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Development of Interdisciplinary Project Based Scientific Research Course for STEM Departments

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Development of Interdisciplinary Project-Based Scientific Research Course for STEM Departments

Abstract

The Project-Based Scientific Research is a new interdisciplinary course developed by the National Science Foundation (NSF - IUSE) funded STEM center team at Sam Houston State University. The implementation of this new course was one of the major three goals for this five-year grant to strengthen the STEM undergraduate research community at Sam Houston State University by helping undergraduates who are interested in hands-on and/or scientific research. The course is designed to introduce undergraduate sophomore and junior science, engineering, technology and math (STEM) students to the vibrant world of real research; to build foundational skills for research; to help STEM students meet potential mentors whose research labs they might join with the goal of gaining experimental research experience while on campus. The aims of the course were to (1) help undergraduate students who are interested in research connect with faculty partners who are committed to mentoring undergraduates in research, (2) to guide students in reading through papers that introduce the type of research being carried out in a faculty partners lab, (3) to guide students in drafting a mini-review of 5 papers relevant to that research, (4) to guide students in identifying and writing up a research proposal which they will complete in the lab of the faculty partner. In the first year, six academic departments out of eight participated in this new course by offering a cross-listed course for their students under one major course taught by one of the PIs at the STEM Center. Due to institutional constraints only two departments contributed students to the course. After thoughtful conversations with stake holder's broad support was found for the goals of the course, but not for the mechanism of using an interdisciplinary course to meet those goals. Currently, we are transitioning from a course-based approach to a non-course-based approach for supporting more effective ramps into research.

Introduction and Literature Review

Training future professionals for science, engineering, and math (STEM) careers is the primary undergraduate training mission of university STEM departments. Ideally, STEM education would provide effective mentoring for talented students from all backgrounds. However, historical disparities persist in many institutions resulting in disparities by ethnicity and gender in the STEM fields.[1] Designing learning experiences and communities that are welcoming and nurturing for people of all backgrounds remains an important goal. Fortunately, there are institutions where undergraduates from traditionally underrepresented groups thrive and find good pathways into the discipline.[2] For example, Howard University, and the University of Maryland, Baltimore County are the two U.S. schools that have provided undergraduate training for the highest number of African-American STEM Ph.D. scientists; the universities of Puerto Rico and the University of Texas at El Paso have played a similar role for the undergraduate training for Ph.D. scientists of Hispanic origin.[3]

For students of all backgrounds, undergraduate research experiences have been linked to post-secondary success and graduate school success.[4] The positive impact of undergraduate research experiences on students' post-secondary success is well-documented.[56] Numerous studies have looked at undergraduate students during and post participation. A study examining students' reasons for participating and differences across institutions and demographic groups found that social and experiential reasons were key motivators for participation and a perceived lack of research readiness was found to be a key barrier.[7] In-depth interviews of undergraduate research mentors who have won awards for excellence in mentoring, show that a defining characteristic of award-winning mentors is the ability to establish and sustain a sense of challenge while maintaining meaningful engagement and a sense of achievement amongst students. This requires an understanding of diverse student backgrounds, and can be transferred to other faculty via faculty conversations and mentoring.[8] Undergraduate research is also a high impact practice for retaining students in the STEM disciplines.[9] A review of nearly forty years of scholarship presents a complex portrait of the myriad factors that influence the undergraduate and graduate experiences of women of color in STEM fields, providing guidance for advancing the status of women of color in STEM.[10] Best practices have been shown to succeed when transplanted to new universities.[11,12]

This paper describes an effort to replicate best practices at Sam Houston State University in the implementation of a cross-disciplinary course designed to provide students from diverse demographics with a more effective ramp into undergraduate research. The specific aim of the course was to provide students from diverse backgrounds with a curriculum designed to build community, introduce students to research faculty, and to counteract a perceived lack of research readiness. The student learning goals for the course included providing opportunities for students to: study key historical examples of excellent research; interact with faculty researchers who perform projects across the STEM disciplines; and to explore the similarities and differences between experimental and theoretical STEM research. Additionally, students were expected to select a future research topic with the assistance of an active faculty researcher who was willing to serve as a mentor; design and present a research prospectus, complete a mini review of literature relevant to their chosen research topic; and to make preliminary plans for starting the research project in the following semester.

Although designed with the best of intentions, the course ran into substantial institutional roadblocks that prevented its continuation. The paper concludes with a summary of the discussions held with stakeholders about the course, its goals, and its challenges, and the evolution from a course-based strategy into a more institutionally viable decentralized strategy for improving undergraduate ramps into research.

This course was implemented under the auspices of a program funded by a national science foundation grant for improving undergraduate STEM education (NSF-IUSE). The primary aim of this program is to increase the number and quality of students completing STEM undergraduate degrees at Sam Houston State University. The program has three major thrusts. The first major thrust uses bridge courses to equip incoming students for success in introductory STEM courses that traditionally have high failure rates. The second major thrust uses faculty workshops and course grants to promote Inquiry-Based Learning and Process-Oriented Guided Inquiry Learning across STEM disciplines. The third major thrust seeks to provide better ramps into research for STEM students.

Replacing the "pre-REU" Component with a STEM Course

Formal programs providing Research Experiences for Undergraduates (REUs) are designed to engage undergraduate students in substantive research projects. Initially, to help raise awareness amongst students about REU opportunities, and to help prepare students to be viable candidates for an REU experience, the PIs proposed to have a summer pre-REU program as part of the main grant proposal. However, in the first round of review, reviewers and NSF-IUSE program officers recommended dropping this component due to cost and sustainability concerns. Two ideas were recommended for consideration in-lieu of the pre-REU component. The critique of the original program and the suggested replacements are summarized in Table 1.

Table 1. Options to replace Pre-REU program suggested by NSF

Critique of the proposed Pre-REU program	**Suggested Replacements**
	Idea 1: In recent years, the IUSE program and others have supported several projects to reform curricula (mainly lower-level courses, and mainly in the biological and geological sciences) to incorporate authentic research experiences—i.e., course-based undergraduate research experiences (CUREs). Models are available for adaptation, and the developers occasionally offer workshops. The CUREs are lower-cost and can reach many more students than the REU model. In addition to implementing IBL and POGIL in various STEM courses, consider implementing CUREs. Doing so would entail the same types of activities and costs (e.g., training for faculty, release time for faculty to redesign courses).
	Idea 2: Within the STEM Center, design and implement a program (1) to educate students about external REU Sites and similar summer research/internship opportunities and (2) to coach them to prepare successful applications for those competitive programs. You could pay special attention to transfer students. (Some REU Sites specifically target first-year and second-year students.)

After careful consideration of the reviewer comments and recommendations, the Project PIs decided to develop a STEM course where all the STEM departments (Table 2) in the College of Science and Engineering Technology (CoSET) would contribute by sending students and providing faculty members as guest speakers and potential research mentors. Two of the project PIs were tasked with developing the course.

Table 2: The eight STEM departments in the College of Science and Engineering Technology

Agricultural Sciences	Biological Sciences	Chemistry	Computer Science
Engineering Technology	Geography and Geology	Mathematics and Statistics	Physics

Course Goals and Learning Objectives

To engage more undergraduate students in research, the STEM Center sponsored the creation of a new course in the CoSET available to all qualified STEM majors. This new course was designed to not only prepare STEM majors for the challenge of original research, but also to provide every enrolled student with the means to continue a rigorous research project with a faculty mentor. The new course was entitled "Introduction to Project-Based Scientific Research."

The learning objectives of this course were broad enough to be relevant to all STEM disciplines, but specific enough to prepare a diverse group of students for the rigor of their chosen discipline. Specifically, the course objectives were to help students (a) build a foundational understanding of the principles of STEM research through the exploration and discussion of important historical interdisciplinary projects; (b) interact with faculty researchers who perform projects across STEM disciplines; (c) be able to describe the similarities and differences between experimental and theoretical STEM research; (d) explore and present several possibilities for future research topics; (e) design and present a research prospectus, complete with a review of some of the relevant literature; (f) and be prepared to continue a research project with a chosen faculty mentor or mentors.

Course Development

The first part of the course was designed to immerse students in the study of specific historical examples of interdisciplinary STEM research, both experimental and theoretical, that are antecedents of current research on campus. Following this introduction, faculty researchers from various disciplines would give presentations on current research. Students would be required to identify potential research mentors on campus, introduce themselves and begin a discussion about topics for research. The plan for the initial part of the course was to have each student find a faculty research mentor, identify an idea for a valid semester-long research project aligned with the mentor's program of research, and identify literature related to their topic.

The plan for the second portion of the course was to help students review a subset of the selected literature, design a research plan, and communicate that plan in the form of a research prospectus. The goal was to have the students write the prospectus in the format consistent with the standards of the corresponding STEM discipline and present the prospectus to their classmates. In addition, the course aimed to provide students with help in identifying and assembling successful applications for external research opportunities. Consequently, by the end of that Fall semester, it was hoped that each student would (1) be fully prepared to be immersed in a Spring research project with an already identified faculty mentor, and (2) have identified several attractive external summer research programs, with applications ready to submit the following January.

The course was limited to 30 students per section, with a single section planned for the first year. The students invited to register for this course are chosen from among the same group who would have qualified for the pre-REU program: a diverse group of qualified STEM majors with particular attention given to newly accepted transfer students and those from groups traditionally underrepresented in the sciences. To be eligible students were required to have completed the first-year mathematics and science courses required for entry into their chosen major. For example, interested math and physics majors were required to have completed the calculus sequence and both semesters of calculus-based physics. Those students majoring in engineering technology had to have completed all required mathematics and physics courses as well as all introductory coursework in that degree plan.

The Fall 2018 semester was spent writing a proposal for the course to be presented to the CoSET (and eventually university) curriculum committee. This course is cross listed across several CoSET departments as MATH 3395, CHEM 3395, ETEC 3395, BIOL 3395, etc. and will be available as an advanced elective for all STEM degree plans. The course was designed to be team-taught by STEM faculty sharing the load across faculty to minimize effect on the college faculty teaching load.

Because of the limited resources required for the implementation of this course, its design may be easily transferred to any institution of higher education with a diverse set of STEM research faculty. This course is also readily scalable; if the demand from students increases, additional sections can be created with more teams of faculty as instructors. A college the size of CoSET at SHSU has dozens of faculty members actively engaged in research, many with a list of problems waiting for willing and qualified undergraduates to help solve.

In fall 2018, the pilot version of this undergraduate research course was offered. Its target audience was second-year STEM majors with no experience with laboratory work or research. Fifteen students registered for the course from several different STEM departments (agricultural sciences, math, physics, engineering technology, chemistry, computer science). The course was designed to introduce students to the benefits and diversity of STEM research, requiring each student to identify a potential research mentor and research topic.

For Fall 2019, a plan to repeat the pilot course was abandoned because departments expressed a preference for handling research preparation at the departmental level rather than in an interdisciplinary course. This is due to two primary factors: (1) students are already constrained to take fewer courses than departments would like in their majors because of financial aid restrictions. When taken, the interdisciplinary course further reduces the number of courses taken in the major; (2) different departments value different approaches for developing ramps into research. After collecting comments from the STEM departments, the project team started discussing new ways to support existing and novel non-course-based ramps into research and the development of new components in existing department-specific courses that enhance student preparation for research. Another step is that, the STEM Center leadership team consulted with STEM faculty, department chairs, program coordinators, and upper administration to discuss the best ways of meeting their needs while serving as many of our students as possible. An idea of future 1 or 2 credit hour STEM seminar class that can be part of the Texas general core curriculum was suggested in a series of meetings with STEM faculty.

The success of this STEM Center initiative will not be difficult to measure: 90% of the students who register for this Fall introductory course will complete a research project the following Spring semester (as determined by the faculty research mentor).

Pre-Course Organization

Once enrollment in the 2018 course was complete, the majors of the enrolled students were noted. Faculty partners from the departments having enrolled majors were invited to serve as partners in introducing students to research. Faculty partners were asked to:

1. Complete one or more *Research Seed Form*s summarizing the faculty partner's program of research (or an area within that program), in a manner that provides fertile ground upon which to build an undergraduate research project.
2. Visit the *Project-Based Scientific Research* course to give a 15-minute in-class overview of the faculty partner's research program, specifically highlighting aspects summarized in the *Research Seed Form*. A question and answer session will follow the presentation.[1]
3. Meet three times with each student who selects to do future research with this mentor.
   Student Meeting 1. Discuss the first paper read by the student.
   Student Meeting 2. Discuss the papers that the student selected for the mini review.
   Student Meeting 3. Begin framing a research project for the student. The project should fall within the scope of the research program outlined in the original *Research Seed Form* and should be designed for the subsequent semester or summer. The goal is for this to be a collaborative process between student and faculty partners. However, if any disagreements arise, the position of the course will be that the faculty partner has the final say in framing the project.
4. Welcome the student into the faculty partner's group to complete the undergraduate research project collaboratively developed in the *Project-Based Scientific Research* course.
5. Complete two brief feedback surveys: one at the end of the course that will serve as a portion of the student's grade, and one after the student's first semester of research in the faculty partner's group.

After reading the Research Seed Forms, and listening to the mentor presentations, each student in the course was asked to select one specific *Research Seed Form* as the foundation for their future research project. In making this selection, they were selecting a future research mentor. The rest of their learning in the Project-Based Scientific Research course was to be focused on preparing for a research project in collaboration with that mentor.

Course Structure

<u>*Introduction (7 Meetings)*</u>

CM 1: Course overview - Breaking into research
CM 2: How to read a paper

CM 3: How to communicate within a discipline and between disciplines.
CM 4: Peer evaluation formative and summative.
CM 5: How to structure a literature review
CM 6: How to structure a research prospectus
CM 7: Test

Assessment:

Test Performance
Successful selection of a research seed project

Zooming In – Deep Study and Summary of a Single Paper (7 meetings)

CM 8: Abstracts, Conclusions, Figures, Tables, Schematics etc.
CM 9: Materials and Methods 1
CM 10: Materials and Methods 2
CM 11: Class meeting 4: Analysis and Conclusions 1
CM 12: Class Meeting 5: Analysis and Conclusions 2
CM 13: Putting it all together Papers - Peer Evaluations 1
CM 14: Putting it all together Papers - Peer Evaluations 1

Assessment:

Participation (20 %): Meeting with the faculty partner to get feedback. Incorporating feedback into the paper. Class participation in reading and offering helpful feedback to fellow students, as they draft and revise their papers.

Writing (80 %): Student paper that (1) summarizes the goals and conclusions of the seed paper, (2) explains the materials and methods used in generating one figure or table (or similar summarizing endpoint) in the seed paper, (3) explains the methods of analysis and how these were used to draw inferences or conclusions from the data.

Zooming Out - Writing a Mini Review (7 meetings)

CM 15: Overview of the unit (Find and read 4 additional papers related to the paper or thesis that you read)
CM 16: First draft of paper 1 summary
CM 17: Revision of paper 1 summary, First draft of paper 2 summary
CM 18: Revision of paper 1 and 2 summaries, First draft of paper 3 summary
CM 19: Revision of paper 1, 2, and 3 summaries; First draft of paper 4 summary
CM 20: Revision of all summaries; First draft of the overall introduction and conclusion
CM 21: Final draft and presentation of the mini review

Assessment:

Student paper that includes a revision of the unit 2 work, and which expands upon that to (1) summarizes the goals and conclusions of the four additional papers, (2) explains the materials and methods used in generating one figure or table (or similar summarizing endpoint) from each paper, (3) explains how each data selection was analyzed and how inferences or conclusions from the data.

Crafting a Research Proposal/Prospectus (7 meetings)

CM 22: Proto-Introduction (Review of prior work, question (or questions))
CM 23: Proto-Conclusion (A hypothetical decision tree that speaks to the questions)
CM 24: Proto-Results and Discussion (Hypothetical Figures, Tables, and Statistics needed)
CM 25: Proto-Materials and Methods (Design the experiments needed to fill the data into the hypothetical Figures, Tables, and Statistics that you have proposed. Determine what Materials and Equipment are needed for the experiment.)
CM 26: Budget and Timeline
CM 27: Present/Peer Review Prospectus 1
CM 28: Present/Peer Review Prospectus 2

Assessment:

Participation (20 %): Meeting with the faculty partner to get feedback. Incorporating feedback into the paper. Class participation in reading and offering helpful feedback to fellow students as they draft and revise their papers. Possibly presenting the research proposal to the faculty partner and or their group.
Writing (80 %): Student paper/presentation that builds on the work completed in units 2 and 3. 20 % of this grade will be based on revisions of the prior work. Sixty percent of the grade will be based on the quality of the research proposal

All departments in the College of Science and Engineering Technology (CoSET) contributed towards this course by encouraging their students and opening cross-listed sections to enable students to earn credits toward their major degrees.

For fall 2019, the plan was to repeat the pilot course; however, decreased enrollment was expected. This is because departments had expressed a preference to handle research preparation at the departmental level rather than in an interdisciplinary course. This is due to two primary factors: (1) students are already constrained to take fewer courses than departments would like in their majors because of financial aid restrictions. When taken, the interdisciplinary course further reduces the number of courses taken in the major; (2) different departments value different approaches for developing ramps into research.

Challenges

The course was intended to be broadly interdisciplinary. In the 2018 iteration of the course, the only departments that advised students into the program were Math and Engineering Technology (ETEC). There was a physics student and a computer science student in the course; however, these two students enrolled in the course as a Math elective, not as a physics or computer science elective. In the 2019 iteration of the course enrollment decreased, there were no math students, only ETEC students.

Potential Solutions

Facing lack of enrollment and limited diversity in majors in the fall 2019 version of the course, we faced two options.

Option 1: Push forward with the course including only majors. Continue reaching out to other departments and trying to develop a consensus approach.

Option 2: Cancel the course, and begin working on building a web site focused on building good ramps into research in our departments; recruit partners from other departments to join us; and draw up a collaborative session for next year's teaching and learning conference focused on ramps into research.

A meeting of the STEM Center Advisory board was called in the spring of 2019 to help us see more clearly the obstacles that prevented chairs from embracing the interdisciplinary "Ramps into Research" course. This advisory board consist of dedicated faculty from all departments in the CoSET. Perhaps the most important obstacle was that in all departments, this course competed with upper-level courses that faculty felt were more important for their students than an interdisciplinary course.

Other challenges that were discussed are listed here. (1) In chemistry and biology, a high number of courses are required for these majors, causing students in these majors to get caught in a financial bind if they take too many electives. (2) This course competed for students with existing departmental elective courses that at times struggle to enroll enough students. (3) The mission to serve underprepared students in research may conflict with PI's responsibility to select the strongest teams so that they can fulfill their research commitments to funding agencies. (4) To give students the feedback that they need to learn requires a significant time commitment on the part of faculty. We did not have any funding to financially remunerate faculty who partnered with us, and in fact several excellent researchers turned us down for this reason. (5) Courses housed within departments may be better able to prepare undergraduates for the rigors specific types of research (e.g. ecological field research), than an interdisciplinary course.

With the resources given, the course instructor(s) worked hard to make this course fly. Strong efforts were expended in assembling a curriculum, accepting overloads etc. In the end, considering low enrollment and lack of support from departmental chairs, the interdisciplinary "Ramps into Research" course that the STEM center had tested for one year was canceled. We have committed ourselves to finding more viable ways for promoting effective ramps into research, and more broadly, into STEM for students.

The STEM Advisory Board were broadly supportive of the overarching goals of the course and encouraged the project team to consider alternative approaches for meeting the original goal of providing more effective ramps into research. Ideas included reorganizing the course as a one- or two-credit course seminar style course or designing an extra-curricular program.

Having thought about the advice given to us, we are proposing to focus on doing something outside of a defined course – specifically to initiate an umbrella program entitled "Ramps into Research" with fostering discussions, and providing vision and advocacy for strengthening the research community at SHSU.

The project team wants this to be a community that organically grows from the good discussions about the Project-Based Research course, and the Ramps into Research goals.

(1) Plan a series of interdisciplinary pizza meetings (Student Leaders and Faculty Reps)
One faculty advisory board meeting followed by planning meetings for each of the following in which student leaders are invited to participate. Food costs covered by STEM Center…
   a. November Pizza Meeting 1 (External REU and Internship Applications)
   b. November Pizza Meeting 2 (Graduate School Applications)
   c. November Pizza Meeting 3 (Job Searches)

(2) Develop an inward-facing Internal Ramps into Research Website.
Faculty advisory board meeting focused on growing and promoting the website targeted at SHSU Undergraduates.
A series of building, discussing and promoting meetings focused on topics such as the following. The goal is that each member contributes something to the website between each meeting.
   a. Group introduction
   b. Group Research Proposals and Prospectus stubs
   c. Link to at least one introductory paper related to each project
   d. Training resources relevant to the project
   e. Mindfulness about both
      i. The individuality of scholarship – how does my brain work? What approaches help me to learn most effectively?
      ii. The community of scholarship – how does an effective scholarly community work? What approaches help me to be an effective and appreciated member of a scholarly community?

The project team wants to find a road forward that our faculty colleagues will embrace and find worthy.

Course Evaluation and Feedback

At the end of the course, students were asked six questions for their feedback about the course. The questions were: What have we done that had helped you learn? What could we change to help you learn better? What changes would be good to make to the course next year? Some faculty have suggested that we reduce the meeting time to 1 per week, that we reduce the credit to 1 or 2 credits, and that the course be made pass/fail, rather than for a letter grade. Would these changes make the course more or less attractive to someone like you? If you could do it again, would you still sign up for this class? Any other comments?

Student responses to these questions are provided in Appendix 1. Fifteen students started the course. One of these dropped out early for non-course related reasons. Of the fourteen students remaining students, thirteen were present on the day that evaluations were carried out. The course faced a challenge in that 6 of the 14 students advised into the course were graduating at the end of the semester and unable to participate in a research project in the following semester. Despite this challenge, ten of thirteen students stated that if they could “do it again” they would still sign up for this course. One student equivocated, saying “No- this class is not related to the field I’m planning to work in. yes – I learned a lot from this class especially when sharing other students’ ideas about their transition/research!” Numerous students were grateful for the accommodations that were made to allow graduating students to use the course to develop a transition plan rather than a research plan, one going so far as to suggest that a separate course be developed for supporting transitions out of college.

For its target audience, the course came close to meeting its objective of having 90 % of enrolled students engaged in research the following semester. Of the eight students who were continuing in their studies, seven successfully engaged in research experiences associated with the course. The research projects engaged by the non-engineering technology students were focused in the areas of theoretical particle physics, diabetes modeling, and algebraic-combinatorics and were mentored by faculty in the physics and mathematics departments. The projects engaged by the engineering technology students included implementing LabView data acquisition from an HVAC system, designing a circuit board for non-contact thermography, participating in an oil and gas drilling internship, and optimizing a 3D scanner.

Conclusion

An interdisciplinary, Project-Based Scientific Research course was designed to introduce undergraduate sophomore and junior science, engineering, technology and math (STEM) students to the vibrant world of real research; to build foundational skills for research; to help STEM students meet potential mentors whose research labs they might join with the goal of gaining experimental research experience while on campus. The course was piloted in the fall of 2018, and student feedback was encouraging. However, due to institutional constraints, only two departments contributed students to the course. After thoughtful conversations with members of other departments in the college of science and engineering technology, broad support was found for the goals of the course, and for many of its design elements; however, faculty were reluctant to direct students into the course because it competed with departmental topics courses that needed the presence of those same students to be able to run, and because there was not room in some departments for students to fit an additional elective into their degree plans. Currently, we are building upon the broad support for the ideas upon which the course was built and are transitioning from an interdisciplinary course-based approach to a non-course-based approach for supporting more effective ramps into research.

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Appendix - Student End-of-Course Feedback

To provide feedback on the course, students were asked six questions at the end of the Project-Based Scientific Research Course. The questions and student responses are provided below.

1. What have we done that had helped you learn?
   - It has helped me learn about the idea of research, and how to actually get with a professor to about it with them. “Teach a man how to fish”
   - Two things: 1) Building an understanding on how to go about research & how to add to what we know. 2)Even though I went the Research route, I did learn college to career transition & how to go about that
   - Working on the transition project really helped me think about my future and begin planning my path I was able to make myself more attractive to employers via improving my resume and even making my own website.
   - I learned how to take apart research papers and actually study them enough to put them into my own words.
   - One thing that I learned is what exactly research is. That was the purpose of me taking this class though.
   - I was very intrigued by the business side of things with one presentation. I like how we had to do research on a job, because now I have three jobs lined up for possible interviews.
   - I learned how to make a whole transition strategy paper from one basic idea to whole rich information that based on self-study, researching, and reading more and more.
   - This class has opened my eyes to what I want to do. It allows a person to really self-reflect on their opinions and career goals.
   - I learned how much work takes to make a research paper, and the time to make sure you understand the main goals of the experiment.
   - I learned how to breakdown a scientific paper, and I was interested to … research opportunities that I wouldn’t have known of otherwise.
   - Breaking down the research process and explaining how it’s done. Then being able to examine research that has been conducted helped to understand the process better.
   - Learning to actively look for jobs in detail and make sure I’m qualified for the job I’m pursuing.
   - Something that has helped me learn was the freedom to move around and actually research without being stuck in my seat. The conversion from the book to the actual reports was calming. It gave the vibe of reading and studying something before just jumping into it.

2. What could we change to help you learn better?
    - I feel like you can't do that much to help us learn while were doing a specific research topic. That's up to the student, what you can do is motivate, help in any way you can, and keep making the deadlines you were making.
    - I understand that this was the launch of this course, but maybe a final presentation of what we put together. Because I feel like I learned a lot from our research/transition presentations.
    - The beginning of the course was not very interesting for me. Being that I planned on graduating after this semester I didn't get interested until I began the transition project. (Make sure that people that plan on graduating know that this is a course that is meant to lead into another so that everyone is on the same page.
    - A change would be less writing and more group activities to engage with the class better.
    - One thing I would change is maybe combining majors, its hard to get an idea of other peoples research areas when you don't specialize in their majors. Or maybe have a class w/ combined majors but separate groups per major.
    - One thing I would change would be how to make a website, because I still have no idea how to do that and how to make the drawing for our design plan.
    - I learned a lot from the class especially the way our dr respond to emails, in class meeting and reviewing other students papers
    - I wouldn't change too much. Maybe allow the person to choose/change their choice of research/transition in the class.
    - I believe that some reference papers broke down in class time can help further understand the dynamics of the class.
    - Have a little more organization when it comes to daily lesson plans.
    - Maybe a better guided process on how we examined others' research. It would have helped working in groups for the big papers and trying to comprehend the research criteria.
    - I learned through activities and hands on. Papers help a bit but I am not a fan of research papers. I did enjoy the PowerPoints from each student who presented a professors research.
    - A change that would help me learn better would be to focus the topics on personal interest instead of only including topic related projects.

3. What changes would be good to make to the course next year?
    - Maybe get two professors for different types of projects. One prof for research, one prof for transition students.
    - A final presentation to see what we each have done. Now that we have done a session, maybe an outline of the course and what is expected of us.
    - Know that this a course that is meant to lead into another so that everyone is on the same page

- A change would be less writing and more group activities to engage with the class better.
- Another thing is I would want to do research PowerPoints till the end of the semester. At that point we would have longer to research and gain understanding to try and explain it to other majors
- 1) class meeting (once a week) 3 hours 2) more PowerPoint presentations, so we could get more ideas about the subject matter 3) HW related to the topics we learn, so improve the writing research paper.
- Make some of the class period time to look at past student research proposals to have a better grasp of one's own proposals. Other than that the dynamic is excellent.
- Make the course available to Chem, Bio, and Physics majors so that it will count towards their degree.
- Students shouldn't feel pressured to learn about a topic they have no desire to learn. With these topics giving the student the opportunity to expand on their own creative tangent will open broader doors than just classroom expectations.

4. Some faculty have suggested that we reduce the meeting time to 1 per week, that we reduce the credit to 1 or 2 credits, and that the course be made pass/fail, rather than for a letter grade. Would these changes make the course more or less attractive to someone like you?
    - These changes make the class more attractive.
    - I enjoyed meeting x2 a week. I think the credits are good, especially, with all the work we put into our research. And a pass/fail would make sense, because we either did the work or did <u>not</u> do the work.
    - I think this course should meet 2 times a week. Many people need 3 credits so it may be awkward to make it for 2 credits.
    - More attractive
    - Yes and no in the sense that if it were only ½ credits then I would be less attracted. Maybe equivalent to the credit people earn in undergraduate research?
    - I feel like you should still meet twice per week, same credit, and same letter grade. If hat changed it would be <u>less attractive</u>.
    - No
    - Less attractive, I believe this class is great for a transition.
    - I believe this class is good as it is, it has enough work assignments and gives rewards to the amount of work put in.
    - Less
    - Yes, with this course being 3 hours and fulfilling an elective credit is the whole reason I took this course.
    - I think making it a 2 credit/once a week class is fine. This is a very helpful class but can be just as productive with meeting once a week.

- 1 per week sounds great, but dropping credits with the same amount of work sounds absurd. The course should be pass/fail instead of a letter grade because some assignments can not necessarily have a percentile placed on them due to transitional students giving out their personal life action plan. However, if a rubric is made and the student does not follow outline then point deductions are in order.

5. If you could do it again, would you still sign up for this class?
    - Yes
    - Yes
    - Yes
    - No
    - Yes
    - Most definitely. I made friends within the course that helped me learn two new things. I liked the class overall.
    - No and yes No- this class is not related to the field I'm planning to work in. yes – I learned a lot from this class especially when sharing other students ideas about their transition/research!
    - Yes
    - Yes, as a class to have my full credit I would definitely sign up for the class again.
    - Yes
    - Yes I would, it was interesting to be able to have the professors from different fields come in and explain what they do.
    - If there is more to learn and expand my knowledge then yes.
    - If I would have known that the class is geared for research students and has 2 parts semesters then I would not have signed up.

6. Any other comments?
    - The way you offered help to us was really motivating and let us know that you cared. You're a likable dude
    - Great class & I am very glad to have taken this course!
    - This course has helped me learn more about my field and about why I want to be in the construction field. When I go into interviews I know what I want to tell them about me. I have become a more attractive prospect for possible future employers through the things I have studied for this course. Thank you!
    - Not really a need for the textbook. We only used it for the first 3(ish) weeks. I would maybe take one week (or 2ish classes) to explain what research is and give an overview of it, and then jump into overall research ideas. IE, no need for PowerPoints over experiments from a story in the textbook.
    - Thank you for your time and consideration for the class. I liked the presenters towards the end and your feedback within our projects!
    - This class has really opened my eyes to what I want to do. You, as an instructor and a person, have impacted my in various ways.

- I learned to expand my knowledge and further learn required information to understand others research papers. As well as plan my future goals from graduating from SHSU. Overall good class to take to understand writing and researching in depth.
- Aside from being slightly unorganized, this class was great. I’m grateful for what I have learned from it and was ultimately able to learn far more than I had expected to. Thank you and please offer this class again, it is worth it.