

Innovative Writing Assignments in the Natural Sciences

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Since I began teaching at PSC in the fall of 1992, I have tried to increase the amount of writing requirements and writing instructions in the upper level biology courses that I teach. This increased amount of writing directly follows from having concurrently required that students exercise the scientific method in these courses, that is, test hypotheses, analyze data, and write up the study in a scientific format. Because of this focus in the upper-level courses I teach, all my 300-level courses are now “W” courses. Here I describe several of the ways that I try to integrate writing instruction into these courses. I then address the appropriateness of these approaches for first-year students. Some of these strategies are based upon the successes and advice of my colleagues in the Natural Science Department (NSD). The degree to which any of these strategies or techniques may be applicable to introductory, first-year courses also depends upon the size of the class and the specific goals of the class.

General instruction in scientific writing—The biology majors at PSC are alerted very early to the value and availability of a well-written guide to scientific writing, Jan Pechnik’s *Writing for the*

Sciences. Scientific writing is unlike other types of writing in that the premium is placed upon being precise and concise, and also because of the rather rigid format of published scientific studies: Abstract, Introduction, Methods, Results, Discussion, Literature Cited. Many of the NSD faculty require that students read primary literature in this format, and several faculty also require written work in this format.

In general, I rarely assign a written scientific paper without also assigning the submission of a first draft which I or other students critique (more on peer review below). This critique is most thorough on the first assigned paper of each class. The focus of the critique is on the overall format and content of individual sections of the paper, but I also correct grammar and spelling. I do not grade first drafts. A clear pattern has emerged, however, in which the most substantive, precise first drafts always result in the best final drafts—no surprise. But I also have noted much progress on the part of those students who begin the class with less skill in scientific writing. In fact, some of us in the NSD who assign fair amounts of scientific writing comment to each other regarding how easy it is to identify a student who has already been through the process, regardless of the initial instructor.

So, multiple drafts are a common practice, usually just a first draft but sometimes two drafts before the final. By helping students develop a better sense of the content of a scientific paper, instructors help students comprehend peer-reviewed journal articles as well.

Special assignments

1. *Peer review*—In certain classes, students have been required to both author and critique scientific papers of their peers. Reviewers are often best if they are randomly assigned, and this is accomplished using an alphabetical listing of the class with reviewer following author. If two such assignments are given in a

single class, the reviewer is changed for the second assignment. Peer review affords at least three benefits. First, students get a better appreciation of their peer context. They become more familiar with the skill-level of their classmates. This can be reaffirming, but it can also present a challenge. The challenge sometimes comes from certain students' realization of a greater skill level among their fellow students. Second, I can review the peer reviews and gain insight into the clarity of the paper and the level of critical thinking demonstrated by the reviewer (I do grade reviews, so far in a relatively non-rigorous manner). Third, the author receives input from others. At times I find it necessary to qualify or augment a critical comment made by a reviewer, but the overall input of multiple reviewers improves the final product.

In one class, I randomly assigned students to groups of four (more below) and each group submitted their co-authored paper to another group. Each member of the group used a different color pen when critiquing so I could identify individual reviewers—of course, allowances must be made for the order in which reviewers critiqued a paper because the initial review is likely to pick up the greater number of obvious flaws. This group approach increases the sense of context each student experiences in learning to write scientifically. That is, students get greater exposure to the level of critical thinking that occurs during this process.

2. *Group authorship*-In a recent upper-level class, I randomly divided a class of 16 into four groups of four (again using the alphabetical list of students). The class had collectively obtained data from the field-morphometric data from birds captured in mist nets and released after data collection—and we used the dataset to generate four testable hypotheses. Each group then selected a hypothesis to test (mostly by mutual consent) and we laid out the timetable for due dates of first drafts, peer review completion, and submission of final drafts.

The merits of this approach are numerous. Any effort that requires group cohesion, delegation of tasks, and peer input at all stages has a host of intrinsic values. The group approach is an efficient means of having all students involved in written work without generating one paper per student. I was pleased with the potential of this assignment and the relative ease of using it for assessment, so I did it again with the same class. In some cases, certain individuals wrote the easier Methods section each time. Others tackled tougher sections. But in general, I was happy with the way this approach brought the students together. Another benefit to this approach is the way it forces students to meet outside of class time for specific academic purposes. The students were generally in favor of this approach even though they knew that a single grade would be attached to each group paper. I do not recommend this approach without any individual assessment of writing, but I believe it was a positive complement to individual work.

3. *Journals*—Regular writing in journals is common in college courses at PSC and elsewhere. I use journals in a combination of ways and I agree with others that they have many values. In my upper level classes, students are instructed to get a bound notebook of any size at the beginning of the class. I give the students a hand-out describing the potential uses of the journals. Journals are confidential so I tell them they may write whatever they like over the course of the semester. I also give them assigned entries such as scientific journal articles to read. In such cases, I ask the students to either react to the article, critique it, or relate it to an experience of their own. For example, a student may read an article on forest fragmentation and relate an experience about the destruction of a forest remnant in their own neighborhood. I have also used journals to get students to capsule a film viewed in a lab (which I indulge them in very sparingly), or to comment on an outdoor lab and provide a species list of what was seen or heard. I

collect the journals approximately 8-10 times throughout the semester, but only keep them for one day or one weekend in order to insure that they will have the journals most any time they have the urge to write.

Some students view the journals as an assignment and their journals have nothing more than what was assigned, which is fine. In fact, students who do not take the opportunity to personalize their journals often still have very thoughtful prose. Other students use the journal for many purposes. I have read thoughtful evaluations of lectures, labs, and field trips, and the value of these student evaluations is heightened by the fact that their impressions are fresh, from events recently experienced. I have also read journal entries with personal content. Journals can be valuable ways for instructors to get to know students. Many of the students who choose to write about personal things are quiet in class. They appear to relish the opportunity to reveal some more of themselves through this forum, and they do so more readily with the strictly positive comments I make in the margins like “Cool” or “Wow” or “I remember the first time I saw a Pileated Woodpecker. . .” In other words, I encourage them to continue to write freely.

The semester-end evaluation of the journals does not end up being a significant part of a student’s final grade, although a student can reveal certain strengths that may not come out in any other method of assessment. But the journal has become a valuable instrument to me. I never correct grammar or spelling, and the students realize there is no penalty for mistakes of this kind. The journal allows me to discern which students are the most capable of distilling scientific literature, and for those who so choose, I get to know them better. I have never had a student be indiscreet in a journal entry. I am not concerned about this happening either.

Relevance to first-year students

Of the three categories of writing assignments described above,

the only one I use with first-year students is the journal in IAC. This is the only strictly first-year student course I am involved with. In IAC, the NSD biologists attempt to compose two sections of strictly biology majors. This has not been 100% effective to date for logistic reasons. We attempt this in the hopes of building a sense of community among the majors as early as possible. We also have attempted this in order to cover certain topics in IAC that are especially relevant to biology majors such as scientific writing, a briefer on statistics, and the particulars of Boyd Hall. I had IAC students use journals to enter written reactions to reading assignments, short chapters in a book of essays. but they were also told they could write whatever they liked and it would be kept confidential. While the concept is workable. the book *Ichose* was not generally popular (*Ever Since Darwin* by Stephen J. Gould). But I learned that a group of TAC students also contains a percentage of students who relish the opportunity to get a bit more personal using this format-sort of like letter writing to their instructor. This can be an important medium for wine first-semester students to form even a small connection to PSC, which is so important at this stage of their college careers.

The other approaches to writing in the classroom could potentially be useful to first-year students. especially students who will need to develop scientific writing skills. The general approach of incorporating greater amounts of peer involvement in each student's written work are transferable to other majors, other disciplines. Team writing exposes students to the work of their peers in a different way. By requiring that one or two assignments be co-authored, the instructor gets the students sharing their relative strengths and weaknesses. The obvious criticism of this approach is that the strong may carry the weak. The danger of this is minimal if these approaches are used to augment individual writing assignments.

The benefit of getting students more involved in the learning process can arguably outweigh the risk of giving a specific student

too much or too little credit, And too, instructors should have an accurate sense of whether a team has benefited from a strong student. Indeed, instructors may make bold to pair the strong with the weak purposely if the method of evaluating the outcome is creative and can be sensibly and sensitively articulated to the students. When it comes to assigning and evaluating written work at the college level, first year and upper level work, we need to be open to new ideas, new approaches, creative ways to engage the students more in the course content and in each other's work.