



**Gateway Science and Math Course
Redesign Program – Proposal
2014-2015
Due: April 7, 2014**

Important Dates

April 7, 2014: Gateway Science and Math Course Redesign proposals due. Submit to Gary Smith (gsmith@unm.edu).

April 14, 2014: Selection of three course-redesign teams announced.

May 20-22, 2014: Course-redesign teams attend STEM Gateway Redesign Institute (2.5 days).

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

August 18, 2014: Revised syllabus for fall-semester implementation provided to STEM Gateway by course-redesign teams (with designated sections for Fall 2014 and Spring 2015 implementation).

2014-2015 Academic Year: Implementation of redesign with collection of assessment data. STEM Gateway will advise throughout the process and arrange for ongoing monthly learning sessions with the combined teams as a faculty learning community.

Compensation Schedule

Summer 2014 compensation for faculty and graduate assistant members of the course reform teams begins on June 2, following attendance at, and proposal update following, the May redesign institute.

Fall 2014-Spring 2015 graduate assistantship (August 15-May 15) contract will be finalized upon receipt of syllabus illustrating changes proposed following the course-design institute.

Summer 2015 compensation for faculty and graduate assistant commences June 1 providing that course-redesign implementation occurred as planned and assessment data were collected.

Continue to complete proposal form

A. Foundational Information

Course number, or numbers (including department/program prefix): _____ MATH 123, MATH 150 _____

Course name(s): _Trigonometry, Precalculus_____

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:

MATH 123: About 20 Sections; Approximately 1000 students annually.

MATH 150: About 20 Sections: Approximately 1000 students annually.

Abstract of the redesign project. In 500-750 words, please summarize what your project redesign will entail and how the implementation of the redesign will impact students' entry to subsequent courses in the department and to other majors:

Any student going into a field requiring Math 162 (engineering calculus) must pass, or test out of, both Math 123 and Math 150. The goal of this redesign project is to create a Math 123/150 combination course. The class will most likely meet MWF, where each class may be up to a two hour session. Our hope is that the combined course will give students an opportunity to complete both courses in one semester, with the benefit of having the continuity of instruction. The opportunity for a Math 123/150 course reform group to work in collaboration with OSET on this grant will help us contribute to the improvement of the education of beginning mathematics students at UNM and CNM. Reforming Math 123/150 will contribute to the development of a culture of excellence, and will directly impact all STEM students who are placed at or below this course.

Objectives

The goal of the Math 123/150 Course Reform team is to improve the engagement, learning and success of students in the course at UNM. We will use a comprehensive approach that will strive to engage students more completely in mathematics both outside of and within the classroom. Specifically, we plan to:

- Improve the retention and success rates of students who enroll in Math 123/150.
- Align the 123/150 combination course with 162/163 as well as 121.
- Improve the rates of Math 123/150 completers who enroll in and succeed in the courses that follow Math 123/150.
- Shorten the amount of time students take to complete their STEM degrees.
- Improve the depth of understanding of Math 123/150 students on core subjects.
- Develop resources of effective teaching practices that will be made available to teachers of lower division math courses.

Strategies

1. Revise the Curriculum. We will look through the learning outcomes and course materials and eliminate redundancy and duplication of topics in both courses. We will also examine what topics are really necessary in order for 123/150 to effectively align with 162 and 163.

2. Develop students' ability to evaluate their own understanding.

We plan to create assignments, or other materials that help students monitor their own progress in understanding. These may include computer-based assignments as a way of giving students immediate feedback on their work, assignments that will incorporate questions such as "why this works", "what would happen if...", and "how is this concept like and unlike another", and assignments that will ask students to write their own questions pertaining to the skills and concepts they are learning.

We expect these strategies, coupled with better engagement in class, will motivate students to improve their understanding when they recognize that they have deficiencies.

3. Engage students in the mathematics in ways that facilitate long term memory and transfer to other situations or contexts.

We will explore strategies to "invert" the classroom. That is, students will learn some fundamental material before class. This will be material such as definitions and simple examples, or possibly review material. Most likely this will be accomplished using an online program such as WebAssign or MyMathLab. This will enable students to identify their own understanding (and lack thereof) before class discussion, helping them to be more engaged during the class activities.

4. Develop productive study skills

We will strive to influence how students relate to mathematics outside of class. Teachers often tell their students to study and give them guidelines for the number of hours they should study. We will go further and give students specific and concrete information about how to study effectively. Utilize formative assessment techniques in the classroom to improve student learning.

Rationale for the redesign; why you need to undertake this work (e.g., dissatisfaction with current curriculum, unsatisfactory student completion rates or grade achievement, etc.)

In addition to getting students through Math 123/150 more efficiently and with a deeper understanding of the material, this is a great opportunity to revisit the curriculum in both courses and see where there is redundancy or duplication of material. It will also help us to align the curriculum with Math 162, 163 and 121. It may be that both courses could be combined to form a three or four credit course.

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 the redesign team has 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 goals
 3. Implementation of teaching methods aimed at maximizing achievement with respect to the specified goals, 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 measurable learning outcomes for the redesign project (these may be synonymous with course-level learning outcomes or may only represent some of those outcomes).

(SLO#1) Use Correct Mathematical Notation and Terminology

(SLO#2) **Graph and Interpret Functions:** Sketch and interpret graphs in context of applications; apply appropriate transformations for the following: polynomial functions (linear, quadratic, followed by those with degree three and higher), trigonometric functions, exponential and logarithmic functions, rational functions, parametric equations, and conic sections. Be able to create and graph piece-wise functions from all of the above. Create graphs to model situations.

(SLO#3) **Perform Operations on Functions:** Be able to use function notation to evaluate expressions and perform operations on functions such as addition, subtraction, multiplication, division, composition and difference quotients of functions. Be able to find the domain and range of functions as well as their inverses (if they exist).

(SLO#4) **Analyze the Behavior of Functions:** Be able to determine the end behavior and intercepts of functions. Be able to determine extreme values of functions and intervals where functions increase or decrease. Apply this analysis to interpreting an applied problem.

(SLO#5) **Solve Equations:** Be able to solve exponential, logarithmic, trigonometric, quadratic, radical, and rational equations. Also be able to solve linear and non-linear systems of equations. Be able to interpret solutions in context of applications.

(SLO#6) **Solve Applied Problems:** Be able to set up models from word problems using appropriate functions or laws.

(SLO#7) Perform Operations with Complex Numbers and Vectors: Be able to determine the trigonometric and polar form of a complex number. Be able to add vectors in two dimensions, project vectors onto one another, and determine the angles between vectors. Use vectors and complex numbers to solve applied problems.

2. How do you plan to assess student achievement of the outcomes stated in #1?

We will assess whether we have met our objectives using:

- Statistical measures that will assess whether we have achieved our goals with regards to success (based on course grade) and retention rates in Math 123/150 and the follow-on courses.
- Exams will reflect the SLOs and common exam problems will be used to assess whether students across sections have understanding of the key concepts in the SLOs.
- Surveys will be given to students and teachers. Student surveys will be used to assess their attitudes towards mathematics, their engagement in the class, and their evaluation of the effectiveness of assignments and grading. Teacher surveys will be used to see which resources they found most effective.
- Long term student achievement evaluation. We will track how students taking the redesigned course perform in Math 162 versus students taking the traditional UNM/CNM sections individually.

The results from our assessment will be analyzed and discussed to identify improvements in our approach and materials.

3. Describe the teaching methods incorporated into the redesign and link these proposed methods to the learning outcomes stated above and to the research on teaching and learning processes.

The teaching methods incorporated into the redesign will be a combination of

- A combination of lecture and active learning.
- In-class assignments that will not only focus on more difficult concepts but give instructors and PLFs a feel for where students are having difficulty. This includes not only the new concepts just presented but also fundamental base skills that students are lacking. These activities will usually take place during the recitation hour of the class each week.
- Students will be required to visit a math 162, 163, 264 class, take notes, and report back to the instructor on the experience.
- Online HW and quizzes will be given utilized in a few ways. The online assignments will cover material recently discussed in class. There will also be questions serving as pre-class preparations for upcoming material. In addition, in order to reduce student tendencies toward “blocked” learning, each assignment will contain a few previous problems from other sections covered as well as basic skill material such as solving quadratic equations or simplifying rational expressions.

4. Describe your plan for expanding the redesign to include all sections of the affected course or courses.

Because some students will only need to take one of 123 or 150, there will still need to be some sections of each course offered on their own. The redesign committee will make a focused effort in creating and maintaining a community of practice. This will include brown bag discussions, (and discussions in the hallway between classes!), the creation of a WIKI (or Dropbox/GoogleDoc) to make materials available to anyone in the department, and sharing results of any assessment data we obtain.

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

We will use the results of our assessment, surveys, and feedback from instructors to inform us on how to improve /update the redesigned course. In addition, we will create an advisory council consisting of faculty from mathematics and other departments like engineering/chemistry/physics to serve as a sounding board for what curriculum changes can have a positive effect on students in their departments. We expect to meet with this council at least once a semester.

Course reform team members

Each team should consist of 3-4 UNM faculty members who regularly teach the course. Including a commonly employed part-time instructor is desirable. Each team must also include an instructor of this same course at CNM. If you do not know an appropriate CNM colleague, please contact Gary Smith for guidance (925-0725; gsmith@unm.edu). A graduate assistant from the UNM department will also be hired to assist the team. Each team member must commit to participating in the events and processes listed on the first page of this document.

UNM Faculty Member; Name [Precious Andrew](#)

Rank/Position [Adjunct Instructor](#)

Number of years teaching this course [Two and a half years.](#)

Typical number of sections of this course taught each year [4-5](#)

UNM Faculty Member; Name [Tim Berkopec](#)

Rank/Position [Lecturer II and Coordinator of 123/150](#)

Number of years teaching this course [Tim has not taught these courses but, being the coordinator, he is completely familiar with the material. He taught both courses over a period of three years at the University of Illinois.](#)

Typical number of sections of this course taught each year

UNM Faculty Member; Name [Dr. Derek Martinez](#)

Rank/Position [Senior Lecturer, Coordinator of 121.](#)

Number of years teaching this course

UNM Faculty Member; Name [Sandra Renee Ward](#)

Rank/Position [Adjunct Instructor](#)

Number of years teaching this course [16](#)

Typical number of sections of this course taught each year [4](#)

CNM Faculty Member; Name [Huynh Dinh](#)

Rank/Position [Full Time Instructor at CNM](#)

Number of years teaching this course [He has been teaching both trig and precalc at UNM and CNM since the spring of 2009.](#)

Typical number of sections of this course taught each year [3-4 Sections.](#)

Graduate Assistant

Each course-reform team must designate a graduate student who will serve as an assistant to the team (see Background to the Gateway Science and Math Course Reform Program). This position will be funded at 0.50 FTE during the summer 2014, at 0.25 FTE during the 2014-2015 academic year, and at 0.50 FTE during part of summer 2015. Further details, if desired, can be obtained from Gary Smith (925-0725; gsmith@unm.edu). The assistant does not have to be named at this time, but if your proposal is selected, you will need to provide the information listed below by May 1, 2014. If you have a candidate for this position, please provide the information at this time.

Name

Qualifications that led to selection of this person (e.g., PhD student with career aspirations in academia; experience as a teaching assistant; opportunity to engage a student from a under-represented group in preparing-future-faculty opportunity)

Certifications

Each team member must sign* below, acknowledging the following:

- ✓ Commitment to attend the May 2013 Designing Courses for Effective Student Learning course-design institute and follow-up meeting
- ✓ Commitment to participate in the course-reform effort continuously from May 2013 through June 2014 including a commitment to the five elements for a scientific approach to optimization of science education (page 5)
- ✓ Commitment to implement the course-reform elements when teaching the reformed course during the 2013-2014 academic year, including classroom observations by project staff, and possible administration of surveys to students
- ✓ Agreement with the content of this proposal

UNM faculty team member

Printed name

Signature

UNM faculty team member

Printed name

Signature

UNM faculty team member **

Printed name

Signature

UNM faculty team member

Printed name

Signature

CNM faculty team member

Printed name

Signature

*If it is not readily possible to obtain all signatures at the time when proposals are due, each unsigned team member may send an email to Gary Smith (gsmith@unm.edu) that lists and acknowledges the commitment and agreement listed above.

** Precious Andrew is unable to attend the redesign institute in May.

Supporting Letters

Proposals must include letters of support from the Department Chair and CNM Dean that (a) certifies that the redesign proposed in the target course has broad support from the unit, and (b) provides assurances that all sections of the course will implement the redesign by the third semester. (It is expected that all sections of targeted courses will utilize the new models developed, but project implementation might only involve a select number of pilot sections during the first semester).