Gateway Science and Math Course Redesign Project Descripton

Issues to Address

- Aspiring and declared STEM majors experience high failure rates in gateway science and math courses
- Research shows that perceived poor quality instruction in science and math courses is the primary factor leading students to depart STEM fields and is a major concern of those who persist
- Implementation of curricular and pedagogical redesign, primarily focused on various aspects of interactive engagement, has improved student learning in STEM gateway courses, across the disciplines

The Goal

The STEM Gateway pathway to successful course redesign is characterized by:

- On-going exploration and adoption of evidence-based instructional practices
- Faculty engaged in continuous improvement of teaching and learning
- Dialogue around teaching supported through a community of practice
- Teaching informed by meaningful assessment

The fulfillment of this vision will result in increased student achievement of learning outcomes, retention, and degree attainment, especially among Hispanic and low-income students.

(Inspired by WIDER PERSIST, Boise State University)

Individual Course Redesign Projects

One (or two instructors) working to redesign a course that is required and is foundational to at least one STEM major (Contact Gary Smith, gsmith@unm.edu to confirm that your course qualifies). Tenure-stream and Lecturer faculty in natural science, mathematics, and engineering departments are eligible to apply; a graduate student or part-time instructor can partner with a regular faculty member.

Successful applicants will form a faculty learning commuity. To encourage access to close collaborators, preference will be given to applicants who are either proposing a partner on their project or where two separate proposals are submitted by faculty in the same department

Timeline

Proposal	Redesign Work	Implementation (one or both semesters)		Assessment	Expanded implementation Plan
March	*May-August*	*Fall Semester*	*Spring Semester*		*May*

STEM Gateway compensation:

The STEM Gateway program is funded through a U.S. Department of Education TITLE V grant, 2011-2016 (total anticipated funding $3.82 million).

Gateway STEM Course Redesign Program – Individual Proposal 2015-2016
Due: March 30, 2015

Important Dates

March 30, 2015: Gateway Science and Math Course Redesign proposals due. Submit to Gary Smith (gsmith@unm.edu).

April 10, 2015: Selection of successful course-redesign projects announced.

May 14, 15, 18, 2015: Course-redesign members *must* attend STEM Gateway Redesign Institute (2.5 days).

June 1-August 15, 2015: Course-redesign members develop proposed curriculum and pedagogical redesign elements; informal meetings between members and with STEM Gateway facilitators.

2015-2016 Academic Year: Implementation of redesign with collection of assessment data. STEM Gateway will advise throughout the process and arrange for ongoing monthly teaching professional development activity sessions for the faculty learning community.

Compensation Schedule

Summer 2015 compensation for faculty (1.5 months) begins on June 1.

Summer 2016 compensation for faculty (0.5 month) begins on June 1 provided that course-redesign implementation occurred as planned and assessment data were collected.

Continue to complete the proposal form

A. Foundational Information

Course number, or numbers (including department/program prefix): ENVS 102L

Course name(s): Blue Planet Laboratory

If the redesign will affect companion laboratory or recitation/problem solving sessions that have a separate course number/title, then please list these course numbers and titles in this space:

Typical number of sections and students taught during fall, spring, and summer semesters (listing lab and recitation/problem solving sessions separately from the lecture) for each course involved in the redesign proposal;also indicate how many sections are typically taught by the applicant(s):

Fall: 14 sections (24 students each);Spring: 12 sections (24 students each);Summer: 1 section (24 students)

No sections taught by faculty applicant (Coordinator of labs); 1-3 sections taught by TA applicant per semester

Purpose. What are the specific, measureable objectives of your proposed redesign project?

We will design new or redesign laboratory activities to meet the NM Higher Education Department's competencies in Area III: Laboratory Science Competencies UNM Core Area 3: Physical and Natural Sciences.

We will align the laboratory activities to correspond with the needs and expectations of outcomes in preparation for students who will take this course as a gateway into the ENVS major, including increasing the quantitative rigor of the activities.

We will design the laboratory exercises to address typical misconceptions regarding the environmental sciences; such as misconceptions associated with climate change (e.g., how the greenhouse effect works and difference between temperature and heat capacity), and energy and resource sustainability (e.g. oil future, environmental impact of demand on resources).

We will design activities to help students understand the basics of doing science, including more authentic activities such as field outings, use of field equipment, having students collect field and laboratory data and interpret their data and results.

Significance: Why are the objectives provided above important to the recruitment, retention, and graduation of students at UNM?

ENVS 102L, along with the companion ENVS 101 lecture course, is the introduction to the environmental science major. This laboratory can be used to excite students about science, introduce them to the field of environmental sciences, and to recruit students into our Environmental Sciences program. Notably, the ENVS majors include a larger number of Hispanic and Native American students than does the Earth and Planetary Sciences program and many of these students become interested in the degree while taking the Blue Planet courses.

B. Preliminary Redesign Plan

STEM Gateway anticipates that your redesign plan will mature and change as a consequence of subsequent participation in the course-redesign institute and during the first-summer planning effort. However, a well-developed proposal should show that you have a foundational understanding of key concepts of course design in university-level science and the assessment of student learning.

The *preliminary* plan, presented as responses to the prompts found below, should show consideration of and a commitment to implement the five elements for a scientific approach to optimization of science education (modified from the Carl Wieman Science Education Initiative, University of British Columbia and the Top 25 Project, Miami University):

1. Specification of measurable learning outcomes
2. Rigorous objective assessment of student achievement of these outcomes
3. Implementation of teaching methods aimed at maximizing achievement with respect to the specified outcomes, that are consistent with empirically established results and principles
    - Use methods to actively engage students in their learning and with other learners and, wherever appropriate, employ inquiry-driven approaches to learning
    - Reduce the amount of class time spent on low-level memory or descriptive material by incorporating approaches to facilitate students learning this material outside of class
    - Methods are built on specific student learning outcomes tied to assessment that continuously monitors student learning and modifies the course as necessary
4. Means for easy dissemination and duplication of materials, methods, and technology to other course instructors
5. Sustainable and continued optimization based on results of assessment

1. List the measureable learning outcomes for the redesigned course (these may be the current student learning outcomes for the course or potential revisions to those outcomes).

Upon course completion, students will

" be able to construct a hypothesis, propose a test, and then complete the test using quantitative and spatial data.

" be able to make measurements and make calculations using those measurements that lead to graphical display and interpretation of data.

" be able to analyze graphical data and use the graphs to make interpretations.

" complete a written report that effectively communicates an interpretation of quantitative and graphical data to evaluate a societally relevant environmental problem.

" demonstrate understanding of the basics of functioning successfully in a field setting, including use of some basic equipment and techniques, and putting into practice the basic steps of collecting field data.

" be able to interpret scales and elevations on a topographic contour map.

2. At this preliminary point in your planning, how do you plan to assess student achievement of the outcomes stated in #1?

We plan to assess student achievement of outcomes by embedding the assessment questions within the laboratory exercises. Instructors will collect assessment data upon grading the laboratory activities and report the data to the Lab Coordinator. Data will be compiled by the Lab Coordinator and reviewed to provide or suggest improvements to the activity to increase success rates of the outcome under evaluation.

B. Preliminary Redesign Plan *(continued)*

3. Describe the teaching methods that your are currently considering for the redesign and link these proposed methods to (a) the purpose of your project described on page 3, (b) the learning outcomes stated above and (b) to your current knowledge of research on teaching and learning processes.

The topics/content selected for the lab would be developed based on the needs and expectations of knowledge as a gateway into the ENVS program. Once those topics are chosen, labs would be developed or modified to meet our objectives of the project. We will design the laboratory activities with the SMART criteria in mind: Specific, Measurable, Attainable, Relevant, and Time-bound. We would like to set up the lab to have three major components: (1) Activities before class, (2) Activities in class, and (3) Activities after class. Before class, we would like to establish having students read the relevant background information and to take a reading quiz to evaluate their understanding. This would be accomplished online in Learn. As a Just-In-Time tool, instructors could review quiz results before class to review any common mistakes and content mis-understandings as part of their initial review during class. In class, the focus would be away from lecturing of any new content, but to focus on students applying their knowledge from their reading and actively participate and engage with content using analogies and/or collecting data to analyze. This would include more quantitative

4. Describe your preliminary plan for disseminating information about your redesign and instructional materials for use by other instructors.

All of the ENVS 102L labs are taught by Teaching Assistants. There would be a template syllabus used by the TAs. We would develop detailed TA guidelines to disseminate for each lab associated with a meeting to review the material. These guidelines would include objectives of the labs, how to start the lab, how to navigate through the lab activities, and incorporate tips and suggestions on how to engage students, such as using the Socratic method of responding to student questions. The materials would also include the background readings, access to quiz questions, the lab activities, the keys along with rubrics to the activities, and established outcomes rubrics for TAs to use in data collection. Other materials may be provided, such as instructions for use of field equipment.

5. Explain how you plan to sustain, and improve upon, the redesigned course components following the one-year funded redesign effort.

Following the one-year effort, we will evaluate if we met our initial objectives. If not, we will need to evaluate how to improve the specific activities to meet our objectives or consider redesigning whole labs to meet our objectives. If successful, we will think of ways to improve the labs and incorporate additional ideas or strategies to further improve student understanding of concepts. We will to incorporate suggestions from the TAs and solicit help from the TAs to improve the labs.

C. Course redesign project members

One, or two, instructors may submit a proposal together to work on the same course. Each applicant must commit to partipating in the events and processes described on p.7 as a member of the STEM Gateway Faculty Learning Community

Primary applicant; name Aurora Pun

Rank/Position Lecturer III

Number of years teaching this course 1 semester as Coor

Typical number of sections of this course taught each year 0 sections

Project partner (optional) Dylan Garcia

Rank/Position MS Graduate Student

Number of years teaching this course 1 year

Typical number of sections of this course taught each year 1-3 sections

Note: The primary applicant must be a tenure-stream or Lecturer faculty member. The project partner, if applicable, can be a graduate student or part-time instructor.

To your knowledge, is anyone else in your department submitting a proposal to STEM Gateway at this time? No

If yes, who? _____

Note: The existence of multiple proposals from the same department enhances, rather than reduces, the likelihood of selection to participate in the STEM Gateway Course Redesign Project

D. Supporting Letter

Proposals must include a letter of support from the Department Chair that (a) certifies that the redesign proposed in the target course has broad support from the unit, and (b) provides assurances that the chair will encourage other faculty to work toward adopting effective innovations that arise from the project.

Certifications

The primary applicant and partner (if applicable) must sign below, acknowledging the following:

- ✓ Commitment to attend the *Designing Courses for Effective Student Learning* course-redesign institute; May 14 and15 (9 am to 3:30 pm each day) and May18 (8:30 am to 12:00 pm), 2015
- ✓ Commitment to participate in the course-redesign effort during Summer 2015 including a commitment to the five elements for a scientific approach to optimization of science education
- ✓ Commitment to implement the course-redesign elements when teaching the redesigned course during the 2015-2016 academic year, including classroom observations by project staff, and administration of surveys to students
- ✓ Commitment to attend at least 8 of the 12 monthly teaching professional development activity sessions throughout the year.

In addition, the *primary applicant* is responsible for the following:

- ✓ Collecting and submitting assessment data
- ✓ Responding to inquiries and correspondence from STEM Gateway

Primary applicant

Printed name Aurora Pun

Signature 

Project partner (if applicable)

Printed name Dylan Garcia

Signature 

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March 27, 2015

STEM Gateway Advisory Council:

I wholeheartedly support the efforts by Dr. Aurora Pun and Dylan Garcia to pursue a course redesign for ENVS 102L. The Blue Planet labs are very popular among students who need to take a 1-credit lab science to fulfill their core-requirements. These labs fill to capacity each semester. More importantly for the objectives of STEM Gateway, the Blue Planet lecture and lab courses are notable for recruiting students, especially Hispanic and Native American learners, into the Environmental Science degree program. Our Department wants to make sure to engage, spark interest, and enlighten our students on how environmental scientists do science. Students are asked to collect data by modeling real-world procedures employed by scientists in today's workforce, such as taking water quality measurements and samples along the Rio Grande. They are asked to think critically in a scientific context in issues such as how environmental problems affect our society and community- issues such as leaking jet fuel spills at nearby Kirtland AFB and how they might be characterized and mitigated. Outcome assessments (aligned with NM HED competencies for laboratory sciences and the Environmental Sciences BS degree) would be developed and data collected for the course. This redesign would complement our departmental efforts (presently under way) to redesign the entire Environmental Sciences undergraduate degree program. The content of the lab would be developed to provide a good foundation for students wanting to pursue a degree in environmental sciences and to be prepared for the more rigorous environmental science program. The labs would also be used to recruit students in pursuing environmental science degrees.

As Chair, I assure the committee that I will encourage our faculty to consider using the teaching and learning strategies being developed in this course redesign. The 102L lab structure is such that all sections are overseen by a coordinator (Aurora Pun for 2015-16) and the results of this redesign can be translated readily to all of our 102L sections. We can take the fundamentals of evidence-based research and best practices to improve teaching and learning as developed and proposed by STEM Gateway as our department begins its redesign of our entire Environmental Sciences Program.

I hope that you will accept the ENVS 102L as a course redesign project. I know that Aurora and Dylan will do an excellent job improving our Blue Planet labs.

Sincerely,

Dr. Laura Crossey
Chair and Professor