



**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): CHEM 101 \_\_\_\_\_

Course name(s): Chemistry in Our Community

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):

CHEM 101 is offered Fall and Spring with 40-45 students per section. Julia Fulghum teaches CHEM 101 in the Fall (as part of a big-little FLC) and Alisha Ray teaches in the Spring. Alisha will also be participating in the implementation and assessment of "writing to learn" in Spring 2016 if the proposal is funded. She is on maternity leave Summer and Fall 2015 and therefore is not participating in the initial planning. Alisha and Julia already work together closely - attending each other's lectures, meeting regularly throughout the year and sharing development of course materials.

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

In Fall 2014, 21 of 42 students enrolled in CHEM 101 identified as STEM-H majors (STEM or health-related) majors. The main objective of this research is to assess the effectiveness of a "Writing to Learn" approach in increasing student success in CHEM 101, as partly measured by improvements in student answers to short answer and essay questions (compared to student responses in Fall 2014, all of which are available), students' increased confidence in writing and course content, students' increased positive attitudes toward writing and course content, and students' retention rates in their STEM-H major.

The research questions for this project are as follows:

1. Does an increased focus on writing as it relates to course content improve students' success in the course?
2. Does the scaffolding of smaller writing assignments increase students' understanding of course content?
3. Does the scaffolding of smaller writing assignments increase students' success on the completion of their larger assignments (e.g. unit exams) in the course?
4. Does a greater focus on writing increase students' confidence in the course subject matter?
5. Does a greater focus on writing increase students' confidence in themselves as writers?
6. Does a greater focus on writing increase students' positive attitudes toward course content?
7. Does a greater focus on writing increase students' positive attitudes toward writing?
8. Does a great focus on writing increase students' retention in their identified STEM-H major?

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

As Kuh (2008) illustrates in *High-Impact Educational Practices*, “educationally purposeful activities” can have a dramatic, positive effect on students, perhaps most notably on the GPA of Hispanic students in their first academic year (p. 18) and on African American students and the probability they will return for their second year of college (p. 19). One of these high-impact practices described by Kuh includes “Writing-Intensive Courses.” Through these courses, “Students are encouraged to produce and revise various forms of writing for different audiences in different disciplines” (Kuh, p. 10). Through what Richard H. Haswell (2005) calls “RAD” research – that which is repeatable, aggregable, and data-driven – this project seeks to design and assess a “Writing to Learn” (WTL) curriculum for CHEM 101, a gateway course for STEM and Health majors, as a positive example of the high-impact practice Kuh describes for “Writing-Intensive Courses.” Specifically, we will design and assess the impact of writing to learn assignments on students' increased understanding of course content, their grades on course assignments and exams, their pass rates in the course, their attitudes about chemistry, their attitudes about writing, their attitudes about themselves as STEM students, their attitudes about themselves as writers, and their rate of retention with a STEM-H major. We are particularly interested in the effect of a WTL approach on first-generation college students, women, and students of color.

The effectiveness of the CHEM 101 WTL curriculum, collaboratively developed by Chemistry and English faculty, will be assessed through the examination of data collected (IRB approval #23614) beginning in Fall 2015 from student pre- and post-surveys, responses to written assignments, assignment and course grades, attendance records, and focus groups as well as instructor interviews. Student demographic information will also be collected. Analysis includes a search for means among quantitative data and thematic patterns among qualitative data.

## 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).

Below is a list of the current student learning outcomes for CHEM 101. The redesigned WTL approach will place particular focus on learning outcomes #2, 4 and 6 through small in-class, out-of-class, individual, and paired writing assignments.

1. Define and explain basic chemical terms, principles and concepts. Recognize simple compounds.
2. Interpret information from data presented in charts, graphs, tables and spreadsheets.
3. Balance chemical and nuclear reactions.
4. Conclude whether or not a statement has both a logical and a scientific basis.
5. Identify reliable government and scientific websites for accessing data relevant to current local, national and international issues.
6. Understand and explain the basic chemistry behind and major issues of debate concerning air quality, global climate change, use of fossil fuels, nuclear power, alternative energy and water quality.

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

The effectiveness of a WTL approach in CHEM 101 and students' progress with the above course outcomes will be assessed, as described above, through the examination of data collected (with IRB approval #23614) beginning in Fall 2015 from student pre- and post-surveys; small in-class, out-of-class, individual, and paired writing assignments and corresponding rubrics; assignment, exam and course grades, student focus groups, and instructor interviews. We will also compare the quality of students' written responses to those from the previous academic year.

## B. Preliminary Redesign Plan (*continued*)

3. Describe the teaching methods that you 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.

As described by David R. Russell, “the WAC [Writing Across the Curriculum] movement is an effort to improve education by encouraging students to write in many fields (or content areas)” (3). The WAC movement arose from the belief that writing is a social process and dependent upon “the communities, organizations, and purposes for which students– and professionals – write” (Russell 9). However, WAC does not simply aim “to develop students’ writing but, more importantly, to develop learning through writing” (Russell 12). This writing to learn approach is one of the “educationally purposeful activities” noted by Kuh (2008) as a high-impact practice that can have a dramatically positive effect on students, particularly among minorities.

For each unit of CHEM 101, we will design small in-class and out-of-class writing assignments with corresponding rubrics that help students build their knowledge of and confidence in each unit topic in preparation for the unit exam and with the above listed student learning outcomes in mind.

While there is a body of literature on the implementation and assessment of Writing to Learn in STEM courses, and more specifically in chemistry courses (see Agutter, 1987; Beall, 1991; Beall, 1998; Bering, 1991; Gilson, 1990; Greene, et al, 1990; Rutz, 2002; Sherwood, 1999; Stout, 2011), this research will contribute to this body of literature in two very distinct ways: 1) the culturally diverse institutional context of this study, a Hispanic Serving Institution, and 2) the examination of a chemistry class containing both majors and non-majors. The latter is a particularly interesting aspect of this course as it will allow us to contrast the effect of a WTL approach on STEM-H majors versus non-majors and whether the WTL approach encourages non-majors to declare themselves STEM-H majors.

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

In addition to sharing our course materials for CHEM 101 with other faculty who teach this course, we will offer a hands-on “Writing to Learn” workshop for faculty in STEM departments who may be interested in implementing this approach. We will also share our teaching and research via the Lightning Lounge presentations organized by the Associate Provost for Faculty Development and seek opportunities through OSET and CTE to provide additional hands-on workshops on a WTL approach across the disciplines.

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

We will continue to collaborate in revising this course as we learn from the student and instructor data collected, as described above, and student final course evaluations. The assignments will be closely linked to both the SLO's and associated general education course assessment and the separate assessment required for the FLC (critical thinking, integrative thinking, teamwork). This close tie to on-going course assessment will assist in improving and sustaining these new course components.

### 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 participating in the events and processes described on p.7 as a member of the STEM Gateway Faculty Learning Community

Primary applicant; name Julia Fulghum

Rank/Position Professor, Chemistry and Chemical Biology

Number of years teaching this course 4 (3 years, totaling 6 sections, at Kent State, 1 at UNM)

Typical number of sections of this course taught each year 1 (+1 section taught by A. Ray)

Project partner (optional) Cristyn L. Elder

Rank/Position Assistant Professor, English

Number of years teaching this course N/A

Typical number of sections of this course taught each year N/A

*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? Yes

If yes, who? Hua Guo and Joe Ho for CHEM 131/132

*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 and 15 (9 am to 3:30 pm each day) and May 18 (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 Julia Gulghum

Signature

Project partner (if applicable)

Printed name Crystyn Elder

Signature Crystyn L Elder

Digitally signed by Crystyn L Elder  
DN: cn=Crystyn L Elder, o=University of New  
Mexico, ou=central@unm.edu, c=US  
Date: 2015.03.29 08:26:20 -0700



Stephen Cabaniss, Professor and Chair  
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Phone: 505.277.6655

March 30, 2015

Prof. Gary Smith  
STEM Gateway Individual Course Redesign Project

Dear Prof Smith:

I am writing in strong support of the redesign proposal for CHEM 101 being submitted by Drs. Julia Fulghum and Cristyn Elder. Chemistry in Our Community (CHEM 101) was offered for the first time at UNM during Spring 2014. This course is designed for non-science majors, however we have observed that it is attracting a surprising number of STEM-H majors. These students either have math deficiencies keeping them from starting CHEM 111 or CHEM 121 or self-report that they lack confidence in their basic chemistry knowledge. As the “writing to learn” approach is predicted to improve both mastery of course material and confidence, this is a particularly interesting group of students for the proposed work.

Julia Fulghum teaches CHEM 101 as part of an FLC in Fall semesters, paired with C&J 130 (public speaking). A regular section of CHEM 101 is offered in the Spring, taught by Alisha Ray. Julia and Alisha are developing the course together and attend each other’s lectures during the semesters they are not teaching. A significant amount of course material involves local examples and current topics in the media, and lectures are updated each semester and shared by Julia and Alisha. I am thus confident that given the existing working relationship, “writing to learn” activities piloted in Fall 2015 will also be used during Spring 2016. Alisha will be on maternity leave during Summer and Fall 2015, otherwise she would be included as an active partner on this proposal.

The CCB faculty teaching freshman chemistry courses have an outstanding track record of learning from each other and sharing successful course innovations. Julia and Alisha both serve on the undergraduate curriculum committee and are well-positioned to discuss “writing to learn” activities and their impact with other CCB faculty during the initial phases. As Sushilla Knottenbelt is currently doing a small pilot project with Cris Elder (which Julia and Alisha are actively following), a more involved “writing to learn” experiment has the potential to benefit freshman chemistry courses beyond CHEM 101.

CCB is committed to CHEM101 and Julia has committed to both A&S and University College to keep teaching CHEM101 as an FLC for at least the next 5 years, while Alisha is planning to continue teaching CHEM101 during this period. The department will provide continuing funds to support on-going development.

Thank you for considering our proposal. If you have any further questions, please do not hesitate to contact me at 272-6655 (Office Phone) or by e-mail at [cabaniss@unm.edu](mailto:cabaniss@unm.edu).

Sincerely,

Stephen Cabaniss, Professor and Chair  
Chemistry & Chemical Biology



