Teaching Innovation Grant Application
Cover Sheet

Instructor Team Information

Primary Investigator/ Representative for Instructor Team

Last Name	First Name	Department
Villalta-Cerdas	Adrian	Chemistry

Email	Sam ID
axv067@shsu.edu	000642286

Participated in: ☐ ACUE ☐ FLC ☒ Engaging Exploration ☒ Writing in the Disciplines

☒ TIG Grant ☒ EL Fellowship ☒ Odyssey Grant ☒ Other TLC Activities ☐ ECO

Instructor 2

Last Name	First Name	Department
Haines	Donovan	Chemistry

Email	Sam ID
dch009@shsu.edu	000390846

Participated in: ☒ ACUE ☐ FLC ☒ Engaging Exploration ☒ Writing in the Disciplines

☒ TIG Grant ☐ EL Fellowship ☐ Odyssey Grant ☐ Other TLC Activities ☐ ECO

Instructor 3

Last Name	First Name	Department
Gross	Dustin	Chemistry

Email	Sam ID
deg013@shsu.edu	000501367

Participated in: ☒ ACUE ☐ FLC ☒ Engaging Exploration ☐ Writing in the Disciplines

☐ TIG Grant ☒ EL Fellowship ☐ Odyssey Grant ☒ Other TLC Activities ☒ ECO

Instructor 4

Last Name	First Name	Department
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Email	Sam ID

Participated in: ☐ ACUE ☐ FLC ☐ Engaging Exploration ☐ Writing in the Disciplines

☐ TIG Grant ☐ EL Fellowship ☐ Odyssey Grant ☐ Other TLC Activities ☐ ECO

Instructor 5

Last Name	First Name	Department

Email	Sam ID

Participated in: ▯ ACUE ▯ FLC ▯ Engaging Exploration ▯ Writing in the Disciplines

▯ TIG Grant ▯ EL Fellowship ▯ Odyssey Grant ▯ Other TLC Activities ▯ ECO

Approvals

In submitting this proposal, the Primary Investigatory / Representative for the Instructor Team verifies that the proposal has been approved by the undersigned and that relevant scheduling and support considerations have been discussed.

Primary Investigator/Representative for Instructor Team:

Print Name: Villalta-Cerdas, Adrian Date: 11/18/2024

Signature: Adrian Villalta-Cerdas

Department Chair:

Print Name: Haines, Donovan Date: 11-19-24

Signature:

Dean:

Print Name: Holt, Melinda Date: 11-19-24

Signature: Melinda Holt

Proposal Title:

Cultivating Resilience in General Chemistry I: Supplemental Instruction to Promote Growth Mindset and Self-Efficacy

Proposal summary (150 words maximum):

This project aims to enhance student success in General Chemistry I by integrating growth mindset principles and fostering chemistry self-efficacy, addressing high DFW rates in this course. Serving approximately 350 students per semester, the project aligns with institutional goals to increase STEM retention and success. The team will develop new materials, including videos featuring students and faculty discussing personal challenges and successes in learning chemistry, alongside resources introducing neuroplasticity and effective chemistry-specific study techniques. Semi-structured Supplemental Instruction (SI) sessions will guide students through key strategies and provide weekly problem sets aligned with course content, facilitating practical application in a supportive environment. By examining how these sessions mitigate known achievement gaps and enhance learning outcomes, the project will inform best practices for curriculum design and instructional strategies in chemistry education, ultimately contributing to a more resilient and successful STEM community.

High-Impact Practices (HIP) checklist

Check all that apply. Applicants are urged to contact the TLC with any questions related to incorporation of HIPs in their proposal.

☐ Collaborative learning
☐ Project-based learning
☐ Improvement/development of a writing intensive course, writing-to-learn
☐ Service learning, or community-based learning
☐ Undergraduate scholarship
☐ Capstone experiences
☐ First-year and transitional experiences
☒ Curriculum improvement
☐ Learning communities and linking of courses
☐ Online course design/improvement
☒ Incorporating critical thinking
☒ Active learning-course redesign
☐ Competency-based course design
☒ Retrieval practice
☒ Interleaving
☒ Student metacognition
☐ Other Click or tap here to enter text.

HIPs generally:

- Involve a greater student investment of time, effort, and purposeful attention to learning.
- Allow students to interact with instructors, staff, and peers concerning substantive matters, and build sustained, substantive relationships.
- Allow students to experience diversity and engage people across their differences.
- Involve a student-centered approach to the curriculum or development of competencies.
- Involve frequent and substantive feedback for students.
- Provide opportunities for students to discover the relevance of, and apply, integrate and synthesize knowledge gained in and out of the classroom within the context of real-world applications and new situations.
- Provide the opportunity for students to be meta-cognitive and reflect on their experiences and the person they are becoming.

Resources

Resources to assist you in development of your plan:

- Course Transformation Guide from Carl Wieman Science Education Initiative at the University of British Columbia - http://www.cwsei.ubc.ca/resources/instructor_guidance.htm
- Impact of faculty development reports, Association of College and University Educators - https://acue.org/impact-reports/
- Description of some HIPs from AACU - http://www.aacu.org/leap/hips
- Summary of the excellent *Make It Stick*, from Belknap Press (2014) - https://onlinelearninginsights.wordpress.com/2015/07/21/make-your-teaching-stick-with-ideas-from-make-it-stick-the-science-of-successful-learning/

Project Plan

Two to five-page description of the project, including how the educational intervention is related to evidence-based practices (with references), expected instructor and student outcomes, approximate number of students impacted, course(s) and majors impacted, how the intervention fits into the course learning objectives and curriculum of the major, and assessment plan. References will not be included in the five-page limit. If the primary course impacted is hybrid or online, explain how this is related to the intervention, and what components (if any) will be face-to-face and which will be online. This should be provided as a PDF submitted via email to the Teaching & Learning Center (tlc@shsu.edu).

Budget

Brief itemized budget description. Proposals may request $2,000 maximum for each instructor stipend and $3,000+ for supplies, with a maximum award of $10,000 per team. can be requested related to books, software, etc.

Budget Justification

PI team stipend: three faculty x $2000**. Total: $6,000.** PI team will organize the undergraduate students and meet over the Spring 2025, Fall 2025, and Spring 2026 semesters. The PI team will also be in charge of disseminating the project's educational outcomes.

Stipend for undergraduates: three students will revise the novel materials created for the project during the Spring 2025 semester (three hours per week for four weeks), and five students will implement the SI sessions during the Fall 2025 and Spring 2026 semesters (two hours of SI sessions + one hour weekly meeting with PI team). The undergraduate students will be selected from the pool of biology, biomedical sciences, chemistry, or forensic chemistry majors that currently work as teaching/research assistants in the Department of Chemistry. The undergraduate students are fundamental to the success of the project.

Spring 2025: Three undergraduate students x $10.00/h x 3 hours/week x 4 weeks = **$360.**

Fall 2025: Five undergraduate students x $10.00/h x 3.0 hours/week x 12 weeks = **$ 1,800.**

Spring 2025: Five undergraduate students x $10.00/h x 3.0 hours/week x 12 weeks = **$ 1,800.**

Undergraduate stipends total = **$3,960.**

Total funds requested for the project: **$9,960.**

Budget Outline

Item / Stipend	Cost per Unit	Quantity	Total Cost	Justification / Purpose
Faculty stipends	$2,000	3	$6,000	PI team will organize the undergraduate students and meet over the Spring and Fall 2025, and Spring 2026 semesters.
Undergraduate student assistant stipends, Spring 2025	--	3	$360	Three undergraduate students x $10.00/h x 3 hours/week x 4 weeks
Undergraduate student assistant stipends, Fall 2025	--	5	$1,800	Five undergraduate students x $10.00/h x 3.0 hours/week x 12 weeks
Undergraduate student assistant stipends, Spring 2026	--	5	$1,800	Five undergraduate students x $10.00/h x 3.0 hours/week x 12 weeks

Grand total: $9,960

Cultivating Resilience in General Chemistry I: Supplemental Instruction to Promote Growth Mindset and Self-Efficacy

1. Project Summary

This project aims to enhance student success in General Chemistry I by integrating growth mindset principles and fostering chemistry self-efficacy, addressing high DFW rates in this course. Serving approximately 350 students per semester, the project aligns with institutional goals to increase STEM retention and success.[1] The team will develop new materials, including videos featuring students and faculty discussing challenges and successes in learning chemistry, alongside resources introducing neuroplasticity and effective chemistry-specific study techniques. Semi-structured Supplemental Instruction (SI) sessions will guide students through key strategies and provide weekly problem sets aligned with course content, facilitating practical application in a supportive environment. STEM students will serve as SI leaders to provide proactive support distinct from traditional reactive and sporadic tutoring. The sessions will be available multiple times weekly, to ensure accessibility, and students will receive credit for attending.

To assess the effectiveness of these SI sessions, the project will measure changes in students' self-efficacy and mindset using the Chemistry Self-Efficacy instrument[2,3] and the Dweck Mindset Instrument.[4,5] The project will evaluate the sessions' influence on academic performance and persistence in chemistry by tracking exam scores and overall course grades, as well as collecting qualitative feedback. By examining how these sessions mitigate known achievement gaps and enhance learning outcomes, the project will inform best practices for curriculum design and instructional strategies in chemistry education, ultimately contributing to a more resilient and successful STEM community.

2. Project Objectives

Objective 1: Create and implement novel learning experiences for General Chemistry I based on growth mindset and self-efficacy principles

The project team will design and implement a series of learning experiences linked to the content covered in General Chemistry I. Aiming to enhance students' self-efficacy and promote a growth mindset—critical factors in academic performance and persistence in STEM fields[3,5,6]—the team will develop new learning materials, including video recordings featuring students and faculty discussing their challenges and successes when learning chemistry. These narratives will provide relatable role models and experiences to strengthen students' self-efficacy. Additional multimedia resources will be incorporated to support discussions on neuroplasticity, growth mindset, and effective learning strategies.

To facilitate these learning experiences, the team will design semi-structured Supplemental Instruction (SI) sessions. Media presentations with clear objectives will introduce effective study techniques specific to chemistry, and weekly problem sets aligned with course content will be developed to enable students to apply these learning strategies and deepen their understanding of key concepts.[5,7] The project also involves coordinating undergraduate SI leaders by recruiting and training them to facilitate the SI sessions. These SI leaders will provide guidance, foster a supportive learning environment, effectively deliver the curriculum, engage students in discussions, and manage course progress. Undergraduate student participation and feedback are essential to the project's success. Engaging students as SI leaders enriches the learning experience and reinforces their understanding and commitment to the subject matter, ultimately contributing to the chemistry program's academic success.[8,9,10]

Objective 2: Evaluate the impact of the SI sessions on student learning and success in General Chemistry I

The project team will lead investigations into the effectiveness of the SI sessions, focusing on their impact on students' self-efficacy, mindset, and academic performance. To evaluate enhanced self-efficacy, we will utilize the Chemistry Self-Efficacy (CSE) instrument[2,3] to measure changes in students' confidence in their ability to learn and perform in chemistry. For assessing the adoption of a growth mindset, the Dweck Mindset Instrument (DMI)[4,5] will be employed to detect shifts toward a growth mindset specific to chemistry, with the anticipated outcome that students will show resilience and a proactive attitude toward challenges while learning chemistry. Improved academic performance will be analyzed by examining exam scores and overall course grades to identify improvements correlated with SI session participation, reflecting the effectiveness of the curriculum.

3. Project Context and Background

High attrition rates present a challenge for the development of a diverse scientific workforce in the United States. Research reveals that over 60% of students entering STEM leave with non-STEM degrees.[5,11,12] Poor performance and negative experiences in gateway courses, such as general chemistry, significantly contribute to this trend.[13]

Students' success in these courses is influenced by self-efficacy—the belief in their ability to perform specific tasks[3]—and their mindset about intelligence and learning.[3,5] Higher self-efficacy is associated with better academic performance, creating a positive feedback loop that enhances confidence. Similarly, students with a growth mindset, believing intelligence can develop through effort and effective strategies, are likely to tackle challenges, persist through setbacks, and perform better academically.[13,14] Studies indicate that interventions targeting self-efficacy and growth mindset can improve students' academic performance and learning attitudes. For instance, implementing chemistry-specific growth mindset modules (GMMs) in first-year courses has shifted students toward a growth mindset, increased chemistry self-efficacy, and boosted performance on standardized assessments.[5,7]

Building on this evidence, we propose to develop supplemental instruction support for general chemistry to enhance chemistry self-efficacy and promote a growth mindset. As a part of this project, we will create a structured curriculum for weekly sessions to help students prepare for chemistry challenges and build effective study habits. A main component of the curriculum will be engaging videos featuring students and faculty sharing personal stories of learning chemistry, discussing challenges they faced, and successful strategies they employed. These videos will provide relatable role models and reinforce growth mindset principles. Unlike reactive tutoring resources, these sessions will provide a structured, proactive approach.

Supplemental instruction will be accessible to all students enrolled in the General Chemistry I course, around 345 (SD=25) students per Fall and Spring semester. Advanced STEM students, hired and trained through project funding, will facilitate the sessions, fostering a supportive learning environment. Sessions will be available multiple times weekly to accommodate varied schedules, including online synchronous options, for a total of ten additional hours of academic support in General Chemistry I. Attendance to the SI sessions will represent 5% of the final course grade for CHEM1411. Students will be required to attend at least 50% of all available sessions (i.e., six sessions on different weeks).

From Fall 2022 to Summer 2024, 1221 students enrolled in General Chemistry I, of which 70.0% were female, 40.5% first generation, 41.8% White, 30.9% Hispanic, and 13.0% African American for a highly diverse student population. Fifty-one different majors took the course, with higher enrollment from forensic chemistry (17.2%), biomedical sciences (16.5%), kinesiology (14.2%), biology (12.7%), and animal science (10.9%). During this period, 62.9% of the students received ABC letter grades, with 15.4% taking the course more than once and 9.4% dropping the class entirely (Q-letter grade).

4. Proposed Work

The initial steps of the project will focus on designing the curriculum for the Supplemental Instruction (SI) sessions, scheduled for implementation in the Fall 2025 and Spring 2026 semesters. This phase involves creating learning materials and resources to enhance students' chemistry self-efficacy and foster a growth mindset.

4.1 Creation of chemistry-specific growth mindset and self-efficacy materials

To create materials tailored specifically for general chemistry students, we will develop a comprehensive set of resources to foster a growth mindset and enhance self-efficacy, building upon research that underscores the effectiveness of domain-specific interventions.[5,16] Central to this initiative is producing new video content, capturing personal narratives from students and faculty at SHSU as they share their experiences, challenges, and achievements in learning chemistry. These stories will be relatable experiences for viewers, providing role models that encourage self-efficacy. The videos will emphasize the growth mindset principles, including the malleability of intelligence in chemistry and the importance of effort, determination, and strategic learning—components of a growth-oriented approach.[14,15] Additionally, to ensure broad relevance and inclusivity, these materials will feature voices from diverse backgrounds and academic levels to resonate with and inspire SHSU's diverse student population.

In addition to these videos, curated multimedia resources such as TED Talks, educational animations, and articles will reinforce neuroplasticity and growth mindset concepts. By incorporating content like "The Power of Belief"[17] TED Talk and using interactive tools and multimedia presentations, we aim to engage various learning styles and foster deeper student engagement with the material.[18] To further support students' success, we will develop presentations on effective learning strategies specific to chemistry, including problem-solving methods, time management, and metacognitive approaches. Each session will have defined learning objectives that align with course content, promoting self-regulated learning and enabling students to apply these techniques directly to their studies.

Finally, these materials will form the basis of semi-structured Supplemental Instruction (SI) sessions that follow a prescribed curriculum designed to provide consistent, proactive support throughout the semester. Rather than solely addressing student-generated questions, these sessions will introduce critical concepts and strategies for mastering chemistry concepts, ensuring students have the skills and mindset necessary for academic success.

4.2 Components and structure of the SI sessions

The SI sessions will be designed to seamlessly integrate growth mindset principles, effective learning strategies, and targeted problem-solving practice, creating a comprehensive support system for general chemistry students.

Growth mindset and self-efficacy sessions will discuss video narratives highlighting student and faculty experiences with learning chemistry. Through these discussions, students will reflect on the challenges and strategies presented, helping them relate to the growth mindset concepts on a personal level. Following this, interactive reflection exercises will allow students to articulate their perceptions of intelligence in chemistry and explore how they can apply growth mindset principles to their learning.

Learning strategies sessions will feature media presentations introducing practical study techniques specific to chemistry. These strategies enhance learning and build skills, including interpreting chemical equations, understanding periodic trends, and applying effective problem-solving techniques. Students will gain valuable skills they can use throughout their studies by directly connecting these techniques to chemistry content.

Problem-solving sessions will offer students hands-on practice through curriculum-aligned materials from the chemistry faculty. These problem sets will align with the topics covered in lectures, ensuring consistency and relevance. Within this structured environment, students will engage in collaborative learning, interacting with their peers and participating in teamwork, which fosters a supportive learning community that enhances both learning and self-efficacy.

Advanced chemistry students will be recruited and trained as SI leaders to run these sessions. Their roles will include facilitating discussions and activities, guiding students through problem-solving, and serving as mentors who provide academic support and encouragement while modeling a growth mindset. They will also offer constructive feedback, reinforcing students' self-efficacy and building their confidence in chemistry-related tasks. Table 1 presents a proposed schedule for the sessions during the semester.

4.3 Assessment and evaluation

A comprehensive assessment and evaluation approach will be implemented to measure the effectiveness of the SI sessions. Pre- and post-intervention surveys will be used, specifically employing the Dweck Mindset Instrument (DMI)[14] to assess changes in students' mindset beliefs related to chemistry and the Chemistry Self-Efficacy (CSE)[2,3] instrument to evaluate shifts in students' confidence in performing chemistry tasks. Additionally, academic performance will be tracked by analyzing students' test scores in laboratory and lecture settings. This will allow us to identify possible correlations between SI session participation and improved academic outcomes. Finally, qualitative feedback will be gathered from the student reflections and feedback (SRF) survey, providing insights into their experiences with the SI sessions and highlighting areas for further improvement.

Table 1: Proposed plan for SI sessions per semester for General Chemistry I courses.

Week	SI Session Activities	Assessments: surveys*	Assessments: course evaluations
1	First week of classes		
2	Learning strategies session	DMI survey (Pre-test)	
3	Problem-solving Chapter 1 + 2	CSE survey (time 1)	
4	Problem-solving Chapter 2 + 3		
5	Problem-solving Chapter 3 + 4		Lecture Exam #1
6	Growth mindset session #1	DMI survey (Post-test #1)	
7	Problem-solving Chapter 4 + 5		
8	Problem-solving Chapter 5 + 10		Laboratory Exam #1
9	Growth mindset session #2	CSE survey (time 2)	
10	Learning strategies session + Problem-solving Chapter 10 + 6		Lecture Exam #2
11	Problem-solving Chapter 6 + 7		
12	Problem-solving Chapter 7 + 8		
13	Problem-solving Chapter 8+ 9	SRF survey	Laboratory Exam #2
14	University Holiday (no session)		
15	Last week of classes (no session)	DMI survey (delayed post-test) CSE survey (time 3)	Lecture Exam #3
16	Final exams week		Final Exam Final Course Grade

* DMI: Dweck Mindset Instrument; CSE: chemistry self-efficacy instrument; SRF: student reflections and feedback survey.

5. Management team

Dr. Adrian Villalta-Cerdas (PI), Associate Professor of Chemistry, will lead the project. His area of expertise is chemistry education research. His primary responsibilities in the project are: (1) the design, creation, and revision of SI session's curricular materials with support from undergraduate students; (2) the collection, analysis, and interpretation of student data for the research initiative of the project; and (3) coordinate external dissemination of evaluation/research products via conference presentations and academic journal article submissions.

Dr. Dustin Gross (co-PI), Professor and Graduate Coordinator of the Department of Chemistry, will support the project. His area of expertise is organic, supramolecular, and macromolecular chemistry research. Currently, he serves as the graduate coordinator in chemistry and will soon move to the chair position at the Department of Chemistry. **Dr. Donovan Haines (co-PI)**, Professor and Chair of the Department of Chemistry, will support the project. He has over twenty years of experience in higher education settings. His area of expertise is biochemistry research of lipids, enzymes, and drug metabolism. Dr. Gross and Dr. Haines' primary responsibilities in the project are: (1) coordinating General Chemistry instructors and establishing teaching assignments to support the project; (2) coordinating the recruitment and hiring process of SI leaders for the implementation phase of the SI sessions; and (3) assisting with interpreting the results from the research initiative of the project.

6. Dissemination Plan

The PI team will disseminate the outcomes of this project through national conferences such as the American Chemical Society National Meeting (Spring 2026) and the Biennial Conference in Chemical Education (Summer 2026). Also, the learning materials will be available to chemistry educators via peer-reviewed journal publications (e.g., Journal of College Science Teaching, Chemistry Teacher International, Active Learning in Higher Education) and in a new webpage, “Teaching Resources,” of the Department of Chemistry website.

7. Project timeline: activities and assessments

Spring 2025 - Activities	**Meeting Schedule**

PI Team:
• Curriculum development:
    o Draft of SI session activities and materials.
    o Design of growth mindset sessions.
    o Recruit students and faculty for interviews.
    o Create video content for student and faculty interviews.
    o Write problem sets for each of the ten chapters in the course.
• SI leader recruitment: identify and train qualified chemistry students to serve as SI leaders.
• Material compilation: gather and curate additional media resources.
	Monthly meetings. One-hour-long sessions.

Undergraduate students: - Revise learning materials for problem-solving sessions.	Three hours of supervised work per week with PI. Four weeks in late spring.
Fall 2025 and Spring 2026 - Activities	**Meeting Schedule**
PI team: - Manage undergraduate SI leaders to deliver the SI sessions. - Implement new SI sessions for all sections of Gen Chem I.	See Table 1 for the proposed plan for SI sessions during the semester.
Undergraduate students (SI leaders) - Hold SI sessions to support student success in Gen Chem I. - Attend meetings with the PI team on SI session management.	Sessions: twice per week per SI leader. Management meetings: one-hour-long weekly meetings.
General Chemistry instructional faculty: - Encourage students to participate in SI sessions as much as possible.	Biweekly during regular class.
SI session availability: - Multiple weekly sessions: offer SI sessions at various times throughout the week to accommodate students’ diverse schedules—four SI leaders with two sessions each per week. - Online synchronous sessions: provide virtual options to ensure accessibility for all students—one SI leader with two sessions per week.	Weekly sessions are held at the Department of Chemistry and other available classrooms—one hour per SI session.
Assessment and data collection: - Monitor the participation of students in SI sessions by SI leaders with attendance tracking. - Utilize the Dweck Mindset Instrument (DMI) to assess changes in mindset beliefs specific to chemistry. - Employ the Chemistry Self-Efficacy (CSE) instrument to evaluate student confidence shifts in performing chemistry tasks. - Collect student reflections and feedback (SRF) to gain insights into their perceptions of the SI sessions and areas for improvement. - Analyze students’ performance on assessments, such as exam scores in lab and lecture. - Collect student reflections and feedback to gain insights into their perceptions of the SI sessions and areas for improvement.	Bi-monthly reports on completed assessments: - Student participation in SI sessions. - Surveys: DMI, CSE, SRF. - Course evaluations from instructors and lab coordinator.
Dissemination - Submit an abstract for the Spring 2026 America Chemical Society national meeting. Due early Fall 2025. - Submit an abstract for the Biennial Conference in Chemistry Education. Due late Fall 2025. - Write and submit the final Teaching Innovation Grant report. Late Spring 2026.	

Cultivating Resilience in General Chemistry I:
Supplemental Instruction to Promote Growth Mindset and Self-Efficacy

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