Integrating Writing into an Introductory Environmental Science Curriculum: Perspectives from Biology and Physics

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ABSTRACT
In the University of Washington, Tacoma’s Environmental Science program, we are implementing a curriculum-wide, scaffolded strategy to teach scientific writing. Writing in an introductory science course is a powerful means to make students feel part of the scientific community, an important goal in our environmental science curriculum. Writing is already an important component of the UW Tacoma environmental science program at the upper levels: our approach is designed to prepare students for the writing-intensive junior- and senior-level seminars. The approach is currently being tested in introductory biology and physics before it is incorporated in the rest of the introductory environmental science curriculum. The centerpiece of our approach is a set of research and writing assignments woven throughout the biology and physics course sequences. The assignments progress in their degree of complexity and freedom through the sequence of introductory science courses. Each assignment is supported by a number of worksheets and short written exercises designed to teach writing and critical thinking skills. The worksheets are focused on skills identified both by research in scientific writing and the instructors’ experience with student writing. Students see the assignments as a way to personalize their understanding of basic science concepts, and to think critically about ideas that interest them. We find that these assignments provide a good way to assess student comprehension of some of the more difficult ideas in the basic sciences, as well as a means to engage students with the challenging concepts of introductory science courses. Our experience designing these courses can inform efforts to integrate writing throughout a geosciences curriculum, as opposed to on a course-by-course basis.

CONTEXT / GOALS
The University of Washington, Tacoma is a small (~3000 student), undergraduate-focused campus of the University of Washington that began as a transfer-only school. In 2006, the campus began accepting freshmen and thus needed to develop lower-division courses. The environmental science B.S. degree, part of the Interdisciplinary Arts and Sciences program, is writing intensive. Majors take a pair of upper-level (junior/senior) seminars designed to develop students’ writing, research, data analysis and presentation skills. Students also typically write a substantial paper as a part of their capstone research or internship project. Ideally, lower-division courses should prepare students for the challenges of scientific writing. Science and engineering students on the UW Seattle campus identified the following challenges in scientific writing [Beyer et al. (2007):
- Mastering styles and conventions of scientific writing (’genre knowledge’ of Beaufort (2005)).
- Thinking critically about the subject of their writing (in particular, experimental results).
- Engaging with the scientific literature.

We are currently testing a scaffolded approach to teaching writing in the UW Tacoma introductory biology and physics sequences (Fig. 1). Here we outline how our strategy overcomes some of the challenges faced by science faculty who teach writing.

Fig. 1 Lower division requirements for a “typical” environmental science student, with writing assignments

<table>
<thead>
<tr>
<th>Year</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Biology I</td>
<td>Chemistry I</td>
<td>Biology II</td>
</tr>
<tr>
<td></td>
<td>Group experiment and analysis in “real” research project; independent primary research paper (Forestry Research)</td>
<td>Biochemistry I</td>
<td>Literature review paper (written to explain topic to struggling fellow student)</td>
</tr>
<tr>
<td>II</td>
<td>Physics I</td>
<td>Biology III</td>
<td>Chemistry III</td>
</tr>
<tr>
<td></td>
<td>Nature summaries of laboratory experiments</td>
<td>Proposal; Independent analysis, independent primary research paper</td>
<td>Review paper of interdisciplinary topic (active research)</td>
</tr>
</tbody>
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Challenges in teaching scientific writing for the instructor

Designing Clear Assignments
Consider simpler genres that emphasize same educational goals (summary paragraph)
Break complex task into focused worksheets (see examples)
Provide models or templates

Providing Timely Feedback
Simplify grading rubrics to target specific problems in student papers (but not too specific)
Allow time for peer editing or review (provide models and specific instructions)
Require drafts

Engaging Students in Material
Allow for low-stakes or ungraded writing
Vary assignments to give students practice with multiple forms and purposes of scientific writing
Discuss current research and role of publication

Challenges in learning scientific writing for the student

Emphasizing Critical Thought
Ask students to state question to be answered
Discuss “most surprising” idea from research, or “things you still don’t understand”
Use exploratory writing/journaling (choose prompts wisely)

Developing Genre Familiarity
Discuss scientific literature as much as possible
Students’ stumbling blocks include Paraphrasing sources Emphasis on sequence Over-personalization Wordiness Tyranny of the 5-paragraph

Developing Literature Familiarity
Discuss scientific literature as much as possible
Request annotated bibliographies
Remember that citation and reference formats change from task to task

REFERENCES