"Writing to Learn" in CHEM 101: Chemistry in Our Community
STEM Gateway Course Redesign
Executive Summary

by
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August 16, 2016

Project Motivation and Goals

This course redesign and resulting empirical study assesses the effectiveness of a "Writing to Learn" (WTL) approach on increasing student success among STEM-H and non-STEM-H majors enrolled in CHEM 101: Chemistry in our Community.

Project Summary

For each unit of CHEM 101, we designed a low-stakes, out-of-class writing assignment with corresponding rubrics aimed at helping students build their knowledge of and confidence in each unit topic in preparation for the unit exam (see Figure 1).

Figure 1: CHEM 101 Textbook Unit and Corresponding Writing Assignment

Textbook Unit	**Corresponding Writing Assignment**
Ch. 1: The Air We Breathe	"Clean Living"
Ch 2: Protecting the Ozone Layer	"Understanding Ozone"
Ch 4: Energy from Combustion	"Understanding Coal"
Ch 5/6: Water for Life/Acid Rain	"Understanding Acid Rain"
Final Writing Assignment	"Dear Resident of the Mesozoic"

Assessment

The effectiveness of a WTL approach in CHEM 101 was assessed through the examination of data collected (with IRB approval #23614) beginning in Fall 2015 and continuing into Spring 2016 using the following assessment tools:

- student pre- and post-course surveys
- low-stakes, out-of-class, individual writing assignments
- assignment, exam, and course grades
- student focus groups
- instructor interviews

Initial survey data indicates an overall positive increase to no change in students' attitudes about CHEM 101 and students' abilities in the course. In end-of-semester focus groups, students reported that the WTL assignments aided in increased understanding of course concepts, increased engagement with course content, increased transferability of knowledge and skills to other courses, and an increased understanding of real-world applications for chemistry. There was no correlation between students' performance on writing assignments and their overall unit exam or course grades, although students did perform better overall on test items related to WTL assignment content than in previous semesters.

Improvement
Future improvements to CHEM 101 will include increasing the number and variety of WTL assignments for rotation over various semesters; a revision of unit exams to include more written, short-answer questions to reflect class activities; and more explicit discussion on defining and avoiding plagiarism.

Expansion
This STEM Gateway Course Redesign project is an expansion in itself of research previously and simultaneously begun by Dr. Cris Elder with Professor Karen Champine for MATH 129: Survey of Math and MATH 162: Calculus I as well as with Dr. Sushilla Knottenbelt for CHEM 122: General Chemistry II. Professor Ray presented in July 2016 on the CHEM 101 redesign project at the 2016 Biennial Conference on Chemical Education (BCCE) in Greeley, Colorado. Dr. Elder has been asked by the Center for Teaching Excellence (CTE) to facilitate workshops on a WTL approach for faculty in additional disciplines. Furthermore, we are writing up our results for submission to two different journals reflecting our disciplinary expertise: The *WAC Journal* and the *Journal of Chemical Education*.

Sustainability
Sustaining the redesign will include our continued collaboration on low- and mid-stakes writing assignments to support students' learning of course content; our continued assessment of students' increased success as it related to a WTL approach, and further publication of our efforts.

Challenges
We will continue to create a large enough range of WTL assignments so that plagiarism among peers doesn't become an issue across semesters and so course content in relation to the writing assignments stays current and relevant. However, without the continued funding and assistance of an undergrad TA to perform the grading of even lower-stakes assignments and some course administration, providing feedback on the WTL assignments may not be sustainable, at least in their current format.

"Writing to Learn" in CHEM 101: Chemistry in Our Community
STEM Gateway Course Redesign
Final Report

By
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Prepared for Dr. Gary Smith and Audriana Stark
August 16, 2016

Project Motivation and Goals

The main objective of this research is to assess the effectiveness of a "Writing to Learn" approach in increasing student success among STEM-H and non-STEM-H majors enrolled in CHEM 101: Chemistry in our Community. The effectiveness of the WTL approach is measured through students' answers to low-stakes writing assignments and their responses to corresponding test items, students' increased confidence in course content, and students' increased positive attitudes toward the course. We are particularly interested in the effect of a WTL approach on first-generation college students, women, and students of color.

As George 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). 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 WTL curriculum for CHEM 101 as a positive example of the high-impact practice Kuh describes for "Writing-Intensive Courses."

The research questions guiding 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 lower-stakes assignments increase students' success on the completion of higher-stakes assignments (e.g. unit exams) in the course?
3. Does a greater focus on writing increase students' confidence in the course subject matter?

4. Does a greater focus on writing increase students' positive attitudes toward course content?

Below is a list of the current student learning outcomes for CHEM 101. The redesigned WTL approach placed a particular focus on learning outcomes #1 and #6 through low-stakes, out-of-class, individual 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.*

Project Summary

For each unit of CHEM 101, we designed a low-stakes, out-of-class writing assignment (five assignments in total) with corresponding rubrics aimed at helping students build their knowledge of and confidence in each unit topic in preparation for the unit exam with the above student learning outcomes in mind. The unit and corresponding writing assignment are listed in Figure 1 below.

Figure 1: CHEM 101 Textbook Unit and Corresponding Writing Assignment

Textbook Unit	**Corresponding Writing Assignment**
Ch. 1: The Air We Breathe	"Clean Living"
Ch 2: Protecting the Ozone Layer	"Understanding Ozone"
Ch 4: Energy from Combustion	"Understanding Coal"
Ch 5/6: Water for Life/Acid Rain	"Understanding Acid Rain"
Final Writing Assignment	"Dear Resident of the Mesozoic"

Detailed guidelines and rubrics for the above-listed assignments can be found in Appendix A.

Assessment

The effectiveness of a WTL approach in CHEM 101 and students' progress with the above course outcomes was assessed through the examination of data collected (with IRB approval #23614) beginning in Fall 2015 and continuing into Spring 2016 using the following assessment tools:

- student pre- and post-course surveys
- low-stakes, out-of-class, individual writing assignments

- assignment, exam, and course grades
- student focus groups
- instructor interviews.

Student demographic information was also collected. Analysis includes a search for means among quantitative data and thematic patterns among qualitative data.

Summary of Survey Data Results[1]

Because we were interested in whether WTL assignments might make students' access to course content easier and therefore possibly have a positive influence on students' attitudes about the course and subject matter, most survey items were focused on measuring students' changes in attitude about the course. Although we cannot make claims regarding correlation, overall students' attitudes about CHEM 101 and their abilities in the class largely improved or stayed the same, as reported in Table 1 below. What is perhaps significant to note is that, in response to the survey items "I am good at CHEM 101" and "I like CHEM 101," when movement over the course of the semester in students' attitudes was negative, this movement tended to be one point on a 5-point Likert scale (e.g., from 3: Not sure to 4: Disagree or 2: Agree to 3: Not Sure) while positive movement on the same scale tended to move one to three points (e.g., from 4: Disagree to 2: Agree or 1 Strongly Agree).

Table 1: Summary of Survey Results on Students' Attitudes about CHEM 101

Term	Survey Item	Positive change in attitude	No change in attitude	Negative change in attitude
Fall 2015	I am generally good at CHEM 101.	N=10	N=10	N=2
	In general, I like CHEM 101.	N=8	N=11	N=2
Spring 2016	I am generally good at CHEM 101.	N=6	N=4	N=3
	In general, I like CHEM 101.	N=5	N=3	N=5

[1] Complete survey tools and survey data in raw numbers are available upon request.

Summary of Focus Group Interviews[2]

Consented students participated in end-of-semester focus groups for CHEM 101 in fall 2015 and Spring 2016 (N=15 participants each semester). Students were asked to comment on how the writing assignments contributed to their learning (or not). Below we have identified five main themes in students' reactions and have included representative comments:

First, students commented on how the act of researching and writing the assignments helped improve their understanding of course concepts. As one student wrote, "[W]henever she gives us a writing assignment that pertains to what she's teaching, we'll like research all of it, learn and have to write it down to make sure that we know what she's talking about."

Relatedly, students commented on how the writing assignments helped them engage more with the course material: "One thing that I did notice, in the way that it did help me is because it, chemistry really interests me, but I wouldn't have put in the time outside of class to look into a subject area, and I actually learned a lot because I had to do some research outside."

Other students noted the transferability of information or skills that occurred in other classes as a result of completing the writing assignments: "I'm also taking Environmental Science, and there were clicker questions about the ozone, so it was pretty cool because of the guys that sat next to me, my friends, I was like telling them which one it was because I remembered how I had to look for information to write the paper and we actually got all those clickers right."

And, finally, students commented that they appreciated having the writing assignments as a way to think through the real-world application(s) of course content: "I also liked that they were like more real world application of the science that we were learning and it gave you, like, a reason to be, like, oh, what is this that we're learning, and not just, like, the facts I guess, like the why. The why behind it. "

Summary of WTL Assignment and Test Grades

Table 2 below compares the average test and final course grades for CHEM 101 in Fall 2014 (when WTL assignments were not incorporated) and in Fall 2015 (when WTL assignments were given). Overall, the Fall 2015 class performed somewhat weaker than the Fall 2014 class (based on a comparison of average test and final course grades).

[2] Complete focus group transcripts are available upon request.

Table 2: Average Test Grades for Fall 2014 (a non-WTL semester) and Fall 2015 (a WTL semester)

	Average Grade	
	Fall 2014	**Fall 2015**
Test 1	78.6	78.4
Test 2	80.1	75.4
Final	88	84.6
Course grade	89.7	86.8

However, as Table 3 depicts below, the Fall 2015 class did better than the course section from the previous year on most of the test questions related to the WTL topics. What this could mean is that, despite the Fall 2015 students being possibly weaker students overall, as demonstrated on exams and final course grades, they perhaps did better than they normally would have in the class as a result of the WTL assignments and students' performance on those specific test items.

Table 3: Percentage of Test Items Related to WTL Assignments that Students Answered Correctly

Multiple Choice Questions related to WTL assignments		
	Fall 2014	**Fall 2015**
	% Correct	**% Correct**
Topic		
Test 1		
Photochemical Smog requires	71.4	92.0
Ozone important because	90.5	100.0
Montreal Protocol	88.1	94.0
Chapman Cycle	48.8	71.0
Test 2		

Natural acidity of rain	82.9	51.0
Anthropogenic source of Sox	92.7	94.0
pH of unpolluted rain	90.2	85.0
Sox and Nox re acid rain	58.5	70.0
Final		
Strategy to reduce CO2 emissions	100.0	92.0
Anthropogenic pollutants in acid rain	76.9	97.0
Sox and Nox re acid rain	74.4	82.0

Improvement

In light of our assessment results for this project and experiences teaching CHEM 101 with a WTL approach, we plan to make the following pedagogical changes in the coming semesters:

- Already over the first semester we have made revisions to the assignment guidelines and rubrics to make them clearer for students and to make the rubric easier to use. Based on these revisions, we'll continue using the same assignments and rubrics in fall 2016.
- A number of students in the focus groups reported that they felt it would be useful to their learning to increase the number of writing assignments. Therefore, because the assignments for chapter one and two are different enough, the whole class will be asked to complete each one (rather than having half the class write about chapter 1 and half the class write about chapter 2.
- Because the material for the writing assignments for chapters four and five overlap so much, half the class will continue to complete the writing assignment for chapter four and half the class will complete chapter five.
- The final assignment will remain optional, allowing students who did not perform well on a previous writing assignment to have the chance to make up for it.
- We will emphasize for students that they should complete the assignments based on their understanding of the topics from the lecture, their notes, and the book, rather than spending a lot of time researching topics through outside resources.
- In the medium-term, we will need to develop additional WTL assignments so they may be rotated during different semesters in order to reduce the chance for plagiarism across sections.
- In Spring 2016, unit exams did not include any short-answer questions. In order to better reflect the use of WTL assignments as low- and medium-stakes activities in

preparation for unit exam, short-answer questions will be included in future semesters.

- We are considering newly reserving one class period for a library session on how to evaluate the reliability of Internet sources, how to cite them, and how to avoid plagiarism more generally. Although the preference is that students use only course materials for their writing assignments, we suspect they may continue to search online, and we want them to do so more effectively.

Expansion

This STEM Gateway Redesign Project is an expansion in itself of research previously and simultaneously performed. Dr. Cris Elder began research on a WTL approach in STEM courses on UNM's campus with Professor Karen Champine for MATH 129: Survey of Math and MATH 162: Calculus I as well as with Dr. Sushilla Knottenbelt for CHEM 122: General Chemistry II. This redesign project is then, in a sense, an expansion of that work. However, more specific to CHEM 101 and the STEM Gateway grant, we initiated this study and WTL approach in Dr. Fulghum's Fall 2015 CHEM 101 course and expanded it to include Professor Ray's Spring 2016 CHEM 101 course. Professors Fulghum, Ray, and Elder will continue working together to create additional low- and medium-stakes assignments for CHEM 101 to be rotated throughout various semesters for the course.

Our expansion of this redesign project will continue to take place in other locations on campus as well. Dr. Elder has been asked by the Center for Teaching Excellence (CTE) to present on a WTL approach in August 2016 to the 2016-2017 CTE Teaching Fellows and in a separate Get Set/Reset Workshop for faculty from across campus.

Furthermore, we have identified venues beyond our institution through which we can share our project results. This summer, for example, Professor Ray and Dr. Sushilla Knottenbelt, in collaboration with Drs. Fulghum and Elder, separately presented on different aspects of the redesign project at the 2016 Biennial Conference on Chemical Education (BCCE) in Greeley, Colorado. Additionally, we have plans to write up a description of our redesign and publish our project results in two different journals, each one reflecting the disciplinary audience of the researchers involved in this project: The *WAC Journal* and the *Journal of Chemical Education*.

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), our 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 the CHEM 101 course, as it will allow us to contrast the effect of a WTL approach on STEM-H majors versus non-majors.

Sustaining
Much of our efforts in sustaining the pedagogical innovations in CHEM 101 as supported by the STEM Gateway Grant have been described above in the ways that we plan to expand on this work. Namely, sustaining the redesign will include our continued collaboration on low- and mid-stakes writing assignments to support students' learning of course content; our continued assessment efforts in the way of student surveys, focus groups, and analysis of students' success on written assignments and corresponding exam items; and the professional publication of our efforts.

Challenges
The major challenges faced in the completion of this project are not necessarily one's we have experienced thus far but are ones we can foresee.

To begin with, we'll need to create a large enough range of WTL assignments so that plagiarism among peers doesn't become an issue across semesters. Also, we'll want to continue designing additional assignments so that course content in relation to the writing assignments stays current and relevant. Relatedly, we'll need to spend additional class time helping students understand plagiarism and how to avoid it as well as discourage students' use of the Internet when completing some of the WTL assignments.

Professors Fulghum and Ray currently have time to grade the WTL assignments because they have an undergrad TA who does some of the even lower stakes grading, course administration, and some office hours. Without an undergrad TA, the WTL assignments might not be sustainable, at least in their current format.

A final challenge is related to the assessment of the WTL approach in CHEM 101. The response rate to the student surveys was inconsistent over the course of the semester. In other words, while some students completed survey #1, they might not have completed one or more of the additional three surveys in fall 2015 or additional two surveys in spring 2016. This made measuring some students' changes in attitude about the class or course topic impossible to measure. In order to increase the response rate to the surveys, we will amend our IRB materials, requesting a consent waiver for the surveys, as they are a part of regular program assessment. With this change, we hope to be able to require the completion of the anonymous surveys as homework in order to increase the response rate and consistency of completion across surveys. (We will still ask students to consent to participation in the focus groups.)

Appendix A

CHEM 101: Chemistry in Our Community **University of New Mexico**
Chapter One: The Air We Breathe

Writing Assignment: "Clean Living"

Due _____ in class as a printed Word document. Double-spaced. 12-point font.

The *Daily Lobo* is celebrating Sustainability Week by soliciting advice from student Lobos on how to live a "cleaner lifestyle." First, for yourself, brainstorm or bullet point 8 ways your lifestyle contributes (positively and negatively) to the "air prints" discussed earlier in chapter one beginning on page 17. Think about your activities at home, at play, at school, and at work. Selecting from that list, write an article for *Daily Lobo* readers that addresses the bullet points below. You don't have a lot of space, so stay focused while you cover the following concepts in your remarks:

- **write half a page** (about 250 words) describing one positive air print you leave on your environment and how it creates a positive effect
- **write an additional whole page** (no more than 500 words) describing one negative air print you leave on your environment and its source (i.e., specific air pollutants). Suggest how you might reduce the impact of the negative air print. Include steps that you (and perhaps your fellow Lobos) can take over the course of the semester to reduce this negative impact.

Feel free to use illustrations as a part of your explanation(s). However, illustrations are not required and will not count toward the 1.5 page limit (or 750 words).

With your focused attention, this project should not take more than three hours to complete.

Your assignment will be evaluated using the following rubric:

Criteria for "Clean Living" Writing Assignment	**2** Well addressed	**1** Minimally addressed	**0** Not addressed
· Describes one positive air print	2	1	0
· Describes one negative air print and its source(s)	2	1	0
· Provides a suggestion for how to reduce the source of the negative impact	2	1	0

· Includes at least one step that can be reasonably taken by the end of the semester by you (and other Lobos)	2	1	0
· Uses chemistry vocabulary correctly	1	0.5	0
· Uses clear language and grammar to describe the above for a general, non-chemist audience	1	1	0
TOTAL (maximum 10 points):			

CHEM 101: Chemistry in Our Community **University of New Mexico**
Chapter 2: Protecting the Ozone Layer

Writing Assignment: "Understanding Ozone"

Due Tuesday, _____ in class as a printed Word document. Double-spaced. 12-point font.

You are a contributor to *Ask a Lobo*, a website that connects UNM college students with students at underprivileged high schools around the state. You write the science page and respond to questions from high school students. One student is having a difficult time understanding the difference between ground-level ozone (or ozone in the troposphere), the ozone layer (or ozone in the stratosphere), and the ozone depletion over Antarctica and how the ozone can be good and bad at the same time. Write a response in your own words (**no more than 750 words**) to this student addressing the following:

- Contributors to and the negative effects of ozone in the troposphere
- Importance of ozone as a UV radiation absorber
- Contributors to ozone depletion in the stratosphere
- Why stratospheric depletion is most severe over Antarctica

Feel free to use illustrations as a part of your explanation(s). However, they are not required and will not count toward the word limit (750 words).

With your focused attention, this project should not take more than three hours to complete.

You writing will be evaluated using the following rubric:

Criteria for Writing Assignment Understanding Ozone	**2** Well addressed	**1** Minimally addressed	**0** Not addressed
Explains the contributors to and negative effects of ozone in the troposphere	2	1	0
Explains the importance of ozone as a UV radiation absorber	2	1	0
Explains the contributors to ozone depletion in the stratosphere	2	1	0
Explains why stratospheric depletion is most severe over Antarctica	2	1	0
Uses chemistry vocabulary correctly	1	.5	0
Uses clear language to describe the above for a general, non-chemist audience	1	.5	0
TOTAL (maximum 10 points):			

CHEM 101: Chemistry in Our Community **University of New Mexico**
Chapter 4: Energy from Combustion

Writing Assignment: *"Understanding Coal"*

Due _____ in class as a printed Word document. Double-spaced. 12-point font.

You are serving in your first year as an elected representative on the Farmington City Council. After a March 5 work session, Public Service Company of New Mexico (PNM) (the company that provides the state's electricity), the state of New Mexico, and the Environmental Protection Agency have come to an agreement regarding the continued operation of power generation at San

Juan Generating station (pictured here). Per the agreement, by December 31, 2017, PNM will retire coal-fired Units 2 and 3 and install emissions controls on Units 1 and 4. This will reduce PNM's reliance on coal from 60% to 40%[3] as well as decrease the production of power. Some of your constituents are concerned about the yet unknown impacts this decrease will have on the local economy and the cost of power to residents. Due to your background in chemistry, the City Council has asked you to address voters at the next council meeting so that voters might get behind this already approved plan. Your remarks will also appear in the next city newsletter. You don't have a lot of time or space, so stay focused while you cover the following three concepts in your remarks (**no more than 750 words**):

- the disadvantages of coal as a fuel
- the components of emissions that are a health hazard
- how emissions from coal-powered plan decrease visibility

With your focused attention, this project should not take more than three hours to complete.

Criteria for Writing Assignment "Understanding Coal"	Very well addressed	Well addressed	Minimally addressed	Not addressed
Explains the disadvantages of coal as a fuel source	2	1.75	1.5	0
Explains the emissions components of a coal-powered plant and how they are a health hazard	2	1.75	1.5	0
Explains how emissions from a coal-powered plant decrease visibility in the surrounding areas	2	1.75	1.5	0
Makes true, factual statements about the chemistry used in your explanations	2	1.75	1.5	0
Uses chemistry vocabulary correctly	1	0.75	0.5	0
Uses clear language and grammar to describe the above for a general, non-chemist audience	1	0.75	0.5	0
TOTAL (maximum 10 points):				

[3] http://www.tricitytribuneusa.com/agreement-reached-local-plant-to-close-units-2-and-3-in-2017/

CHEM 101: Chemistry in Our Community **University of New Mexico**
Chapter 5/6: Water for Life/Acid Rain

Writing Assignment: *"Understanding Acid Rain"*

Due _____ in class as a printed Word document.
Double-spaced. 12-point font.

You are serving in your first year as an elected representative on the Farmington City Council. After a March 5 work session, Public Service Company of New Mexico (PNM) (the company that provides the state's electricity), the state of New Mexico, and the Environmental Protection Agency have come to an agreement regarding the continued operation of power generation at San Juan Generating Station (pictured here). Per the agreement, by December 31, 2017, PNM will retire coal-fired Units 2 and 3 and install emissions controls on Units 1 and 4. This will reduce PNM's reliance on coal from 60% to 40%[4] as well as decrease the production of power. Some of your constituents are concerned about the yet unknown impacts this decrease will have on the local economy and the cost of power to residents. Due to your background in chemistry, the City Council has asked you to address voters at the next council meeting so that voters might get behind this already approved plan. Your remarks will also appear in the next city newsletter. You don't have a lot of time or space, so stay focused while you cover the following three concepts in your remarks (**no more than 750 words**):

- the disadvantages of coal as a fuel
- how components of coal fuel emissions contribute to acid rain
- how acid rain is different from unpolluted rain water that is slightly acidic

With your focused attention, this project should not take more than three hours to complete.

Your writing will be evaluated using the following rubric:

Criteria for Writing Assignment "Understanding Acid Rain"	**Very well addresse**	**Well addresse d**	**Minimall y addressed**	**Not addressed**

[4] http://www.tricitytribuneusa.com/agreement-reached-local-plant-to-close-units-2-and-3-in-2017/

	d			
Explains the disadvantages of coal as a fuel source	2	1.75	1.5	0
Explains how the emissions components of a coal-powered plant contribute to acid rain	2	1.75	1.5	0
Explains how acid rain is different from unpolluted rain water that is slightly acidic	2	1.75	1.5	0
Makes true, factual statements about the chemistry used in your explanations	2	1.75	1.5	0
Uses chemistry vocabulary correctly	1	0.75	0.5	0
Uses clear language and grammar to describe the above for a general, non-chemist audience	1	0.75	0.5	0
TOTAL (maximum 10 points):				

CHEM 101: Chemistry in Our Community **University of New Mexico**

Writing Assignment: "*Dear Resident of the Mesozoic"*
Due _____

Dinosaur Discovery!
It's been an exciting month for dinosaur fans everywhere and particularly for Amanda Cantrell, the geoscience collection manager for the New Mexico Museum of Natural History and Science. Pictured below, Cantrell found the skull of a baby Pentaceratops, the first ever to be discovered, in the Bisti/De-Na-Zin Wilderness area south of Farmington, N.M.

Amanda Cantrell inspects the condition of a juvenile Pentaceratops fossil on Thursday, Oct. 29, 2015. (Jon Austria/The Daily Times via AP)

As reported by the Associated Press, visitors to the New Mexico Museum of Natural History and Science, where the Pentaceratops is now housed, will be able to watch from

behind windows as paleontologists and technicians work to remove the dinosaur fossil from the rock where "it has been encased for some 70 million years."[5]

The Pentaceratops likely used its horns and shield-like part of its skull both for defense and to attract potential mates. (University of Bath/Facebook)

Public Response

While some have responded to the dinosaur's discovery by lining up outside the museum to get a glimpse of the baby Pentaceratops, others have viewed the dinosaur's discovery in the high desert as evidence that climate change is a natural event independent of human actions or involvement. For example, five days after the Pentaceratops' unveiling, John J. Schinkle of Los Lunas wrote the following letter titled "Temperatures fluctuate on their own" to the editor of the *Albuquerque Journal* (November 10, 2015, A7):

Temperatures fluctuate on their own

NASA HAS RELEASED the latest Antarctic ice satellite data, and it reveals that the Antarctic ice sheet is growing, not shrinking. This is noteworthy given that most of the planet's glacial ice is contained within Antarctica, with Greenland a distant second and alpine glaciers a far distant third.

Carbon dioxide opponents predicted that the Antarctic ice would melt. Instead it is increasing.

The growing Antarctic ice sheet is distressing news for solar panel and windmill investors who allege that carbon dioxide generated by fossil fuels is causing global warming.

This is also disturbing news for politicians who receive large donations from investors in solar panels and windmills.

Many costly government-funded research grants have attempted to estimate the probability of a sea level rise due to melting Antarctic ice. Last year dozens of government "scientists" sailed to Antarctica to observe the melting ice. Their ship became intractably stuck in an immense expanding ice sheet.

The government sightseers were eventually rescued. Meanwhile politicians remain stuck in a perverse belief that carbon dioxide generated by fossil fuels causes global warming.

The simple fact is that global temperatures have fluctuated between ice ages and temperate periods dozens of times.

Dramatic evidence of natural climate fluctuation can be seen in northwestern New Mexico in the desolate Bisti De-Na-Zin Wilderness. Last week, the fossilized skeleton of a pentaceratops was transported from the Bisti to the New Mexico Museum of Natural History and Science. That dinosaur survived on lush foliage that grew along many riverbanks.

Replacing efficient and reliable fossil fuel plants with expensive and unreliable windmills and solar power will not change inevitable global climate fluctuation.

At one time northwestern New Mexico was a coastal swamp. And there were not many fossil fuel power plants in the Mesozoic Era.

JOHN J. SCHINKLE
Los Lunas

…The simple fact is that global temperatures have fluctuated between ice ages and temperate periods dozens of times.

Dramatic evidence of natural climate fluctuation can be seen in northwestern New Mexico in the desolate Bisti De-Na-Zin Wilderness. Last week, the fossilized skeleton of a pentaceratops was transported from the Bisti to the New Mexico Museum of Natural History and Science. That dinosaur survived on lush foliage that grew along many riverbanks.

Replacing efficient and reliable fossil fuel plants with expensive and unreliable windmills and solar power will not change inevitable global climate fluctuation.

At one time northwestern New Mexico was a coastal swamp. And there were not many fossil fuel power plants in the Mesozoic Era.

Your Task:

You are a student volunteer at the New Mexico Museum of Natural History and Science. As such, you feel compelled to respond to Schinkle's letter, which employs a number of logical fallacies, including begging the question and cherry picking data. For example, although, as we have discussed in class, wind and solar are intermittent energy sources, Schinkle dismisses them out of hand as expensive and unreliable. In your own letter, respond to the following from the letter excerpt above:

1. Discuss any errors you see with Schinkle's argument.

[5] http://www.cbc.ca/news/technology/new-mexico-dinosaur-pentaceratops-unveiling-1.3306269

2. Discuss why wind and solar are particularly feasible in New Mexico.
3. Explain in general terms how humans contribute to climate change. Offer 2-3 pieces of data/types of evidence to support your argument that humans do in fact contribute to climate change.

Criteria for Evaluation	Very well addressed	Well addressed	Minimally addressed	Not addressed
Explains how Schinkle's argument is flawed.	2	1.75	1.5	0
Explains why wind and solar are particularly feasible in New Mexico.	2	1.75	1.5	0
Explains how humans contribute to climate change with 2-3 types of evidence.	2	1.5	1.0	0
Uses chemistry vocabulary correctly	1	0.75	0.5	0
Makes true, factual statements about the chemistry used in your explanations	2	1.5	1.0	0
Uses clear language and grammar to describe the above for a general, non-chemist audience	1	0.75	0.5	0
TOTAL (maximum 10 points):				