



Affordable Materials Grants, Round 18:
Transformation Grants
(Fall 2020 – Fall 2021)
Proposal Form and Narrative

Applicant and Team Information

Requested information	Answer
Institution(s)	Georgia State University
Applicant name	Dr. Antara Dutta
Applicant email	adutta@gsu.edu
Applicant position/title	Associate Professor
Submitter name	Glenn Pfeifer
Submitter email	gpfeifer@gsu.edu
Submitter position/title	Director, Grants Development and Administration

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.

Team member	Name	Email address
Team member 1	Dr. Antara Dutta	adutta@gsu.edu
Team member 2	Dr. Maher Atteya	matteya@gsu.edu
Team member 3	Dr. Jose Gonzalez-Roman	Jgonzalezroman1@gsu.edu
Team member 4	Dr. Ahmed Abdullah Baosman	abaosman@gsu.edu
Team member 5	Dr. Mike Nelson	mnelson38@gsu.edu
Team member 6	Mary Ann Cullen	mcullen@gsu.edu

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

Jeremy Speed-Schwartz, jspeedschwartz@gsu.edu

Project Information

Requested information	Answer
<p>Priority Category / Categories</p> <p><i>Projects in these categories will receive three extra points in the final score for fitting a priority of these particular rounds of Transformation Grants. The type of funding for the project is determined by the funding categories criteria above. As of Round 18, projects can be a part of more than one category. Note that the below categories only indicate priority, not which applications qualify for a grant. Select all that apply.</i></p>	<p>Priority categories:</p> <ul style="list-style-type: none"> • Collaborative Projects with Professional Support
<p>Requested Total Amount of Funding</p> <p><i>\$30,000 maximum total award per grant</i></p>	<p>\$30,000.00</p>
<p>Final Semester of Project</p>	<p>Fall 2021</p>
<p>Using OpenStax Textbook?</p> <p><i>This is to indicate to OpenStax that they can provide additional support and resources to your team during the adoption process.</i></p>	<p>No</p>

Impact Data

Please fill in the data below with impact data in below with *one course taught by one instructor* in each table, and only include courses and instructors that are specifically part of the scope of this grant proposal. Add or remove tables as needed. **Please only put a single averaged or totaled (as appropriate) number in each box. Do not put ranges or mathematical equations in any of these boxes.**

For a multi-course project, if a significant amount of students are assumed to take courses in a sequence and only one textbook is used for these courses, please take this into account in your total (*i.e. only include that book in the first course they would purchase it for OR adjust the number of students affected. Please explain in the notes section if making such adjustments*).

Course 1

Row #	Requested information	Answer
N/A	Course title and number	Principles of Chemistry I & CHEM 1211
N/A	Course instructor	Dr. Antara Dutta
1	Average number of students enrolled per section	35
2	Average number of affected course sections scheduled in a summer semester	1
3	Average number of affected course sections scheduled in a fall semester	2
4	Average number of affected course sections scheduled in a spring semester	2
5	Total number of course	5

Row #	Requested information	Answer
	sections scheduled in an academic year <i>Add up rows 2-4.</i>	
6	Total number of student section enrollments per academic year <i>Multiply row 1 and row 5.</i>	175
7	Original <u>required</u> commercial materials <i>Include each title, author, price for a new copy purchased from either your campus bookstore, the publisher, or Amazon, and a URL to the book showing the price.</i>	Chemistry By Zumdahl 10 th ed. \$220.00 https://www.bkstr.com/georgiastatestore/search/keyword/Zumdahl
8	Original cost per student section enrollment	\$220.00

Row #	Requested information	Answer
	<i>Add up the cost of all materials in row 7.</i>	
9	Average post-project cost per student section enrollment	\$0.0
10	Average post-project savings per student section enrollment <i>Subtract row 9 from row 8.</i>	\$220
11	Projected total annual student savings per academic year <i>Multiply row 10 and row 6.</i>	\$38,500

Course 2

Row #	Requested information	Answer
N/A	Course title and number	Principles of Chemistry I & CHEM 1211
N/A	Course instructor	Dr. Maher Atteya
1	Average number of students	35

	enrolled per section	
2	Average number of course sections scheduled in a summer semester	1
3	Average number of course sections scheduled in a fall semester	1
4	Average number of course sections scheduled in a spring semester	1
5	Total number of course sections scheduled in an academic year <i>Add up rows 2-4.</i>	3
6	Total number of student section enrollments per academic year <i>Multiply row 1 and row 5.</i>	105
7	<u>Original required</u>	Chemistry By Zumdahl 10 th ed. \$220.00

	<p>commercial materials</p> <p><i>Include each title, author, price for a new copy purchased from either your campus bookstore, the publisher, or Amazon, and a URL to the book showing the price.</i></p>	<p>https://www.bkstr.com/georgiastatestore/search/keyword/Zumdahl</p>
8	<p>Original cost per student section enrollment</p> <p><i>Add up the cost of all materials in row 7.</i></p>	\$220.00
9	<p>Average post-project cost per student section enrollment</p>	\$0.0
10	<p>Average post-project savings per student section enrollment</p> <p><i>Subtract row 9 from row 8.</i></p>	\$220
11	<p>Projected total annual student savings per academic year</p>	\$23,100

	<i>Multiply row 10 and row 6.</i>	
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Course 3

Row #	Requested information	Answer
N/A	Course title and number	Principles of Chemistry I & CHEM 1211
N/A	Course instructor	Dr. Ahmed A. Baosman
1	Average number of students enrolled per section	35
2	Average number of course sections scheduled in a summer semester	0
3	Average number of course sections scheduled in a fall semester	1
4	Average number of course sections scheduled in a spring semester	1
5	Total number of course sections	2

	<p>scheduled in an academic year</p> <p><i>Add up rows 2-4.</i></p>	
6	<p>Total number of student section enrollments per academic year</p> <p><i>Multiply row 1 and row 5.</i></p>	70
7	<p>Original <u>required</u> commercial materials</p> <p><i>Include each title, author, price for a new copy purchased from either your campus bookstore, the publisher, or Amazon, and a URL to the book showing the price.</i></p>	<p>Chemistry By Zumdahl 10th ed.</p> <p>\$220.00</p> <p>https://www.bkstr.com/georgiastatestore/search/keyword/Zumdahl</p>
8	<p>Original cost per student section enrollment</p> <p><i>Add up the cost of all materials in row 7.</i></p>	\$220.00
9	<p>Average post-project cost per student</p>	\$0.0

	section enrollment	
10	Average post-project savings per student section enrollment <i>Subtract row 9 from row 8.</i>	\$220
11	Projected total annual student savings per academic year <i>Multiply row 10 and row 6.</i>	\$15,400

Course 4

Row #	Requested information	Answer
N/A	Course title and number	Principles of Chemistry I & CHEM 1211
N/A	Course instructor	Dr. Jose Gonzalez-Roman
1	Average number of students enrolled per section	35
2	Average number of course sections scheduled in a summer semester	1
3	Average number of	2

	course sections scheduled in a fall semester	
4	Average number of course sections scheduled in a spring semester	2
5	Total number of course sections scheduled in an academic year <i>Add up rows 2-4.</i>	5
6	Total number of student section enrollments per academic year <i>Multiply row 1 and row 5.</i>	175
7	Original <u>required</u> commercial materials <i>Include each title, author, price for a new copy purchased from either your campus bookstore, the publisher, or Amazon, and a URL to the</i>	Chemistry By Zumdahl 10 th ed. \$220.00 https://www.bkstr.com/georgiastatestore/search/keyword/Zumdahl

	<i>book showing the price.</i>	
8	Original cost per student section enrollment <i>Add up the cost of all materials in row 7.</i>	\$220.00
9	Average post-project cost per student section enrollment	\$0.0
10	Average post-project savings per student section enrollment <i>Subtract row 9 from row 8.</i>	\$220
11	Projected total annual student savings per academic year <i>Multiply row 10 and row 6.</i>	\$38,500

Narrative

1. Project Goals

OVERREACHING GOAL:

Develop a supplementary digital textbook for students taking Principles of Chemistry I course which supports the tenets recommended by Vision and Change to integrate core concepts and competencies throughout the curriculum, focus on student-centered learning for all students and

employ relevant, interactive, effective, collaborative, outcome-oriented, engaging learning materials.

SPECIFIC GOALS:

1. Identify student learning outcomes from each chapter content, keep students engaged through different learning activities (active learning).
2. Assign homework questions based on the learning objectives, encourage collaborative work through group questions and various different types.
3. Include glossary terms, sample questions/answers, sample problems, self-assessment test within each module and topic commonly taught in the course.
4. Include feedback for the interactive quiz section in each module. Students will get a clear explanation on their work as well as they will be able to comment on peer's responses.
5. Arrange the difficulty level of questions in such a way to help students from novice learner to more intermediate and advanced level.
6. Improve course retention and student success by making the content available at a very low cost to zero expense.
7. Improve accessibility for the students by making the content accessible on standalone web version satisfying standard requirement of accessible content.
8. Improve learning ability of students with disability issues by adding appropriate features in the digital textbook.
9. Improve students' attitudes (Survey results) of the relevance and importance of Chemistry in everyday life.
10. Ensure that the course, learning outcomes and assignments adhere to the philosophy of transparency in teaching and learning.
11. Provide the entire content online so students can download the materials on their mobile devices.
12. Provide self-paced and self-controlled learner oriented, personalized space so that students can make decisions regarding their learning.
13. Disseminate the resources and results of this project at a state-wide meeting (Georgia Academy of Science Spring 2022) and national meeting (ACS National Meeting).
14. Publish the materials as completely free Open resource materials for Principles of Chemistry I students.

2. Statement of Transformation

VISION AND CHANGE IN UNDERGRADUATE EDUCATION:

The student population at access institutions is drastically changing year after year. The current generation of students prefers to get information on the go, not at the designated time and any specific part of the day. In their busy multitasking lives, students need knowledge in a different format, in terms of imagination, visualization, practice and mastery. Unfortunately, change is not easy and although change is occurring, it is occurring slowly and in isolated pockets. In a traditionally taught classroom, students are encouraged to follow the textbook but sometimes they get frustrated when a new edition is published. When new editions are published, students are unable to sell back their books. Often the new editions are still missing the crucial linkage

between the original course materials. Coming from a minimum-science background, it is difficult for the students to grasp content materials if the concept is incomplete, presented in a complex way and if the flow of the material is disconnected.

Another big obstacle for student success is the modern expensive higher education system. Tuition costs aren't the only thing driving up the cost of higher education. Textbook prices have skyrocketed in recent years. Since 2006, the cost of a college textbook has increased by 73 percent or more than four times the rate of inflation — according to a new report from the non-profit Student PIRGs (Public Interest Research Groups). It's not uncommon for an individual book to cost more than \$200, and some have price tags that go as high as \$400, the report said. At access institutions many students cannot afford to have a textbook and therefore they fall behind in class due to lack of a standard reference to understand the concept and gain the mastery of the content materials.

Today we find that institutions are gradually shifting from publisher-produced printed or electronic format materials to creating and adopting Open Educational Resources (OERs). OERs are materials that are openly licensed, giving users the legal permission to retain, reuse, revise, remix, and redistribute the material (Wiley, 2017). OERs range from comprehensive materials such as curriculum and textbooks to individual videos, syllabi, lecture notes, and tests. Emerging research finds that students using OERs are no worse in course performance than those using costly printed materials (Lane Fischer, 2015). In a non-experimental case study, Hilton and Laman (Feldstein, 2012) compared the performance of 690 students using an open textbook in an introductory psychology class to the performance of 370 students who used a traditional textbook in a previous semester. They concluded that students who used the open textbook achieved better grades in the course, had a lower withdrawal rate, and scored better on the final examination.

Some of the advantages of using OER include:

Expanded access to learning. Students anywhere in the world can access OERs at any time, and they can access the material repeatedly.

Scalability. OERs are easy to distribute widely with little or no cost.

Augmentation of class materials. OERs can supplement textbooks and lectures where deficiencies in information are evident.

Enhancement of regular course content. For example, multimedia material such as videos can accompany text. Presenting information in multiple formats may help students to more easily learn the material being taught.

Quick circulation. Information may be disseminated rapidly (especially when compared to information published in textbooks or journals, which may take months or even years to become available). Quick availability of material may increase the timeliness and/or relevance of the material being presented.

Showcasing of innovation and talent. A wide audience may learn of faculty research interests and expertise. Potential students and donors may be impressed, and student and faculty recruitment efforts may be enhanced.

Ties for alumni. OERs provide an excellent way for alumni to stay connected to the institution and continue with a program of lifelong learning.

Continually improved resources. Unlike textbooks and other static sources of information, OERs can be improved quickly through direct editing by users or through solicitation and incorporation of user feedback. Instructors can take an existing OER, adapt it for a class, and make the modified OER available for others to use.

The objective of this project is to prepare an open source free resource for the science major students who are taking college level Principles of Chemistry I course. All students who are STEM majors and students who are pre - health majors must take this course. The name of this course is called in some colleges and universities “Principles of Chemistry” and in major universities is called “General Chemistry”. The course is taught in two - sequence part 1 and 2. Principle Chemistry 1 course is a pre-requisite for the general or principle 2. The corresponding labs are considered as co – requisite. This course is taught in many methods such as Flipped Model method, POGIL (Process Oriented Guided Inquiry Learning) method and in traditional methods.

The Flipped Model and POGIL methods are more effective since they incorporate different ways of interactive studies such as case studies, open ended inquires and problem-based inquiries. Topics to be covered include composition of matter, stoichiometry, gas laws and behaviors, periodic relations, and nomenclature. Laboratory exercises supplement the lecture material. The first course in a two-semester sequence covering the fundamental principles and applications of modern chemistry for science majors.

The students registering for this course come from a minimum-science background from high school and often get overwhelmed with college-level textbook materials, impeding their critical thinking and problem solving skills. The goal of the digital course content developed in this project is to prepare structured course materials with all needed benefits of the regular textbook to assist students in being able to read and understand the material and build up their foundational knowledge. The digital course content will provide them with a supplementary resource to help in improving their performance. The content will also include engaging learning activities tied to visual diagrams, simulations, videos and interactive quizzes that would exemplify core concepts, and introduce and reinforce competencies (Junco, 2015). Since the students enrolled in this course are primarily from minimum-science backgrounds, a high level of visual content of the concept with real life examples will be implemented in concept building. The final outcome of this project is to develop a full OER textbook and make it available as open source free materials to the students anywhere and everywhere.

ACCESSIBILITY & DISABILITY IN MODERN EDUCATION

Accessibility refers to the use of a product, service, framework or resource in an efficient, effective and satisfying way by people with different abilities. Functional diversity is a key issue in the development of any online resource, including OER, since it is potentially focused on almost every single user. The approach has moved from special needs users (essentially, those with motor, cognitive or sensorial impairments) through accessibility (improving specific issues to facilitate a better user experience) to functional diversity and e-inclusion (of any feature of any user who requires additional support, like the ones associated with elderly or those on sick leave).

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The number of special needs students is rapidly increasing worldwide, but many schools and universities have failed to keep up with their learning needs. Consequently, large numbers of special needs students are dropping out of school or university. Open Educational Resources (OER) contains several relevant features, including the possibility of reusing and remixing, which have led researchers to consider using OERs to facilitate meeting the needs of the special needs and functional-diverse students in order to increase their accessibility and e-inclusion capabilities in educational settings. The very limited research to date, however, has provided a limited holistic understanding of accessibility within OERs in order to aid researchers in pursuing future directions in this field.

A study has been conducted that found that the impact of affordable materials had a larger impact on disadvantaged students, indicating that they succeeded in equalizing the opportunity for success for those students. Such as: Colvard, N., Watson, E., and Park, H. (2018). "The Impact of Open Educational Resources on Various Student Success Metrics." International Journal of Teaching and Learning in Higher Education.

This project is sought to answer the following research questions:

R1: Does the use of free/open education resources have an economic effect on students?

R2: Does the use of free/open education resources influence student satisfaction?

R3: Does the use of free/open education resources influence students' retention and performance?

R4: What are the effects of free/open education resources on faculty subject matter experts?

R5: What are the effects of free/open education resources on instructional designers?

R6: Do the use of embedded visual activities such simulations, videos and interactive quizzes within the OERs have substantial impact of students' retention and performance?

STAKEHOLDERS

Students are the central stakeholders in this endeavor. Principles of Chemistry I course is the first science course in Area "D" for any undergraduate STEM major student. Having a strong foundational chemical knowledge can increase the likelihood that a student is successful. It is essential to engage students in relevant curriculum, ensure the development of foundational skills and grow scientific literacy.

Faculty teaching the course are also stakeholders as is the institution offering the course. Faculty outside the discipline are also stakeholders. Since the broadly based skills acquired in these foundational, general educational courses are needed by students to complete upper level courses in other science major courses.

Georgia and society, in general, are stakeholders in the success of students in this course and their solid understanding of science. These students may not become chemists or teachers but need a foundational understanding of science to be productive, knowledgeable and contributing members of society.

IMPACT ON STAKEHOLDERS AND COURSE SUCCESS

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Impact on Students:

1. Financial: Standard textbooks are very expensive and unaffordable to many students. Typically, college bookstores do not buy the used access codes for online resources that often accompany the standard textbook. As a result, students do not receive very much of a refund for their used textbooks. This supplementary textbook will be completely free of cost and available to the students online, anywhere and everywhere.
2. Skill Development: Foundational skills (graphing, critical thinking, cognitive knowledge, effective comprehension) that will be introduced and developed in this course will not only serve the students throughout their time in higher education but throughout their careers, as these skills are frequently cited to be important to employers.
3. Science literacy/relevance: The importance of science and technology in today's world is indisputable. Students will have a better understanding of science and technology at the completion of this course.
4. Retention and performance of students will be enhanced and improved since the eBook is available to them anywhere and everywhere at no cost with all interactive and visual tools and activities
5. The number of STEM major students will increase since the major obstacle of finding the funds to buy traditional textbooks is eliminated. In addition, the many embedded visual and interactive tools and activities will attract them more and these tools will be very appealing to them as well.

Impact on Faculty:

1. Faculty will be able to use the materials as they are or customize the materials to suit their own learning objectives of the course.
2. Faculty will be provided with access to the 24/7 helpdesk by WPLMS to resolve any technical issue.
3. Implementation of this digital textbook may encourage faculty to implement these practices in other chemistry courses and even pursuing the writing their own OERs in the future.

Impact on the Institution:

1. Successful implementation should lead to increased student success and higher retention in the course.
2. A positive experience in the course may lead some students to excel in the STEM pathway. Successful implementation of the digital textbook would potentially increase the number of students in the STEM pathway.
3. The proposed digital textbook would align the college's curriculum with the current expectations.

Impact on the State:

1. Georgia would have a more Science (Chemistry) literate citizenry.
2. Graduates will have stronger workforce-required skills.

IMPACT ON THE COURSE, PROGRAM, DEPARTMENT, INSTITUTIONS, ACCESS INSTITUTION, AND/OR MULTIPLE COURSES:

The potential impact of this digital textbook as envisioned could be significant. At the course level, this digital textbook could increase engagement, student success and retention. The Principles of Chemistry I course serves as a general education science requirement for a large number of students. These students may decide to matriculate in a science major if they enjoy and are successful in this course. The department and institution will benefit from increased retention and student success. Although all students benefit from active learning strategies, students with academic deficits exhibit the greatest academic gains when these strategies are introduced into the curriculum. The skills acquired in this course will lay the foundation for future courses. Students will learn how to be better students and move from novice learners to intermediate learners which will benefit faculty teaching these students in other courses.

3. Action Plan

THE IDENTIFICATION, SELECTION, ADOPTION/ADAPTION/CREATION, AND REVIEWS OF THE NEW COURSE MATERIALS:

Principles of Chemistry I course (CHEM 1211) is the first year freshman course for STEM majors students at Perimeter College-GSU. Historically, this is one of the highest enrollment courses offered at Perimeter College-GSU with more than one thousand students registering per academic year. But success in this course has always been challenging because of the vast content and variation in the nature of the content. Studies from the last five years show that the withdrawal rate is as high as 15% and enrollment has dropped in the last couple of semesters drastically. Here is the % success and withdrawal results from the last five years with each individual academic year.

CHEM 1211	Total Enrollment	% ABCs	%W
Fall 2016-Summer 2017	1577	60.7	14.8
Fall 2017-Summer 2018	1263	68.1	12.8
Fall 2018-Summer 2019	997	65.7	12.9
Fall 2019-Summer 2020	880	71.4	14.6

From the above data, it is evident that withdrawal rate in this course reached at a record high 14.6% in the last five years of all the courses taught at Perimeter College-GSU.

A significant percentage of students enrolled in the Principles of Chemistry courses are attending classes without the critical aid of a textbook. The traditional textbook used at Perimeter College-GSU for this course costs more than \$200. Students are consistent in their complaints about the high cost of the required textbook and have decided to try the courses without its purchase. Consequently, an increasing percent of students in these courses are under-performing. This decline in academic performance negatively impacts students' morale and causes them to give up, submitting to underachievement and stagnation in career aspiration. Many students are surviving by meager means even after governmental support and student loans. It would be ideal if there were more affordable ways for students to obtain the materials that would enable them to perform better in these courses. Such materials are becoming increasingly abundant online and

readily available to students. Several institutional research and investigations show that students rank OERs as #1 on their wish list for instructors' use of technology.

As the costs of textbooks continue to rise, students are avoiding buying a book more than before and looking for more free online resources. This project will endeavor to create modules that are fully online and free of cost. With the current academic year student population, this digital textbook can save students more than \$200,000 if it is completely adopted all across the Perimeter College-GSU campus.

OER Textbooks have also been very effective in case of students learning and student success at various other institution. An article (Colvert, 2018) reports the results of a large-scale study (21,822 students) regarding the impact of course-level faculty adoption of Open Educational Resources (OER). Results indicate that OER adoption does much more than simply save students money and address student debt concerns. OER improve end-of-course grades and decrease DFW (D, F, and Withdrawal letter grades) rates for all students. They also improve course grades at greater rates and decrease DFW rates at greater rates for Pell recipient students, part-time students, and populations historically underserved by higher education. OER address affordability, completion, attainment gap concerns, and learning. These findings contribute to a broadening perception of the value of OERs and their relevance to the great challenges facing higher education today. Below are some results.

Percent Student Grade Distribution Data for All Students Enrolled in non-OER and OER Courses.

Grade	Non OER	OER
A,A+, A-, B, B+, B- C, C+, C-	88.24	91.8
DFW	10.87	8.19

I. TOPIC IDENTIFICATION & SELECTION:

Topics for Principles of Chemistry I (CHEM 1211) are fairly standard. However, the pedagogical approach can vary widely. The textbook was created after consulting with the following:

- A) Topic Review of major standard textbooks
- B) Topic Review from campuses within Institution taught
- C) Syllabus solicitation from colleagues

II. DESIGN:

Concepts are discussed in QA based format for students to focus on the key materials. All the numerical problems and additional questions are solved following the current textbook Chemistry 10th ed. by Zumdahl used in this course. For homework and self-assessment tests, a reference textbook Zumdahl Atoms first and (Chemistry by OpenStax) are used. A variety of other visual contents and questions are developed or collected from standard available web resources.

1. Course Topics

- A) Essential Ideas
- B) Atoms, Molecules & Ions
- C) Composition of Substances & Solutions
- D) Stoichiometry of Chemical Reactions
- E) Thermochemistry
- F) Electronic Structure & Periodic Properties of Elements
- G) Chemical Bonding & Molecular Geometry
- H) Advanced Theories of Covalent Bonding
- I) Gases

2. Module Structure

Module: Essential Ideas

- A) Learning Objectives
- B) Explain the concept, supplement with free simulation or/and video
- C) Sample questions and answers related to the topic
- D) Worked out solutions to the problems
- E) End of Chapter Self-Assessment Quiz

III. DELIVERY

The design of the syllabus will be still at the discretion of the instructor.

As a broad, general science course, Principles of Chemistry I (CHEM 1211) has been taught chapter by chapter starting with a brief history and definition of Chemistry and the scientific method. Often chemistry has been taught in chunks and it has been left up to the students to connect the chunks. Unfortunately, those connections are not always obvious to the students. Faculty, as expert learners, frequently are unaware that their novice learning students are not “getting it”. Shifting from stoichiometry to thermochemistry or electronic structure of atoms to gases is always a challenge for students.

Without any connections that build on previous knowledge, true learning doesn't occur. Learning is easier when the connection is evident and students can build a cognitive knowledge map. Some forms of repetition in which concepts are introduced one week and then reinforced in activities during a succeeding week can be beneficial. Learning requires repetition and repeated exposure to a concept. As a part of the project, team members will explore ways to connect the modules conceptually and repeat the exercises. Different pedagogical approaches to optimize the active learning and integrative conceptual cognitive mapping will be observed. Materials would be circulated within the Chemistry Curriculum Committee for review and comment. Their comments will be used and appropriate revisions considered. Though currently, Zumdahl 10th - edition textbook is the accepted textbook, this OER textbook can be simultaneously used across the campus.

LIBRARIES & INSTRUCTIONAL DESIGNERS: COLLABORATION & INNOVATION

In response to the potential of OERs to reduce barriers to access, increase student achievement, and encourage pedagogical innovation, many academic libraries have taken on the oversight of

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programs that incentivize the adoption of open and affordable course materials on their campuses. Many articles have described local library-coordinated OERs or textbooks affordability incentive programs (Blick & Marcus, 2017; Thomas & Bernhardt, 2018). Many libraries also seek to support OER creation and authorship in addition to OER adoption. Although academic libraries are increasingly taking on responsibility for the promotion, discovery, evaluation, and preservation of open textbooks, library involvement in the creation and publication of open textbooks is still relatively new (Okamoto, 2013). In 2012, SUNY Libraries launched Open SUNY Textbooks in order to promote the creation of open textbooks and establish an infrastructure to support publishing projects (Pitcher, 2014). In 2013, Oregon State University Libraries and Press began collaborating on a similar open textbook publishing program (Sutton & Chadwell, 2014). OER publishing programs enable faculty to create course materials tailored to the needs of their students and showcase their expertise beyond their own institution. These resources can fill the gaps in existing OERs, leading to their adoption elsewhere, which in turn provides opportunities for the authoring faculty to demonstrate far-reaching impact. However, because OERs' creation is more time-consuming than simply adopting existing resources, such programs may need to consider different financial incentives. For example, Kansas University offers up to \$5,000 to faculty who are interested in creating an open textbook ("Open Educational Resources"), an amount that seeks to acknowledge the level of time and effort required.

One of the major challenges faced by OERs and textbook affordability incentive programs is recruiting interested faculty and determining how to best support and reward the considerable work involved in adopting new course materials. Librarians are needed to help the faculty who will write these OERs in understanding licensing information, adopting materials for their classes and providing them with excellent references and links that help them to be successful in their writing endeavor. This process is very crucial in the process of OERs creation. Librarians are an integral part of this project as they continue working to support faculty and instructors through the OERs discovery and selection process.

DIGITAL MEDIA IN MODERN UNIVERSITY

The LMS (Library Management System) has increasingly become an integral part of higher education, especially in the past decade. It would be surprising to find a university that did not provide faculty access to some type of LMS. The most common LMS platforms utilized in higher education today include Blackboard, Moodle, Canvas, Desire2Learn, eCollege, and Sakai, although there are many others. While access to these systems has become more common, the usage of the LMS still varies immensely from university to university and course to course. Much of this depends on the requirements of the institution, administrative oversight, and the training and support available to assist faculty with integrating this type of technology into their classes. While online and hybrid courses may require extensive guidance and support by the librarian and instructional designer because much or all of the content and resources must be in digital form, many traditional courses are now utilizing the LMS course as a central access point for all resources and content as well. This is a positive step for students in that the abundance and variety of multimodal resources that can now be integrated into their courses and accessed so easily can make a big difference in how well students learn and retain information. This is very evident in recent times where the COVID-19 epidemic has forced many universities and colleges

as well as K-12 students to stay home and study from home using virtual classes utilizing several online LMS platforms.

Integrating digital media into the curriculum is a good instructional strategy that can make a huge impact on student learning in higher education. This media format is growing exponentially, creating ample opportunity for university faculty to integrate these resources to increase student attention, engagement, and learning. All of us are exposed to a wide variety of digital media daily. One Google search can bring thousands, even millions, of results that can then be sorted by media types, including websites, images, videos, and more. A report by the Nellie Foundation asserts, “Computer technology and digital media have fundamentally transformed all aspects of our lives, and many education reformers agree that it can and must be an important part of our current efforts to personalize education.” (Eshleman, Moniz & Mann 2016).

Due to the digital media technologies that are now available to the educator, an opportunity has been created for librarians, instructional designers, and faculty to work together to build well-crafted and pedagogically sound courses, thereby meeting a critical need in higher education. With each department bringing its expertise to the table, a powerful pool of knowledge and skills can be used to improve student learning and enhance the student experience.

INTEGRATING THE LIBRARY AND LMS

The connection to service is obvious. The difference may lie in that librarians have historically focused more on issues related to accessing information as a part of the learning process, whereas instructional designers have a greater focus on the arrangement of knowledge or skill building for the associated learner. Both professions also seem to recognize that an iterative process involving research, reflection, and assessment is critical to the vitality of their ongoing initiatives.

One regular occurrence in academia is the need to attend meetings. All campuses have some meetings that are more productive than others. For our purposes, what is being referred to is inclusive of meaningful meetings that involve some form of representation from both the library and the instructional design department. These meetings could be exclusive to those groups or they could be bigger, including other key faculty or departments on campus.

The development of a librarian role is a good first step to develop library resource integration into an LMS course and may be worth a conversation with the university LMS representative.

THE ACTIVITIES EXPECTED FROM EACH TEAM MEMBER AND THEIR ROLE(S):

Credentials of Dr. Antara Dutta:

The PI of this project. Dr. Antara Dutta serves as the Principal Investigator of this project and brings a wealth of prior experience in writing course materials. In 2013-2016 she was the Principle Investigator of an initiative on learning methods and strategies for science major students that was funded by a USG grant. She has also has received two prior textbook transformation grant awards in 2018 and 2020 as PI.

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Dr. Antara Dutta is Associate Professor in Chemistry at Perimeter College-GSU with more than 10 years of experience. Dr. Dutta has a strong philosophy of teaching in which she frequently applies modern technologies in her instruction to motivate and engage students to improve their performance. Dr. Dutta is committed to helping college students develop their full potential in various ways of active learning. Dr. Dutta is constantly engaged in science educational research to improve learning methods and strategies. She is a GSU University senator and dedicated to different University service programs and professional society outreach events in promoting learning and supporting the community. Dr. Dutta completed her Ph.D. in Theoretical Physical Chemistry and worked as post-doctoral researcher at Emory University (2003-2005). She has published work in reputed international journals such as the Journal of Physical Chemistry, Theochem, etc. Dr. Dutta presented her research work on “Develop New Learning Strategies and Materials in CHEM 1151” at the National ACS meeting in 2016. She was the recipient of the Governor’s Teaching Fellow Award in 2016. Dr. Dutta received a prestigious “STAR” fellowship by Perimeter College-GSU and received a “Badge” for excellence in “Mastering Online Teaching”. She is the recipient of two consecutive Textbook transformations awards in 2018 and 2020 respectively.

Credentials of Dr. Mike Nelson:

Dr. Nelson has been teaching at Perimeter College-GSU since 2005. He completed his Ph.D. in Analytical Chemistry at the Georgia Institute of Technology in 1998. He was the recipient of the 1997 Outstanding Teaching Assistant Award. Dr. Nelson worked in the Pharmaceutical Industry and the Microelectronics Industry before beginning his career as a full time chemistry instructor at Perimeter College-GSU. He received the 2012 GPC Alumni Association Outstanding Faculty Member of the Year Award and the NISOD 2015 Teaching Excellence Award. Dr. Nelson is currently the Associate Chair for the Physical Sciences Department at Clarkson as well chair for the chemistry curriculum committee.

All four faculty members of this project teach this course on a regular basis either face to face or online.

Credentials of Dr. Maher Atteya:

In 1994, Dr. Maher Atteya received Ph.D. in Applied Chemistry as a major degree and Petroleum Engineering as a minor degree at Colorado School of Mines and in 1990, Dr. Atteya received a Master’s degree in chemistry from Kansas State University in Chemistry. In 1994-1995, he served as a visiting professor at Colorado School of Mines. Dr. Atteya completed his post doctorate 1995-1997 at University of Denver. He received two Distinguished Awards during his post doctorate at University of Denver. Furthermore Dr. Atteya finished the “Diploma” equivalent to a Master’s Degree in Chemical Engineering from Carl Schorlemmer Hochschule (now University of Halle – Germany).

Dr. Atteya has been teaching for more than twenty-one years at Perimeter College-GSU. Dr. Atteya received numerous honors and recognitions throughout his career. Dr. Atteya has developed flipped classroom models for the Survey of Chemistry I lecture. He has also developed an online laboratory for CHEM 1151 course as well as a hybrid model of CHEM 1151 lab. Dr. Atteya wrote lab manuals for General Chemistry 1 lab as well as for General Chemistry 2 lab. Dr. Atteya is the co-advisor of the Perimeter College-GSU Science and Pre-Professional

Chemistry clubs. He has received the NISOD Award for Excellence in Teaching in 2005 and was the recipient of the 2017 Outstanding Senior Faculty Award. In 2018 he again received the NISOD Award for Excellence in Teaching.

Dr. Atteya received the Clark Atlanta University Center of Nano Science and Technology Fellowship for 2-year Colleges. He also received the Emory University PRISM Program Fellowship. In 2007, he received the Governor's Excellent Teacher's Fellowship for the University System of Georgia. Dr. Atteya received a Certificate of Achievement Connecting Teachers and Technology at Georgia Perimeter College-Clarkston Campus in 2009. Also, in 2009, he received the Quality Matter Certification for Online Peer Reviewers. In 2004, Dr. Atteya was an editor of the Central European Science Journal. In the summer of 2020, Dr. Atteya developed with other colleagues an Online Master Template for Survey of Chemistry 1 Lab which will be used for all faculty who are and will be teaching this online lab.

Credentials of Dr. Jose Gonzalez-Roman:

Dr. Jose Luis Gonzalez-Roman graduated with a Bachelor's of Science and a Master of Science in Chemistry from the University of Puerto Rico in 1995 and 1997, respectively. Later, he obtained a Ph.D. in Chemistry from Georgia State University in synthetic organic chemistry in 2002, followed by some post-doctoral work at the same institution. His research interests included the synthesis of oligopeptides and their interactions with nucleic acids and in medicinal chemistry, the design of potential prodrugs against leishmania, the organism responsible for leishmaniasis. His teaching experience includes 23 years of teaching at private and public universities, including 17 years at Georgia State University-Perimeter College. His teaching portfolio includes courses in general, organic and biological chemistry. At GSU PC, he has been teaching chemistry courses online for more than 15 years. He has collaborated in some chemistry education research and has been a member of teams responsible for the design and development of online courses. He has also served in the Faculty Senate.

Credentials of Dr. Ahmed Abdullah Baosman:

Dr. Ahmed A. Baosman holds a Ph.D. in Industrial Chemistry from the University of York, UK and a Post-Doctoral Researcher from Georgia Institute of Technology, Atlanta, Georgia in the year 2002. He is named inventor on several Patents and published numerous articles in international journals with contributions in areas such as Electrochemical Process and Nanotechnology. Dr. Baosman, before joining Georgia State University, was the Vice Chairman and the lead Research and Development Scientist in ECR Technology, Dublin GA and American Enviro-Solution, Atlanta GA. During these period, Dr. Baosman co-developed new and advanced cutting-edge state-of-the art chemical and process technology based on "*Nano-Heterogeneous Catalysis Process*" that was used in commercial application of renewable fuel energy production industry and in the large wastewater and water treatment plants of Georgia and Florida. Dr. Baosman has credit to invent more than 6 U.S. patents for new chemical product development and its application in chemical and process industries.

Credentials of Mary Ann Cullen

Mary Ann Cullen is the Associate Department Head at the University Library's Alpharetta campus. She has a Master of Science in Library Studies from Florida State University and a Master of Science in Psychology from the University of Georgia. Mary Ann has been a librarian

at Perimeter College-GSU for 15 years and has been involved with Open Educational Resource advocacy, advising, and creation since 2014. These affordable resource projects include participating in developing an open textbook for introductory composition (ENGL 1101), which later developed into one of Affordable Learning Georgia's most successful projects in terms of dollars saved to students, and a project for geology and astronomy classes that demonstrated effective use of library resources as an affordable alternative to traditional textbooks. She was selected as the Affordable Learning Georgia Featured Advocate for May 2016 and won an Affordable Learning Georgia Textbook Transformation Award in 2015.

She has presented and published about librarian involvement in open education resources collaborations including a poster presentation at the Association of College and Research Libraries (ACRL), a Georgia Library Association Carterette webinar ("Open Educational Resources: Librarians as Advocates, Advisors, and Creators"), and a book chapter ("Accessing Science through an Online Database: A Comparison of Student Learning and Engagement Using Library Database Readings as a Textbook Alternative" with Dion Stewart and C. Bayard Stringer). She is currently co-editing two upcoming peer-reviewed publications: A Library Trends journal special edition on the topic "OER and the Academic Library" and a book to be published as part of ACRL's Publications in Librarianship series, Intersections of Open Educational Resources and Information Literacy.

Credentials of Jeremy Speed-Schwartz

Jeremy Speed Schwartz is an instructional designer with over a decade of experience in higher education instruction and curriculum design. His career has repeatedly intersected with science communication, and past projects include collaborations with the Ground Water Institute at the University of Memphis, Bradley University's Engineering Department, and NASA's Athena Science Team. His recent work was awarded the Lumen Prize for Artificial Intelligence in art, as well as awards from the Chautauqua Film Festival and the Association Internationale du Film d'Animation. He has presented papers on hands-on-learning and peer-instruction techniques at the Society for Animation Studies, and is currently revising "A New History of Animation" for Thames and Hudson press. Jeremy holds an MFA in Experimental Animation from the California Institute of the Arts.

OER Content Development: PI Dr. Dutta & Collaborators: Drs. Atteya, Gonzalez-Roman & Baosman

All of the project collaborators along with the PI will divide the topics equally. Each of them will be responsible for developing a part of the content (videos, quizzes, homework questions, self-assessment tests). They will also develop concept maps and similar devices for linking module concepts and recommend assessment strategies.

Dr. Dutta will create the course framework and serve as the primary editor for the materials. This digital textbook will be continuously updated. She will serve as the PI with regard to communication with the other faculty and staff partners of this project. Dr. Dutta has credentials in institutional research and she will oversee implementation efforts.

Materials will be provided to the faculty through access to LMS platform of Perimeter College-GSU and WordPress-LMS, resource for open source course materials. Faculty can choose the availability period of any module when the students have free access to them. Faculty will be able to select homework questions and assessment tests from within the various modules based

on the time allotted per module. WordPress-LMS support system will be used in order to control this process.

Materials will be provided to the faculty through a free website:

<https://chemistrylearningbydoing.org>, an online repository for open source course materials.

Faculty can choose the availability period of any module when the students have free access to them. Faculty will be able to select homework questions and assessment test from within various modules based on the time allotted per module.

Project Reviewer: Dr. Michael R. Nelson

Project reviewer is Dr. Mike Nelson; he will be using his expertise and knowledge and fully contributing to panel discussions and producing accurate and substantive evaluations of our digital textbook.

Dr. Nelson is required to make a time commitment to the process for short durations (typically 1 to 2 weeks), confirm compliance with participation requirements, and certify that there are no conflicts of interest.

Librarian: Mary Ann Cullen

These are some of the ways a librarian can assist:

locating similar projects (or verifying there aren't similar projects) as required in the grant application

writing the grant application and/or final report

finding OER/library/freely available materials for the course

preparing/presenting the results at a conference or publication

instruction (in person, written, or other) for students about how to use library materials

organizing materials into a LibGuide or other format – this could be the final product or a working document for the team

advising about OERs in general

Instructional Designer (ID): Jeremy Speed-Schwartz

The ID serves as a learner analyst, instructional innovator, and leader in educational technology to assist instructors in developing teaching materials. With the help of an Instructional Designer, the faculty members will develop a course template using LMS features to help teaching other instructors using this ebook and also developing a standalone Web compatible version of the eText. The instructional designer will be a good resource in the future to create a mobile device-friendly app to access the eText from anywhere and everywhere in this world.

The ideal role of the ID is complex and varied, ranging from course development, faculty development, project management, research and evaluation as well as inherent technical skills and knowledge required to undertake those activities.

4. Quantitative and Qualitative Measures

QUALITATIVE MEASURES:

Comparison of Pre-OER and Post-OER student satisfaction will be measured using a pre/post survey design

1. Student's attitudes toward Chemistry: Students will be surveyed at the beginning and at the end of the semester using iCollege (Desire to Learn LMS) Survey tool.
2. Student Focus group: Students will be asked at mid-point and at the end of the semester to respond to a set of questions regarding their perceptions on the efficacy of the course approach and offer constructive criticism.
3. Discussion sessions will be held with peer faculty members to reflect on the improvement and suggestions of this eTextbook.

QUANTITATIVE MEASURES:

Data Collection:

1. Student success data will be gathered through institutional research. ABCD and WF rates will be calculated and compared to previous semesters. The college-wide success rate (students earning an A, B, C for students in the Principles of Chemistry I course is 71.4% in last academic year. 28.6% of the students enrolled in this course earn a D, W or F grade. This DFW rate is exceptionally high for an important science major chemistry course at an access institution. Improving the pass rate profoundly affects the student's chances of making academic progress and remaining in college. Additionally, a significant focus of this digital textbook is to improve student's understanding and literacy in Chemistry with no cost. Although the gains in retention and success is expected, improvements of students' learning are the major goal of this eBook creation.
2. To assess the effectiveness of the book, student usage data (number of login attempts and amount of time spent) will be collected from the publishers group for certain assignments. An engagement index will be created based on this data. Student success rates will be compared with this engagement index.
3. Knowledge development: College-wide nationally standardized final exam average raw scores will be compared with the engagement index to evaluate the effectiveness of this eBook.

5. Timeline

FALL 2020

1. Attend the Kick-Off meeting.
2. Create course framework.
3. Divide and assign topic content development.
4. Meet with team members to touch base.

SPRING 2021

1. Complete review of the materials. Modules, images, fonts, typos will be checked.
2. Create videos, interactive homework questions, self-assessment test.
3. Review images of each module.
4. PI meets with collaborators to review and compare each other's materials to ensure consistency.
5. PI meets with librarian to verify the OER information used in ebook.
6. PI meets with instructional designer to plan and structure the digital media.

7. Order any materials needed for activities.
8. Monthly meeting with team members to continue the process of development

SUMMER 2021

1. Work to expand the supplemental electronic textbook to release it as a full Chemistry textbook.
2. Conduct monthly meeting with team members to continue the process of development and ready for implementation.

FALL 2021

1. Use selective modules of the digital textbook across the campus.
2. Administer student skill survey, attitude survey in the first week of classes.
3. At midpoint, administer student perception of course survey.
4. At midpoint, contact the Office of Institutional Research to discuss data fields to be collected.
5. At the end of the semester, administer student skill survey, attitude survey, and student perception of course survey.
6. Work toward the completion of the Chemistry textbook.
7. Send completed materials to the Chemistry Curriculum Committee for review. The review of the materials may extend into spring 2022.
8. Conduct monthly meetings with team members to complete the creation, discuss the results and any further changes required.

SPRING 2022

1. Complete final report in January, 2022.
2. Discuss with team members to close the loop and future plan.
3. Review students' feedback and make changes as appropriate.
4. Collect comments from curriculum committee and make changes as appropriate.
5. Disseminate the information and findings to colleagues.
6. Present at local conference and national meetings.

6. Budget

Personnel

Dr. Antara will receive \$3,703 in salary buyout during the Spring 2021 semester plus \$1,297 in fringe benefits = \$5,000. The three full-time faculty team members will receive \$3,703 in summer salary plus \$1,297 in fringe benefits for a total of \$5,000 per faculty member = \$15,000.

The librarian and IT specialist are 12-month employees and will receive \$1,000 in salary buyout plus \$350 in fringe benefits for a total of \$1,350 per person. 2 team members X \$1,350 each = \$2,700

TOTAL PERSONNEL = \$22,700

Travel

The team members request travel funds to attend two local conferences (Teaching matters in spring'21 & 1 RoTL Summit fall'21) This enables the team members to obtain additional expertise on OERs and to build a network of people with shared objectives on OER textbooks. The team members have lot to share with others as they have been engaged in this research since last three years (2018-present). 7 team members x \$200 each for travel x 2 conferences = \$2,800

In addition, the PI request funds to attend the National ACS Meeting in 2021: 1 PI: \$1,000 (including airfare, lodging and meals)

TOTAL TRAVEL = \$3,800

Supplies

Funds are requested for miscellaneous supplies for each PI such as flash drive, stylus pen etc.: \$100 per faculty X 7 team members = \$700.

TOTAL SUPPLIES = \$700

Other

Conference registration fees for the faculty members to attend local conferences and for the PI to attend the regional or national conference. 8 conference registration x \$350 each = \$2,800.

TOTAL OTHER COSTS = \$2,800

TOTAL REQUEST = \$30,000

7. Sustainability Plan

Though this proposal is presented as a supplemental book for a science major course, the ultimate goal is to give it the shape of a full textbook, making it interactive, explanatory and with collaborative learning activities. The following developing strategies will be incorporated in developing the full text.

- 1) **Questions and responses:** Questions and responses are the most fundamental and important activities in education, and a great way to grasp the understanding level of each student on specific learning contents. This digital textbook, therefore, would have the facility to support them, in particular instructor's questions and students' reactions, and to collect and manage the data relative to questions and answers on further steps.
- 2) **Monitoring students based on learning data:** To grasp students' understanding and to provide feedback, instructors should monitor student learning activity data. Learning data is a highly meaningful resource to observe and document learning behaviors.

- 3) **Assessment:** Another factor of digital textbooks is the ability to support assessment. There are many alternatives to traditional assessment types that can be used to broaden the scope of the teacher's classroom assessment activities. The typical techniques of the alternatives are self, portfolio, and peer assessment. The next generation of digital textbooks should support alternatives as well as traditional types of assessment.
- 4) **Experimental learning and learning by doing:** Involving students with in-class activities is a pedagogical method intended to promote active learning. This digital textbook should support the creation of various activity-based objects for experimental learning or learning by doing. This is the facility that paperback books can never provide. Digital books should incorporate a variety of learning activities and cloud-based resources such as immersive simulation environments for practice, collaborative/individual homework, and adaptive testing and assessments.
- 5) **Including some functionalities of learning management system (LMS) and course management system (CrMS):** This digital textbook will not be restricted to duplication of the printed page on a digital device, and will be able to provide more types of learning contents and digital tools. It will include many functionalities of iCollege at our current institution.

The course is offered every semester. The modular nature of the materials will facilitate the maintenance and updating of the course materials. Dr. Dutta will assume that responsibility as a service to the college.

In the future, more course sections will be included if improvement in student success is demonstrated by the use of the digital textbook. Future plans are to expand this supplementary textbook into a full textbook and use it college-wide for free.

Discussion sessions will be held with peer faculty members to reflect on the improvement and suggestions of this eText. Their valuable suggestions will be incorporated to improve the quality of the textbook.

The materials and results of this project will be presented at the Georgia Academy of Science Spring 2022 Meeting and the 2022 ACS National Meeting.

Dr. Glenn Nomura, Chair of Physical Science, Dunwoody, Associate Dean of Science Dr. Paulos Yohannes and Dr. Mike Nelson, Chair of Chemistry Curriculum Committee have given their assurance that the college will support this initiative.

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Dr. Solomon Fesseha

Chair, Physical Sciences

Dr. Paulos Yohannes

Associate Dean of Science, Perimeter GSU

Grants or Business Office Letter of Acknowledgment

Please provide the name and title of the grants or business office representative who provided you with the Letter of Acknowledgment.

Glenn Pfeifer

Director, Grants Development and Administration