Abstract: Beginning in the fall 2014 semester, we were provided with funding to develop a Writing to Learn (WTL) program in the College of Natural Sciences at Colorado State University. The first year of the program has been devoted to developing faculty understanding of WTL, to the development of WTL activities - specifically in Mathematics and Physics, and to exploring the importance and best approaches to giving meaningful feedback. We asked, "How might writing deepen learning and influence the student experience in gateway courses across the College of Natural Sciences?" We drew upon Writing Across the Curriculum theory particularly as it relates to low-stakes write-to-learn/write-to-engage approaches. These approaches provide tools for student exploration of conceptual understanding and low-effort assessment approaches for faculty and GTAs. The first year of the program has been focused not only on the processes and goals of writing for engagement but also on faculty identification of the central disappointments with student math understanding that our WTL program hopes to address. Preliminary results indicate that students who participate in writing activities that are incorporated in the classroom as well as outside of the classroom perform better on exam questions. These findings suggest that well designed writing interventions can positively affect math and science learning.

In this presentation we will provide the framework of the WTL program, provide prompts that emerged from our processes, share sample student responses, and provide preliminary results.

FRAMEWORK:
1. Discuss and write about the frustrations with student understanding
2. Discuss and write about the deeper goals that students often leap over in their effort to “solve the equation”
3. Discuss the implications to later courses of shallow learning
4. Agree upon the central goals and what’s lost in terms of “coverage” when addressing them
5. Develop writing prompts -- draft, test, revise
6. Distinguish daily writing prompts from synthetic ones
7. Upload examples to dropbox for sharing with others
8. Test with whole classes and compare
9. Revise prompts
10. Work on syllabus information
11. Work on how to respond to student writing
12. Work on changes required for GTA preparation
**Desired Project Outcomes:**

A **learning community of faculty** will support faculty as they adopt more robust teaching techniques, enabling them to:

1. Learn how to implement writing assignments in science courses.
2. Better their understanding of student comprehension in gateway courses.
3. Support students in their development as scientific thinkers, and help students become more metacognitive.
4. Learn how to provide effective feedback on writing assignments. [1]
5. Train the next generation of science teachers who will experience the benefits of engaging in deep learning of science content.

The WTL program in CNS courses will enhance student learning in the following ways:

1. Increase student engagement, enjoyment, and appreciation of subjects in CNS.
2. Help students abandon shallow approaches to earning in favor of developing metacognitive abilities, enhancing student’s ability to synthesize new information, think critically, and transfer knowledge to new situations.
3. Shift from a focus on grades to challenging deeply ingrained misconceptions.
4. Develop learning skills that transcend subject area.

We also believe that this project will produce desirable course outcomes:

1. Development of a set of activities that incorporate writing into gateway courses in mathematics and physics.
2. Examples of writing assignments that could be envisioned for a course like PH 121 are:
3. Sense making activities – students will be asked to describe, in words, the physical realities embodied in equations such as Ohm’s Law. Current is proportional to voltage, inversely proportional to resistance—and this makes sense physically. Expressing the reasons for the relationship will help them better understand it.
4. Synthesis – students will be asked to describe the content of a unit just finished. For instance: What do we mean when we say “energy is conserved”? 
5. Development of a sustainable learning community of faculty across the College of Natural Sciences that will encourage faculty to learn about and engage in research-supported teaching techniques. As the activities are adopted in the gateway courses, we anticipate that we will create a culture of both teaching and learning in faculty and students alike, that will be sustainable and long term.
6. Independent evaluation design and implementation through the STEM center, with the activities and potential gains in student learning from the implementation leading to at least one scholarly publication.
**Preliminary Results:**

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<thead>
<tr>
<th></th>
<th>Writing Section of Math 160</th>
<th>Non-writing Section of Math 160</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>36</td>
<td>33</td>
</tr>
<tr>
<td>Exam Mean</td>
<td>74%</td>
<td>69%</td>
</tr>
<tr>
<td>Writing Question Mean (out of 8pts) p=0.005</td>
<td>4.3</td>
<td>2.82</td>
</tr>
<tr>
<td>Procedural/Computational Question Mean</td>
<td>13.2</td>
<td>11.9</td>
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