell Grants in 2018, indicating a high number of low-income students in our student body.

The Department of Chemistry offers an American Chemical Society (ACS) certified Bachelor of Science (BS) degree in Chemistry, and a BS degree in chemistry that is not certified by ACS, which includes pre-professional, business, and general concentrations. Organic Chemistry I (CHEM2411) and II (CHEM3422) are required for both degree tracks. Approximately 20 students graduate each year with a BS degree in chemistry. One semester of Organic Chemistry is required for all BS degrees in Biology, and Organic Chemistry II is recommended for students who plan to attend graduate or professional school. Approximately 110-120 biology students graduate from UWG per year. Of the student body in CHEM2411 and CHEM3422, about 60% of the students are biology majors, 30% are chemistry majors, and 10% are others.

CHEM 2411 is taken by approximately 150 students per year, and CHEM 3422 is taken by approximately 75 students per year. Two faculty members, Dr. Victoria Geisler and Dr. Partha Ray teach these courses. The lab classes are taught by Drs. Geisler, Ray, and Megumi Fujita, and the lab contents are selected to align with lecture learning, and in some cases, to supplement the lecture (e.g. infrared and mass spectroscopy are covered only in the lab). Organic Chemistry is one of the most challenging science classes and consequently it has a high DFW rate of approximately 30-40% (2015-2019), resulting in many students retaking the courses.

Currently only those who received A or B in Principles of Chemistry II (CHEM1212) can proceed to CHEM2411. In 2017, we started to offer a separate one-semester “Principles of Organic Chemistry” (CHEM2455), a survey course with a biological emphasis for those who received C in CHEM1212. This course does not count toward chemistry major, but counts toward other majors (mostly biology). Approximately 50 students per year takes this course. We created CHEM 2455 to mitigate the struggles and high DFW rate in CHEM2411, by creating a venue for underprepared students. However, we have seen less than a 6% reduction of the DFW rate in CHEM2411 in the past 3 years after implementing CHEM2455. Therefore, we are going back to the original curriculum, to direct all students who received A, B or C in CHEM1212 into CHEM2411. We plan to mitigate the high DFW rate by a pedagogical transformation, including this proposed project. Upon the re-integration of the organic chemistry courses, the total number of student enrollment in CHEM2411 will likely increase from the current 150 to 200 per year, the enrollment in CHEM3422 is estimated to increase from 75 to 100 per year, and the total count per year will increase from 225 to estimated 300 students.

Currently, the required textbook for CHEM2411 and CHEM3422 is the ninth edition of Organic Chemistry by John McMurry (Cengage). The UWG Bookstore price is $287.88.

We currently do not use an online homework system. This is partly because of our perception that reaction-mechanism-drawing type questions are difficult to create. However, due to the large class size (maximum 72), it is difficult to give manually graded homework frequently enough, and give prompt enough feedback. We do assign problems from the textbook and tell students that they are a crucial part of the study and preparation for the exams, and some of these problems are worked out at the weekly Supplementary Instruction (SI) sessions that are held outside of the class, led by a trained student SI leader. However, since these assigned problems are not graded, only a handful of serious students tend to work through them. We do, therefore, recognize the need to implement graded homework assignments, given on a regular basis, in order to direct students to read and work problems from the textbook in a consistent manner. Benefits of the use of online homework in organic chemistry has been reported positively in the literature [Richards-Babb et al. J. Chem. Educ. **2015**, 92, 1813-1819].

Overall Impact of the Project

No-cost textbook. The first edition of Organic Chemistry: Structure, Mechanism, and Synthesis by Robert Ouellette and David Rawn (Elsevier, 2014) is a permanent ebook acquisition by GALILEO with unlimited access. Students can access this as an e-book with no cost. The second edition (2018) is the latest edition of this textbook, which costs $168.75 for hardcover or ebook from the publisher. We will adopt the no-cost first edition for CHEM2411 and CHEM3422. Since students in CHEM3422 have already taken CHEM2411 and do not need to buy a textbook again, the total annual savings based on the CHEM2411 enrollment is $287.88 x 150 = $43,182 (AY2020-2021). After the re-integration of the CHEM2411 and CHEM2455 paths (Fall 2021), the estimated annual savings will be approximately $287.88 x 200 = $57,576.

Course redesigning. The lecture instructors will redesign their lecture courses to be aligned with the new textbook. They will develop weekly plans covering appropriate sections, lecture materials including

powerpoints, and select problems from the textbook. Part of these selected problems will be converted to online homework questions (see below), and others are actively promoted in the weekly study plans (see below).

No-cost Online Homework. We will develop online homework for the textbook sections that are covered in class each week. We will build our own homework on the existing D2L platform, so there is no cost for students. We have considered commercial online homework systems such as Saplings Plus, but the price per semester is $42 for Saplings, which exceeds the low-cost criteria defined by the Affordable Learning Georgia. Therefore, we have decided to develop our own. The weekly homework will consist of 5-10 questions that are from the assigned end-of-chapter problems but modified to auto-gradable format (multiple choice, multi-select, matching, ordering, or fill-in-the-blanks). Each question will refer to the corresponding textbook section (e.g. Chapter 5, Section 5.3), to promote textbook reading. Chemdraw program will be used to create molecular structure and reaction graphics to embed in the D2L questions.

Currently the D2L system is not equipped with a way to construct organic structure-drawing problems. During the project year, we plan to seek a way to incorporate structure-drawing and automatic grading into our D2L online homework. O'Sullivan and Hargaden incorporated MarvinSketch, a chemical drawing editor based on SMILES (Simplified Molecular Input Line Entry Specification) algorithm, to create structure-based problems embedded in standard learning management systems such as Blackboard and Moodle [J. Chem. Educ. 2014, 91, 1851]. Marvin Sketch is free for academic purposes. If MarvinSketch applet is uploaded in the Blackboard or Moodle, a correctly drawn structure can be recognized. Our Center for Teaching and Learning inquired about the possibility of uploading the MarvinSketch applet into our D2L system to the Board of Regents, and at this point it cannot be done. However, we plan to seek ways to implement online structure-drawing problems during the project year. The actual implementation will be in Year 2, after the project period.

Promotion of weekly study habits. We consider students working ALL assigned problems a crucial part of learning organic chemistry. A set of end-of-chapter problems will be assigned weekly. While we plan to convert some of the end-of-chapter problems into Online Homework, students still need to tackle all assigned problems. We will encourage students to build a structured weekly study habit by introducing incentive points. Students will receive small incentive points by visiting office hours and/or supplemental instruction (SI) sessions to work on the assigned problems (for example dropping the lowest online homework quiz for participating in 4 sessions). By doing this we will promote-structured weekly study habits, instead of waiting until a few days before an exam day. We will give additional small incentive points for solving/attempting ALL assigned problems within a week. This will not be graded in detail, but students receive these points by showing the work to the instructor or SI leader. This will promote the importance of solving or attempting all problems in a timely manner. Each instructor and their SI leaders will have a copy of the solution manual if students want to check their answers, and one extra copy will be made available in the Chemistry Department Office if they want to check their answers outside of the office hours or SI sessions.

Overall, by relieving students of a financial burden by adopting a no-cost textbook, and by a major course redesigning including the weekly online homework and the purposeful promotion of weekly study habits, the proposed project is intended to help students financially as well as to increase the student success rates in Organic Chemistry courses, and improve the retention, progression and graduation rates of chemistry and biology majors.

Transformation Action Plan

The team of three faculty members have already examined several no-cost textbook options, and has selected Organic Chemistry by Ouellette and Rawn, which is available at no-cost to students through GALILEO.

Drs. Partha Ray and Victoria Geisler (Course Instructors)

Drs. Ray and Geisler are the two veteran instructors of Organic Chemistry I and II. They will share the responsibility to develop a weekly plan, develop lecture course materials based on the new textbook, and assign end-of-chapter problems for each week. They will create online homework problems based on some of the end-of-chapter problems.

Drs. Geisler and Ray will deliver re-designed CHEM2411 and CHEM3422 courses in Fall 2020 and Spring 2021. They will administer the weekly study incentivization and active incorporation of end-of-chapter problems outside of the classroom.

Dr. Megumi Fujita (Project Lead)

Dr. Fujita teaches the laboratory sections of CHEM2411 and CHEM3422, and has experience with D2L pre-laboratory quiz development for the lab sections. She will assist Drs. Ray and Geisler in creating online homework questions and transferring them into the D2L format. She will create a common question pool in a shared "sandbox" that will be available for future use. She will work with the Center of Teaching and Learning to find a way to incorporate MarvinSketch into D2L.

Dr. Fujita will serve as a Project Lead. She will serve as a lead contact to the Center for Teaching and Learning and the Library Liaisons for technological support. She will develop the assessment surveys, and lead the analysis of the project outcome and writing of the final report. Dr. Fujita will be responsible for placing developed materials in GALILEO Open Learning Materials, and will be a contact person for sharing the D2L homework questions developed.

Quantitative & Qualitative Measures

- **The student satisfaction survey.** A survey will be created and administered along with the end-of-the-semester course evaluations. The survey questions on the e-textbook itself will be designed following an article by Jaggars et al. titled "Understanding Students' Satisfaction with OERs as Course Materials" [Performance Measurement and Metrics, **2018**, 19, 68-74].

The survey will have questions on the textbook itself: (i) quality of the textbook contents, (ii) how well the textbook was integrated into the learning, (iii) which features of the textbook students used the most (reading the main contents, sample problems, end-of-chapter problems, summary of terms and concepts, etc), (iv) overall experience of the digital textbook, including the ease of access, ease of reading, ease (or lack) of annotation, and physical environment issues (neck/shoulder problems, distractions) compared to traditional book format.

The survey will also ask questions on the new course design and supplemental materials: (v) how helpful was the online homework, (vi) how much of the assigned end-of-chapter problems they actually solved, and (vii) how often they used office hours and SI sessions.

We will collect comments from the regular course evaluations to see students' overall satisfaction or dissatisfaction.

- **ACS Exam Scores.** With an exception of Spring 2020 (affected by COVID-19), we have administered the ACS Exam as the final exam in Organic Chemistry I and Organic Chemistry II. We will compare the ACS Exam scores after adopting the new textbook and new pedagogy to the data from the past 5 years.
- **Grade distribution analysis.** We will compare the grade distribution (A, B, C, D, F, W) of "before" and "after the new textbook and pedagogy implementation. In particular, the DFW rate and the overall grade (% of A, % of B....) will be compared to the data from the past 5 years.

The team will need approval from the Institutional Review Board (IRB) in order to disseminate the assessment results at the USG Teaching and Learning Conference. The support for the UWG IRB approval process will be provided by Ms. Charla Campbell, the Assistant Director of the Office of the Research and Sponsored Projects at UWG, once the project is funded.

Timeline

May 2020

- Team will review course objectives, learning outcomes, and a 15-week content coverage plan based on the chapters of the new textbook.
- Team will distribute the workload to create online homework.
- Team will work on the IRB approval process.

June-July 2020

- Team will develop weekly online homework questions and implement them in the D2L.
- Geisler and Ray will redesign the CHEM2411 course according to the new textbook, and develop strategies to actively incorporate many end-of-chapter problem solving.
- Fujita will create a general instruction on how to access the Ouellette and Rawn Organic Chemistry textbook through GALILEO for students.

August-December 2020

- Geisler and Ray will teach their CHEM2411 lecture sections in Fall 2020.
- Fujita will troubleshoot technical issues with the D2L quizzes and the online textbook.
- Fujita will search for ways to incorporate MarvinSketch into D2L to create structure-drawing questions.

October - December 2020

- The team will start working on developing Reading Guides and D2L Reading Quizzes (should we add a description back into the plan) for Spring 2021 CHEM3422.
- Fujita will develop a student satisfaction survey

December 2020

- Geisler and Ray will administer the Student Satisfaction Survey and general course evaluation.
- The ACS-Exam scores and the final grade data will be collected.
- The team will reflect on the implementation in CHEM2411 in Fall 2020
- Geisler will work on the remaining CHEM3422 preparation for Spring 2021.
- Ray will make adjustments as needed on CHEM2411 for Spring 2021.
- The team will submit an abstract for the USG Teaching and Learning Conference in April 2021.

January - May 2021

- Geisler will teach CHEM3422 with the new course design.
- Ray will teach CHEM2411, and make further adjustments/improvements as needed.
- Fujita will assist the D2L management and trouble-shooting.
- Fujita will analyze the ACS Exam scores and the course grades from the Fall 2020 CHEM2411 courses with the new textbook and pedagogy implementation, and compare to the data from the past 5 years.

April 2021

- The team will present the outcomes of the project at the UWG Teaching and Learning Conference.

May 2021

- Geisler and Ray will administer the Student Satisfaction Survey along with the general course evaluation for CHEM3422 and CHEM2411 of Spring 2021.
- Fujita will analyze the CHEM3422 survey and grades data and compare with the data from the last 5 years.
- The team will reflect on the past two semesters and critically assess the impact of the project on student success.

May-June 2021

- Fujita will lead the writing of the final report. The team will submit the final report.

Budget

Dr. Partha Ray, $3,333.50

Dr. Victoria Geisler, $3,333.50

Drs. Ray and Geisler will share the responsibility to redesign Organic Chemistry lecture courses based on the new textbook, develop lecture materials, and create D2L online homework problems. They will deliver CHEM2411 courses in Fall 2020 in the new format. Dr. Geisler will deliver CHEM3422 class in the new format in Spring 2021, and Dr. Ray will deliver CHEM2411 with revisions made upon the reflection of Fall 2020.

Dr. Megumi Fujita, $3,333.00

Dr. Fujita will assist creating D2L homework questions and their implementation to D2L. She will troubleshoot and maintain the D2L homework, including creating a common question pool. She will create and administer surveys, and analyze the survey data, course grades, and the ACS exam results. She will be the point of contact with technological support entities, the grant office, and with Affordable Learning Georgia. She will lead the preparation of the abstract submission and presentation for the UWG Teaching and Learning Conference. She will lead the writing of the final report, and repository of developed materials to GALILEO Open Learning Materials.

Solution manual and ChemDraw license, $800

Since the travel fund is no longer needed to attend a face-to-face kick-off meeting, this fund is requested to purchase five copies of Organic Chemistry Study Guide, First Edition, by Ouellette and Rawn (paperback, $91, Elsevier). This book contains solutions to all end-of-chapter problems, and additional study aids. Five copies are requested for two instructors, their SI leader's copies, and one copy to keep in the Department of Chemistry office. $91 x 5 = $455 plus tax plus shipping is requested.

We would like to request the remainder of the $800 fund to help the cost of annual ChemDraw Prime subscription ($1,753). ChemDraw software will be used extensively to create graphics in the D2L quiz questions and other course materials. The Department of Chemistry provides the balance for the subscription.

Sustainability Plan

The textbook, Organic Chemistry: Structure, Mechanism, and Synthesis (first edition) by Ouellette and Rawn, is a permanent ebook collection by GALILEO with unlimited access, therefore it will stay accessible for years to come. If some of the contents get old, or if we need to add topics that are not covered in the book, supplemental materials will be created.

The homework quizzes developed on D2L are easily transferable from course to course, semester to semester. We will create a sandbox, a common place to store question pools, and future courses can select questions from the pool.

Other course materials (syllabus, class handouts, powerpoints, etc) will be stored in a common drive and will be shared with all organic chemistry instructors. They will be sorted by the year/semester.

All the developed materials will be deposited to GALILEO Open Learning Depository. Reading Quizzes developed on D2L can be easily exported to the D2L course of another institution upon request.

The preliminary assessment outcomes from Fall 2020 will be presented at the USG Teaching and Learning Conference in April 2021, and more complete assessments of the entire year, and following years will be shared at the American Chemical Society meetings in the Chemical Education division.

Acknowledgment

Grant Acceptance

[Acknowledged] I understand and acknowledge that acceptance of Affordable Learning Georgia grant funding constitutes a commitment to comply with the required activities listed in the RFP and that my submitted proposal will serve as the statement of work that must be completed by my project team. I further understand and acknowledge that failure to complete the deliverables in the statement of work may result in termination of the agreement and funding.

UNIVERSITY of West Georgia

Office of Research and Sponsored Projects
Carrollton, Georgia 30118

Division of Academic Affairs

April 7, 2020

Jeff Gallant
Program Manager, Affordable Learning Georgia
Library Services, Board of Regents of the University System of Georgia

Dear Mr. Gallant and the ALG Textbook Transformation Grant Committee:

Please accept this letter of support for the Textbook Transformation Grant submitted by Drs. Megumi Fujita, Partha Ray, and Victoria Geisler of the Department of Chemistry at the University of West Georgia. Their project will adopt a no-cost textbook, develop no-cost online homework, redesign courses, and implement strategies to promote weekly study habits to help students succeed in the Organic Chemistry I and II sequence (CHEM 2411/3422). Adoption of a no-cost textbook and online homework platform will save 225 students approximately $287.88 each in textbook costs.

Their proposal requests funding to support the creation of materials and will be completed by June 2021. Once created, the materials will be easy to revise and maintain so that they will be a sustainable resource for the department. The textbook being adopted is a permanent collection within GALILEO; therefore, it will stay available to future students at no cost.

Professors Fujita, Ray, and Geisler have the full support and endorsement of their department chair and college dean. With this level of support and with the quality of this project, we are confident that this project is worthy of funding and we look forward to providing support for it.

Sincerely,

Denise Overfield
Denise Overfield (Apr 7, 2020)

Denise Overfield, Ph.D.
Associate Vice President for Research and Dean of the Graduate School

Fujita_ALG_LETTER OF SUPPORT

Final Audit Report 2020-04-07

Created:	2020-04-07
By:	Dixie Curley (dcurley@westga.edu)
Status:	Signed
Transaction ID:	CBJCHBCAABAA1DWPpWKQnsey3Jax5K9C8YeXHjV2eJZ4

"Fujita_ALG_LETTER OF SUPPORT" History

Document created by Dixie Curley (dcurley@westga.edu)
2020-04-07 - 4:32:41 PM GMT- IP address: 107.125.24.233

Document emailed to Denise Overfield (doverfie@westga.edu) for signature
2020-04-07 - 4:33:31 PM GMT

Email viewed by Denise Overfield (doverfie@westga.edu)
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Document e-signed by Denise Overfield (doverfie@westga.edu)
Signature Date: 2020-04-07 - 5:30:27 PM GMT - Time Source: server- IP address: 108.81.94.180

Signed document emailed to Denise Overfield (doverfie@westga.edu) and Dixie Curley (dcurley@westga.edu)
2020-04-07 - 5:30:27 PM GMT

Textbook Transformation Grants, Round Seventeen (Summer 2020 – Summer 2021)

Proposal Form and Narrative

Notes

- The proposal form and narrative .docx file is for offline drafting and review. Submitters must use the InfoReady Review online form for proposal submission.
- The only way to submit the official proposal is through the online form in Georgia Tech's InfoReady Review. The link to the online application is on the Round 17 RFP Page.
- The italic text provided below is meant for clarifications and can be deleted.

Applicant, Team, and Sponsor Information

*The **applicant** is the proposed Project Lead for the grant project. The **submitter** is the person submitting the application (which may be a Grants Officer or Administrator). The submitter will often be the applicant – if so, just list the applicant as the submitter.*

Institution(s)	University of West Georgia
Applicant Name	Megumi Fujita
Applicant Email	mfujita@westga.edu
Applicant Phone #	678-839-6024
Applicant Position/Title	Professor
Submitter Name	Dixie Curley
Submitter Email	dcurley@westga.edu
Submitter Phone #	*678-839-5354*
Submitter Position	*Pre-Award Coordinator,* Office of Research and Sponsored Projects

Please provide the first/last names and email addresses of all team members within the proposed project. Include the applicant (Project Lead) in this list. Do not include prefixes or suffixes such as Ms., Dr., Ph.D., etc.

	Name	Email Address
Team Member 1	Megumi Fujita	mfujita@westga.edu
Team Member 2	Partha Ray	psray@westga.edu
Team Member 3	Victoria Geisler	vgeisler@westga.edu

If you have any more team members to add, please enter their names and email addresses in the text box below.

n/a

Please provide the sponsor's name, title, department, and institution. The sponsor is the provider of your Letter of Support.

Denise Overfield, Ph.D. Associate Vice President for Research & Dean of the Graduate School University of West Georgia

Project Information and Impact Data

Project Title: **Adopting a no-cost textbook for Organic Chemistry I and II and creating no-cost online homework at UWG**

Priority Category / Categories	*None*
Requested Amount of Funding	*$10,800*
Course Names and Course Numbers	Organic Chemistry I (CHEM 2411) -lecture Organic Chemistry II (CHEM 3422) -lecture
Final Semester of Project	Summer 2021
Total Number of Student Section Enrollments Affected by Project in One Academic Year	CHEM2411: approximately 150 total. Average 50/section x 3 sections (2 in Fall, 1 in Spring) CHEM3422: approximately 75 total. Ca. 50 in Spring (1 section) + 25 in Summer (1 section) All-year total: 225
Average Number of Student Section Enrollments Affected per Summer Semester	CHEM3422: approximately 25 in Summer (1 section) Summer total: 25
Average Number of Student Section Enrollments Affected per Fall Semester	CHEM2411: approximately 100: average 50/section x 2 sections Fall total: 100

Average Number of Student Section Enrollments Affected per Spring Semester	CHEM2411: 50 (1 section) CHEM3422: 50 (1 section) Spring total: 100
Original Required Commercial Materials	Organic Chemistry, 9th ed. McMurry ($287.88 UWG Bookstore) To see the UWG Bookstore price, (1) Go to bookstore.westga.edu (2) Course Materials --> Buy Textbooks --> Scroll down (3) Select Spring 2020, CHEM, 2411, 01. On the right, click GET BOOKS
Average Price of Original Required Materials Per Student Section Enrollment	$287.88
Average Post-Project Cost Per Student Section Enrollment	$0
Average Post-Project Savings Per Student Section Enrollment	$287.88
Projected Total Annual Student Savings Per Academic Year	Based on expected CHEM 2411 enrollment for AY2020-2021: $287.88 X 150= $43,182
Using OpenStax Textbook?	*No.*

Narrative Section

1. Project Goals

The team of three organic chemistry instructors at the University of West Georgia (UWG) are aiming to (i) **adopt a no-cost textbook for the Organic Chemistry I and II** sequence to replace the traditional textbook, (ii) create **no-cost online homework** on the existing D2L system, and (iii) actively promote weekly study habits to enhance student success.

Organic Chemistry is a required subject for chemistry majors as well as biology majors, typically taken in the sophomore year. It also is one of the prerequisites for medical schools. However, Organic Chemistry is deemed a challenging subject. One reason is that the nature of the subject is quite different from the Freshman (General) Chemistry, which is based on more quantitative thinking. Organic Chemistry is heavily conceptual, and the content is both broad and detailed. The central goal of the course is to understand how structures of organic molecules dictate their reactivity. In particular, this course emphasizes understanding mechanisms (how bonds are

broken and formed) and how these mechanisms can be used to predict the outcome of an unfamiliar reaction and thus carry out functional group transformations. Another major part of organic chemistry is to use the above information to synthesize novel molecules with important chemical, physical and biological properties such as pharmaceuticals, cosmetics, and polymers. Finally, students need to be able to interpret spectral data to elucidate the structures of organic molecules. Learning Organic Chemistry is like learning a new language; to communicate one must learn the alphabet, basic grammar, and word structure. Organic chemists communicate by drawing and naming structures, showing mechanisms, and sharing spectral data.

To become reasonably fluent in Organic Chemistry, not unlike learning a new language, requires time, patience, and repetition. The main reason that students do not succeed in organic chemistry is that they do not spend sufficient time on trying to understand the concepts and rely too heavily on memorizing the material. While memorization is necessary for learning anything, in the physical sciences it is simply not enough.

We believe that reading a textbook is a vital part of student learning. A good textbook provides a structure and context to the concepts that they learn in class, and offers many practice problems for students to work on to test their own understanding. We have been using Organic Chemistry by McMurry for years, due to its high quality and depth of the content coverage, and due to a good number of practice problems provided. However, because of the high cost, many students do not buy the textbook. Knowing this reality, we have not fully implemented an active usage of the textbook, such as reading assignments and quizzes based directly on the reading and practice problems. We have looked into low-cost textbooks options from time to time, but in the past, we could not find any options that were better and/or substantially cheaper than McMurry.

Organic Chemistry: Structure, Mechanism, and Synthesis by Robert Ouellette and David Rawn (first edition, Elsevier, 2014) is the first no-cost textbook that we find suitable for our purpose, available as an ebook at no-cost to students through GALILEO. It takes a traditional textbook format (a hardcover book is actually sold, $175 from the publisher), with a comprehensive coverage of topics comparable to the published mainstream textbooks. What we like the most about the textbook is the number of practice problems at the end of each chapter as well as after each subsection. We have re-examined the latest LibreText options and OpenStax options (including Michigan State University's webpage-based textbook), but decided on the Ouellette and Rawn textbook for the organized presentation of the topics throughout the book, instead of hodge-podge gathering of contents.

The goal of this project is to adopt the Ouellette and Rawn Organic Chemistry textbook, available at no cost to students via GALILEO, for the Organic Chemistry I and II sequence (CHEM2411 and CHEM3422), and redesign the lecture courses. In addition, we will create no-cost online reading and homework assignments, actively incorporating the end-of-chapter problems to help create a weekly study routine to maximize the student learning and success in these courses. Instead of using commercial online homework systems such as Sapling, we plan to create our own online homework problems on the existing D2L systems (called "CourseDen"

at UWG). All developed materials, including the lecture materials and D2L online homework, will be made available for sharing with other USG institutions.

2. Statement of Transformation

Current state

UWG is a comprehensive university serving over 13,000 students, of which 35% is African-American, and 7% Hispanic or Latino (doubled in the past 5 years). Approximately 60% of students are from the primary service area of 37 counties in the West Georgia area, and over 25% are from the Metro Atlanta area. Over 40% of the students received Pell Grants in 2018, indicating a high number of low-income students in our student body.

The Department of Chemistry offers an American Chemical Society (ACS) certified Bachelor of Science (BS) degree in Chemistry, and a BS degree in chemistry that is not certified by ACS, which includes pre-professional, business, and general concentrations. Organic Chemistry I (CHEM2411) and II (CHEM3422) are required for both degree tracks. Approximately 20 students graduate each year with a BS degree in chemistry. One semester of Organic Chemistry is required for all BS degrees in Biology, and Organic Chemistry II is recommended for students who plan to attend graduate or professional school. Approximately 110-120 biology students graduate from UWG per year. Of the student body in CHEM2411 and CHEM3422, about 60% of the students are biology majors, 30% are chemistry majors, and 10% are others.

CHEM 2411 is taken by approximately 150 students per year, and CHEM 3422 is taken by approximately 75 students per year. Two faculty members, Dr. Victoria Geisler and Dr. Partha Ray teach these courses. The lab classes are taught by Drs. Geisler, Ray, and Megumi Fujita, and the lab contents are selected to align with lecture learning, and in some cases, to supplement the lecture (e.g. infrared and mass spectroscopy are covered only in the lab). Organic Chemistry is one of the most challenging science classes and consequently it has a high DFW rate of approximately 30-40% (2015-2019), resulting in many students retaking the courses.

Currently only those who received A or B in Principles of Chemistry II (CHEM1212) can proceed to CHEM2411. In 2017, we started to offer a separate one-semester “Principles of Organic Chemistry” (CHEM2455), a survey course with a biological emphasis for those who received C in CHEM1212. This course does not count toward chemistry major, but counts toward other majors (mostly biology). Approximately 50 students per year takes this course. We created CHEM 2455 to mitigate the struggles and high DFW rate in CHEM2411, by creating a venue for underprepared students. However, we have seen less than a 6% reduction of the DFW rate in CHEM2411 in the past 3 years after implementing CHEM2455. Therefore, we are going back to the original curriculum, to direct all students who received A, B or C in CHEM1212 into CHEM2411. We plan to mitigate the high DFW rate by a pedagogical transformation, including this proposed project. Upon the re-integration of the organic chemistry courses, the total number of student enrollment in CHEM2411 will likely increase from the current 150 to 200 per

year, the enrollment in CHEM3422 is estimated to increase from 75 to 100 per year, and the total count per year will increase from 225 to estimated 300 students.

Currently, the required textbook for CHEM2411 and CHEM3422 is the ninth edition of Organic Chemistry by John McMurry (Cengage). The UWG Bookstore price is $287.88.

We currently do not use an online homework system. This is partly because of our perception that reaction-mechanism-drawing type questions are difficult to create. However, due to the large class size (maximum 72), it is difficult to give manually graded homework frequently enough, and give prompt enough feedback. We do assign problems from the textbook and tell students that they are a crucial part of the study and preparation for the exams, and some of these problems are worked out at the weekly Supplementary Instruction (SI) sessions that are held outside of the class, led by a trained student SI leader. However, since these assigned problems are not graded, only a handful of serious students tend to work through them. We do, therefore, recognize the need to implement graded homework assignments, given on a regular basis, in order to direct students to read and work problems from the textbook in a consistent manner. Benefits of the use of online homework in organic chemistry has been reported positively in the literature [Richards-Babb *et al*. *J. Chem. Educ.* **2015**, 92, 1813-1819].

Overall Impact of the Project

No-cost textbook. The first edition of Organic Chemistry: Structure, Mechanism, and Synthesis by Robert Ouellette and David Rawn (Elsevier, 2014) is a permanent ebook acquisition by GALILEO with unlimited access. Students can access this as an e-book with no cost. The second edition (2018) is the latest edition of this textbook, which costs $168.75 for hardcover or ebook from the publisher. We will adopt the no-cost first edition for CHEM2411 and CHEM3422. Since students in CHEM3422 have already taken CHEM2411 and do not need to buy a textbook again, the total annual savings based on the CHEM2411 enrollment is $287.88 x 150 = $43,182 (AY2020-2021). After the re-integration of the CHEM2411 and CHEM2455 paths (Fall 2021), the estimated annual savings will be approximately $287.88 x 200 = $57,576.

Course redesigning. The lecture instructors will redesign their lecture courses to be aligned with the new textbook. They will develop weekly plans covering appropriate sections, lecture materials including powerpoints, and select problems from the textbook. Part of these selected problems will be converted to online homework questions (see below), and others are actively promoted in the weekly study plans (see below).

No-cost Online Homework. We will develop online homework for the textbook sections that are covered in class each week. We will build our own homework on the existing D2L platform, so there is no cost for students. We have considered commercial online homework systems such as Saplings Plus, but the price per semester is $42 for Saplings, which exceeds the low-cost criteria defined by the Affordable Learning Georgia. Therefore, we have decided to develop our own. The weekly homework will consist of 5-10 questions that are from the assigned

end-of-chapter problems but modified to auto-gradable format (multiple choice, multi-select, matching, ordering, or fill-in-the-blanks). Each question will refer to the corresponding textbook section (e.g. Chapter 5, Section 5.3), to promote textbook reading. Chemdraw program will be used to create molecular structure and reaction graphics to embed in the D2L questions.

Currently the D2L system is not equipped with a way to construct organic structure-drawing problems. During the project year, we plan to seek a way to incorporate structure-drawing and automatic grading into our D2L online homework. O'Sullivan and Hargaden incorporated MarvinSketch, a chemical drawing editor based on SMILES (Simplified Molecular Input Line Entry Specification) algorithm, to create structure-based problems embedded in standard learning management systems such as Blackboard and Moodle [J. Chem. Educ. 2014, 91, 1851]. Marvin Sketch is free for academic purposes. If MarvinSketch applet is uploaded in the Blackboard or Moodle, a correctly drawn structure can be recognized. Our Center for Teaching and Learning inquired about the possibility of uploading the MarvinSketch applet into our D2L system to the Board of Regents, and at this point it cannot be done. However, we plan to seek ways to implement online structure-drawing problems during the project year. The actual implementation will be in Year 2, after the project period.

Promotion of weekly study habits. We consider students working ALL assigned problems a crucial part of learning organic chemistry. A set of end-of-chapter problems will be assigned weekly. While we plan to convert some of the end-of-chapter problems into Online Homework, students still need to tackle all assigned problems. We will encourage students to build a structured weekly study habit by introducing incentive points. Students will receive small incentive points by visiting office hours and/or supplemental instruction (SI) sessions to work on the assigned problems (for example dropping the lowest online homework quiz for participating in 4 sessions). By doing this we will promote-structured weekly study habits, instead of waiting until a few days before an exam day. We will give additional small incentive points for solving/attempting ALL assigned problems within a week. This will not be graded in detail, but students receive these points by showing the work to the instructor or SI leader. This will promote the importance of solving or attempting all problems in a timely manner. Each instructor and their SI leaders will have a copy of the solution manual if students want to check their answers, and one extra copy will be made available in the Chemistry Department Office if they want to check their answers outside of the office hours or SI sessions.

Overall, by relieving students of a financial burden by adopting a no-cost textbook, and by a major course redesigning including the weekly online homework and the purposeful promotion of weekly study habits, the proposed project is intended to help students financially as well as to increase the student success rates in Organic Chemistry courses, and improve the retention, progression and graduation rates of chemistry and biology majors.

3. Transformation Action Plan

The team of three faculty members have already examined several no-cost textbook options, and has selected Organic Chemistry by Ouellette and Rawn, which is available at no-cost to students through GALILEO.

Drs. Partha Ray and Victoria Geisler (Course Instructors)

Drs. Ray and Geisler are the two veteran instructors of Organic Chemistry I and II. They will share the responsibility to develop a weekly plan, develop lecture course materials based on the new textbook, and assign end-of-chapter problems for each week. They will create online homework problems based on some of the end-of-chapter problems.

Drs. Geisler and Ray will deliver re-designed CHEM2411 and CHEM3422 courses in Fall 2020 and Spring 2021. They will administer the weekly study incentivization and active incorporation of end-of-chapter problems outside of the classroom.

Dr. Megumi Fujita (Project Lead)

Dr. Fujita teaches the laboratory sections of CHEM2411 and CHEM3422, and has experience with D2L pre-laboratory quiz development for the lab sections. She will assist Drs. Ray and Geisler in creating online homework questions and transferring them into the D2L format. She will create a common question pool in a shared "sandbox" that will be available for future use. She will work with the Center of Teaching and Learning to find a way to incorporate MarvinSketch into D2L.

Dr. Fujita will serve as a Project Lead. She will serve as a lead contact to the Center for Teaching and Learning and the Library Liaisons for technological support. She will develop the assessment surveys, and lead the analysis of the project outcome and writing of the final report. Dr. Fujita will be responsible for placing developed materials in GALILEO Open Learning Materials, and will be a contact person for sharing the D2L homework questions developed.

4. Quantitative and Qualitative Measures

- **The student satisfaction survey.** A survey will be created and administered along with the end-of-the-semester course evaluations. The survey questions on the e-textbook itself will be designed following an article by Jaggars et al. titled "Understanding Students' Satisfaction with OERs as Course Materials" [*Performance Measurement and Metrics*, **2018**, *19*, 68-74].

  The survey will have questions on the textbook itself: (i) quality of the textbook contents, (ii) how well the textbook was integrated into the learning, (iii) which features of the textbook students used the most (reading the main contents, sample problems, end-of-chapter problems, summary of terms and concepts, etc), (iv) overall experience of

the digital textbook, including the ease of access, ease of reading, ease (or lack) of annotation, and physical environment issues (neck/shoulder problems, distractions) compared to traditional book format.

The survey will also ask questions on the new course design and supplemental materials: (v) how helpful was the online homework, (vi) how much of the assigned end-of-chapter problems they actually solved, and (vii) how often they used office hours and SI sessions.

We will collect comments from the regular course evaluations to see students' overall satisfaction or dissatisfaction.

- **ACS Exam Scores.** With an exception of Spring 2020 (affected by COVID-19), we have administered the ACS Exam as the final exam in Organic Chemistry I and Organic Chemistry II. We will compare the ACS Exam scores after adopting the new textbook and new pedagogy to the data from the past 5 years.

- **Grade distribution analysis.** We will compare the grade distribution (A, B, C, D, F, W) of "before" and "after the new textbook and pedagogy implementation. In particular, the DFW rate and the overall grade (% of A, % of B….) will be compared to the data from the past 5 years.

The team will need approval from the Institutional Review Board (IRB) in order to disseminate the assessment results at the USG Teaching and Learning Conference. The support for the UWG IRB approval process will be provided by Ms. Charla Campbell, the Assistant Director of the Office of the Research and Sponsored Projects at UWG, once the project is funded.

5. Timeline

May 2020

- Team will review course objectives, learning outcomes, and a 15-week content coverage plan based on the chapters of the new textbook.
- Team will distribute the workload to create online homework.
- Team will work on the IRB approval process.

June-July 2020

- Team will develop weekly online homework questions and implement them in the D2L.
- Geisler and Ray will redesign the CHEM2411 course according to the new textbook, and develop strategies to actively incorporate many end-of-chapter problem solving.

- Fujita will create a general instruction on how to access the Ouellette and Rawn Organic Chemistry textbook through GALILEO for students.

August-December 2020

- Geisler and Ray will teach their CHEM2411 lecture sections in Fall 2020.
- Fujita will troubleshoot technical issues with the D2L quizzes and the online textbook.
- Fujita will search for ways to incorporate MarvinSketch into D2L to create structure-drawing questions.

October - December 2020

- The team will start working on developing Reading Guides and D2L Reading Quizzes (should we add a description back into the plan) for Spring 2021 CHEM3422.
- Fujita will develop a student satisfaction survey

December 2020

- Geisler and Ray will administer the Student Satisfaction Survey and general course evaluation.
- The ACS-Exam scores and the final grade data will be collected.
- The team will reflect on the implementation in CHEM2411 in Fall 2020
- Geisler will work on the remaining CHEM3422 preparation for Spring 2021.
- Ray will make adjustments as needed on CHEM2411 for Spring 2021.
- The team will submit an abstract for the USG Teaching and Learning Conference in April 2021.

January - May 2021

- Geisler will teach CHEM3422 with the new course design.
- Ray will teach CHEM2411, and make further adjustments/improvements as needed.
- Fujita will assist the D2L management and trouble-shooting.
- Fujita will analyze the ACS Exam scores and the course grades from the Fall 2020 CHEM2411 courses with the new textbook and pedagogy implementation, and compare to the data from the past 5 years.

April 2021

- The team will present the outcomes of the project at the UWG Teaching and Learning Conference.

May 2021

- Geisler and Ray will administer the Student Satisfaction Survey along with the general course evaluation for CHEM3422 and CHEM2411 of Spring 2021.
- Fujita will analyze the CHEM3422 survey and grades data and compare with the data from the last 5 years.
- The team will reflect on the past two semesters and critically assess the impact of the project on student success.

May-June 2021

- Fujita will lead the writing of the final report. The team will submit the final report.

6. Budget

Dr. Partha Ray, $3,333.50

Dr. Victoria Geisler, $3,333.50

Drs. Ray and Geisler will share the responsibility to redesign Organic Chemistry lecture courses based on the new textbook, develop lecture materials, and create D2L online homework problems. They will deliver CHEM2411 courses in Fall 2020 in the new format. Dr. Geisler will deliver CHEM3422 class in the new format in Spring 2021, and Dr. Ray will deliver CHEM2411 with revisions made upon the reflection of Fall 2020.

Dr. Megumi Fujita, $3,333.00

Dr. Fujita will assist creating D2L homework questions and their implementation to D2L. She will troubleshoot and maintain the D2L homework, including creating a common question pool. She will create and administer surveys, and analyze the survey data, course grades, and the ACS exam results. She will be the point of contact with technological support entities, the grant office, and with Affordable Learning Georgia. She will lead the preparation of the abstract submission and presentation for the UWG Teaching and Learning Conference. She will lead the writing of the final report, and repository of developed materials to GALILEO Open Learning Materials.

Solution manual and ChemDraw license, $800

Since the travel fund is no longer needed to attend a face-to-face kick-off meeting, this fund is requested to purchase five copies of Organic Chemistry Study Guide, First Edition, by Ouellette and Rawn (paperback, $91, Elsevier). This book contains solutions to all end-of-chapter problems, and additional study aids. Five copies are requested for two instructors, their SI leader's copies, and one copy to keep in the Department of Chemistry office. $91 x 5 = $455 plus tax plus shipping is requested.

We would like to request the remainder of the $800 fund to help the cost of annual ChemDraw Prime subscription ($1,753). ChemDraw software will be used extensively to create graphics in the D2L quiz questions and other course materials. The Department of Chemistry provides the balance for the subscription.

7. Sustainability Plan

The textbook, Organic Chemistry: Structure, Mechanism, and Synthesis (first edition) by Ouellette and Rawn, is a permanent ebook collection by GALILEO with unlimited access, therefore it will stay accessible for years to come. If some of the contents get old, or if we need to add topics that are not covered in the book, supplemental materials will be created.

The homework quizzes developed on D2L are easily transferable from course to course, semester to semester. We will create a sandbox, a common place to store question pools, and future courses can select questions from the pool.

Other course materials (syllabus, class handouts, powerpoints, etc) will be stored in a common drive and will be shared with all organic chemistry instructors. They will be sorted by the year/semester.

All the developed materials will be deposited to GALILEO Open Learning Depository. Reading Quizzes developed on D2L can be easily exported to the D2L course of another institution upon request.

The preliminary assessment outcomes from Fall 2020 will be presented at the USG Teaching and Learning Conference in April 2021, and more complete assessments of the entire year, and following years will be shared at the American Chemical Society meetings in the Chemical Education division.

Note: Letter of Support