Writing & Speaking to Learn Biology: An Intersection of Critical Thinking and Communication Skills

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Abstract: A collaborative effort between biology and communication instructors to facilitate speaking skills for senior biology majors resulted in improved organization, clarity and confidence in delivering an oral scientific presentation. But this instruction also favorably impacted students' scientific writing. This benefit seems best attributed to additional opportunities for students to talk about science, to critically evaluate the quality and structure of their arguments and evidence, and to express in their own words a clear resolution to a biological controversy.

Keywords: biology, communication, writing, speaking.

Introduction

The Boyer Commission Report on *Reinventing Undergraduate Education* concluded that "The failure of research universities seems most serious in conferring degrees upon inarticulate students" (Boyer Commission 1998). Having these findings about the failure of higher education to promote students' ability to speak and write supported a decade of complaints from corporate and government leaders about the declining writing and speaking skills of college graduates (Schneider, 1999; Zernike, 1999). These communication deficits have triggered a movement to promote *communication across the curriculum,* prompting many universities to redesign core requirements to include communication in writing and speaking for all students, regardless of their discipline (Cronin, Grice, & Palmerton, 2000). As stated in the Boyer Commission Report, "Every university graduate should understand that no idea is fully formed until it can be communicated, and that the organization required for writing and speaking is part of the thought process that enables one to understand material fully" (Boyer Commission 1998).

The impetus for the current study arose from the Biology instructor's prior experience in a course entitled "Writing in the Biological Sciences." When I (KC) graded my students' biology writing assignments, I often found myself at the end of a sentence, puzzled about what the student intended to say. I anticipated that certain types of information would occur in a certain place in the sentence, but I failed to receive a logical flow of ideas or clear explanation of the material. In general, my "reader expectations" had not been met (Gopen, 2004a,b).

In one-on-one instructor/student conferences, students would patiently explain "What I meant to say" in a problematic sentence or section and we would work to revise that section. Even though students struggled to express their thoughts using the language of science, they reported in surveys at the end of the semester that these discussions with the instructor were vital for improving their final drafts. It occurred to me that if *talking* about the science was helpful, the addition of a short oral presentation might be another opportunity for students to talk about their topics, receive additional feedback, rework their ideas into a sharper focus and become more adept in speaking and writing the language of biology.

That was the beginning of an effort to include an oral component in a required two-credit biology majors' course entitled "Writing in the Biological Sciences." This small class (typically 14) consisted initially of formal lectures on writing a scientific document to resolve a biological controversy, peer review of other students' writing, accessing and discussing data in figures/tables from primary literature resources and a skill workshop on electronic database searching. One lecture was added on the specifics of an oral presentation during which biology instructors explained that a talk should have three sections consisting of an introduction, body and conclusion; it should focus on a single idea and include clearly visible data slides to support the verbal commentary. In response to this direction, students tended to simply condense information on the resolution of a

biological controversy into a six–minute talk and, although based on a topic they had been researching all semester, these one-time presentations had many problems. Talks were poorly organized and too long, visuals were difficult to see and students lacked a sense of confidence with both the science and their presentation skills. While the limited pre-oral directions resulted in poor one-time presentations, students recognized their shortcomings and expressed a desire to improve their talks in a follow-up presentation. Thus, future versions of the course allowed for an initial and final oral presentation of students' research. Although adding the second presentation did result in an improvement in students' speaking and writing, the quality of both genres continued to fall well below the norm of effective writing and speaking in the biological sciences.

It was becoming apparent to the instructors that if the oral presentation assignment was to be beneficial, then something beyond a brief lecture would be required. Thus, a more intensive treatment of the oral component was introduced in Fall/2003 and Spring/ 2004 when this study was conducted to examine the following question: What impact, if any, on student writing and speaking would occur from specialized instruction on translating a written scientific document into an oral presentation? To answer this research question, the current course revision included a formalized treatment of the oral component, through a collaborative effort with the director of the university's Oral Communication Lab--a center to promote speaking across the curriculum.

Preparing for the Communication Lab

The Oral Communication Lab director (TB), a faculty member in the communication department, conducted an initial survey of students enrolled in "Writing in the Biological Sciences," to measure their level of instruction, experience, and self-perceived abilities and challenges as "speakers."

Of the 68 participants completing this initial survey, 49 had *never* taken a course or workshop in public speaking or other type of oral communication. In addition, only 16 of them engaged in oral presentation/communication activities such as discussions, presentations, running or participating in meetings, teaching/tutoring, giving campus tours, etc., on a regular basis.

Students were asked to indicate their level of understanding about constructing a talk, comfort in public speaking, and self-perceived competence as a speaker by circling a number on a Likert scale. For all three questions, a score of 1 represented the low end of the scale and 10 represented the high end of the scale. The mean responses are reported in Table 1 and are similar for both semesters of the course. The values fell toward the midpoint of the scale suggesting that students could benefit from specialized communication instruction. Twenty-five percent of the students admitted to a marked lack of understanding about preparing a talk, and nearly half of the students reported considerable discomfort and uncertainty about their current speaking abilities.

Finally, the students were asked to identify *specific* aspects, issues, or questions about developing an oral presentation that they wanted to explore in their forthcoming communication workshops. Responses to this question were grouped into thematic categories with two dominant challenges emerging: learning about organizing a presentation and learning about delivery (including speaking anxiety). Of the students who responded to this question, 18 identified some element of organization such as "making message clear," "organization process in presentations directed towards biology," "organization," "how to present clearly," "how to structure introduction and conclusion," and "how to decide what's important." Twenty-five identified delivery/anxiety issues such as "how to keep audience interest," "how to relax," "how to be effective and not look nervous," "tips on calming nerves," "some relaxing exercises," "how to slow down and relax when standing in front of an audience," and "how to deal with anxiety." Eight students listed wanting to learn "everything."

The results of the initial survey were strikingly similar across all six sections of biological science students. This seemed particularly significant since students completed the surveys in class without any advance knowledge or opportunity to discuss it.

In response to the initial survey data, I (TB) developed two two-hour communication workshops. I began the first workshop by explaining to students that good public speaking is *audience-centered* and that effective presentations begin with trying to understand the knowledge, attitudes, and needs of a specific audience about a specific topic. From that understanding, a speaker can meaningfully begin to think about developing a presentation. To provide an example, I explained the rationale behind the initial survey as *my* attempt to understand and analyze my audience. I discussed the survey data and highlighted that through the survey they had essentially defined their own learning objectives. As a result, the first workshop would focus on organizing a presentation, and the second workshop would focus on delivery/speaking anxiety.

Students were asked to prepare a preliminary outline of their presentations in advance of the first communication workshop. After presenting material and exercises on developing a specific purpose and clear thesis statements, students formed two groups with approximately seven students and a communication instructor. They discussed their research topic and data, preliminary

speaking outlines, and engaged in a discussion of their research questions with the Communication Lab director. Students received feedback and input from both the Communication Lab director and peer group members. This format provided both sustained individual attention and multiple examples of organizing ideas as each student worked through his/her topic, specific purpose, and thesis.

This beginning transformation from the written to the oral genre required students to reevaluate and reorganize their presentations. It was a critical thinking process with the goals of abstracting and defining a focus from a complex array of data and articulating the main ideas and essential supporting material to effectively communicate this complex message to a particular audience within prescribed time limitations. Although initiated and guided by direction from the Communication Lab director, the transformation from the written to oral genres prompted students to grapple differently with the ideas and evidence collected from their research.

To begin the process of moving from the written draft to the oral presentation, the Communication Lab director posed questions such as the following: "What conclusion have you reached about your scientific controversy? " and "What do you feel is most important for your audience to know about your controversy?" Using their written outlines, students usually responded with a restatement of their topic assignment or a list of information compatible with outline headings such as introduction, background, experimental studies and conclusion. They replied, for the most part, with *the words of others.* Thus, a restatement of the topic assignment was essentially in the words of the biology instructor, while the lists of information came from the words of their primary refereed literature or published review sources.

A rephrasing of the question by the Communication Lab director attempted to elicit students' *own thoughts* about their research analyses rather than their resources. Thus, the Lab director would continue with questions such as, "Given the problem and what you now know about its background and alternative solutions, what solution are you advancing for your audience in your paper?" After some pause for thought, discussion and a few glances at the written outlines, a very different statement typically began to emerge. It was a single idea, a focus, which was the raw version of the student's assimilation and synthesis of a resolution. Although tentative, this initial "step away" from the written word required that the information be articulated *in their words.* In place of stating information in a list-like fashion, students formulated a preliminary "specific purpose" and the thesis or main ideas and support to develop that purpose. After each student expressed his or her focus, the Communication Lab director requested that this new idea become the basis or thesis for a revised outline assigned for the following week.

The development of focus fits well into the paradigm of critical thinking, which Chaffee defines as "the organized cognitive process that we use to carefully examine our thinking and the thinking of others, in order to clarify and improve our understanding" (Chaffee, 1999). By the second draft, students are familiar with the background of their problem and typically decide on its resolution. Yet, when initially asked by the Communication Lab director what the focus of their talk would be, they had difficulty answering. They were able to talk about their topic and list ideas regarding the issues around the controversy, but they lacked an integrated focus. The challenge question required that they *critically rethink* this information to recognize a salient feature to drive their argument toward a resolution for audiences with varied science backgrounds.

At the conclusion of this session, students were asked to revise their outlines with greater organizational detail and clarity prior to the next communication workshop. Students were also asked to evaluate the usefulness of this workshop on a scale of 1 – 10 with 10 representing "Very useful." Of the 68 students participating in the first tutorial, 51 rated it 8 or higher with an average rating of 8.5.

The second communication workshop focused on delivery/speaking anxiety. As the Lab director, I provided information, handouts, exercises on delivery, and tips for coping with anxiety, while emphasizing that speaking anxiety is a common predicament that declines with knowledge and practice. Students were then asked to do an impromptu presentation on a "place we all ought to visit" that included a thesis statement comprised of two clearly stated main points and support for each point. This gave students another opportunity for individual and group practice on organizing ideas, illustrating the competence they had already acquired in oral communication, and demonstrating the confidence with which individuals can stand and speak about something they genuinely understand.

In addition, the revised speaking outlines were reviewed. In the second communication lab workshop, students more readily replied with an organized answer to questions about the content of their talks. They had "figured out" the quality and organization of information in response to the Communication Lab director's query and their target audience. The second oral outlines differed from the first versions and attested to a revisiting and rethinking of their information.

Initial and Final Oral Presentations

Students delivered their oral research presentations on two occasions. The first presentations were videotaped. Students received written and oral feedback from their biology instructor on organizing, managing, and delivering their presentations and using appropriate scientific language. In addition, students reviewed the videotape of their initial presentations and developed concrete plans for improving them. Not surprisingly, given the volume and variety of feedback, their final oral presentations were greatly improved (Jerde & Taper, 2004).

Follow-up Survey

A follow–up survey was developed by the Communication Lab director to measure the degree of change in students' perception of their ability to organize and deliver an oral research presentation. These surveys were administered in class without any advance notice to students or opportunity for them to discuss them. The results of the follow-up survey, described in Table 2, are striking when compared to the initial survey data. Mean responses for the two semesters were similar and, unlike the scores recorded prior to the communication instruction (Table 1), responses occurred well above the midpoint of the scale. In fact, the percentage of scores of "5 and below" now fell to the single digit range.

Table 1
Mean Likert Scale Responses to Initial Survey Questions 3, 4, and 5

	Mean Response Fall Classes n = 31	Mean Response Spring Classes n = 36	Overall Mean	Percentage of Scores 5 & Below
3. On a scale of 1 – 10, how well do you understand the process of preparing a talk?	6.6	6.4	6.5	25%
4. On a scale of 1 – 10, how comfortable are you in speaking in front of either a small or large group?	5.5	5.9	5.7	48%
5. On a scale of 1 – 10, how would you rate yourself as a speaker?	5.7	5.6	5.7	45%

Table 2
Mean Likert Scale Responses to Follow-up Survey Questions 5 and 6

Question	Mean Response Fall Classes	Mean Response Spring Classes	Overall Mean	Percentage of Scores 5 & Below
5. On a scale of 1 - 10, how clearly do you feel that you communicated your message (i.e., rate how well you organized your FINAL presentation)?	8.4	7.9	8.2	3%
6. On a scale of 1 –10, how comfortable did you feel in delivering your FINAL presentation?	7.6	7.7	7.7	6%

Table 3
Responses to Follow-up Survey Question 1

Question	Themes	% Students Expressing Theme	Sample Quotations
1. What do you feel were the strengths of your *FINAL* presentation?	Statements of Confidence in Organizing Ideas	50	"transitions," "it flowed well," "was able to narrow it down to specific points that were better supported," "clear," "organization," "I feel my final presentation effectively condensed my paper into a few main points," " the main strength of my presentation was organization," "I felt that I was more prepared in delivering my speech and that it was more organized."
	Statements of General Confidence and Improved Delivery	58	"I was calm and spoke clearly and slowly," "less nervous," "addressed class in confident tone," "more comfortable," "more confident," "confidence," "I think I battled back the nervousness." "much less nervous," "ease of talking in front of class," "eye contact & confidence," "talked slowly."
	Statements of Confidence about Data	13	"good knowledge of materials," "data," "knew the material well enough to talk about it," " I was confident about the material that I was presenting," "presented the data well," "greater comfort with the material," "explained slides well," "knowledge of the slides," "confidence in the ability to get across my major points."

When asked to specifically identify the strengths of the final presentation, students' comments were rewarding. Almost all of the 66 students who completed the follow-up survey listed several strengths within the themes of organization, confidence about understanding the data, and confidence in delivering their presentations. Table 3 is representative of students' characterization of the strengths of their final research presentations.

IV. Written Component Results

In addition to the follow-up survey conducted by the Communication Lab director in Spring 2004, the biology instructors conducted their own survey to identify what students perceived as the most and least helpful assignments/exercises in "Writing in the Biological Sciences." Twenty-three out of 38 students surveyed identified the oral communication workshops and exercises as among the most helpful, while none of them identified them as among the least helpful.

While the oral presentation itself improved from the additional communication instruction, an original intention was to improve the quality of the science writing as well. From an assessment perspective, the overall quality of the final written document did improve, even though different instructors taught course sections. This was especially true for the average (C grade) students, who without the additional attention to the material necessitated by the oral preparation, tended toward minimal revision. For one instructor, as a rough estimate of improvement, the number of "C's"

dropped by nearly half (from 29% to about 18%), while for another instructor the frequency decreased from 38 to 31% in a comparison to the earlier versions of the course. Most encouraging was the fact that the number of "A's" increased from an average of about 7% to 24% for all sections (see Appendix for grade determination).

What accounted for this improvement? Increasing the number of times students rethought, revised and reworked the scientific information helped them to learn more about the material and *speaking and writing like a biologist* (see Summary of Feedback in Appendix). Now, in the revised course, along with three written draft assignments, students returned to their research on five occasions in conjunction with the oral presentations as they prepared, practiced, critiqued and revised their six-minute talk. Condensing their information into a PowerPoint format also served as an exercise in organizing ideas into clear and concise visuals to support an explanation.

But more intriguing to the biology (writing) instructor was what happened between the speaking outline, generated as a guide for discussion at the first Communication Lab workshop, and the final written document. The initial speaking outline, based on the students' organization of information from the second revision of their written drafts, typically had one of the two following forms: a "bare bones" listing of the section headings from their papers or a "detailed outline" that listed many facts under each heading. It rarely, however, resembled the order and organization of either the *final* talk or written document.

From the biology instructor's perspective, this exercise in the Communication Lab was a pivotal point linking the oral presentation instruction to the final written document. Although anecdotal in nature, a statement such as, "I really didn't know where my paper was going, until I had to develop a focus for my talk" was a typical unsolicited student comment. Verbalization of that focus was the beginning in creating a clear perspective of what they needed to express, not only in their talk, but in the written format as well.

V. Critical Thinking, Writing, and Speaking to Learn Biology

In addition to clarifying focus, which was initiated in the oral outlines, other parts of the oral communication preparation impacted the writing assignment. Two broad intersecting categories of *organization* and *audience* from the oral preparation process were particularly important, not only in improving speaking abilities, but also in improving student writing and understanding of the science. Table 4 highlights the specific writing issues that appeared to benefit from the oral instruction component.

Table 4

Writing Problems Likely Improved by the Oral Communication Process

Writing Problem	Oral Preparation Process Benefit
1. Multiple main points confused readers about the document's primary recommendation.	Identified a dominant focus, purpose, and main points supported by background and data.
2. Uncertainty regarding how to write about data derived from the primary literature resulted in lists of one author/data followed by the next author/data.	Working with the data to support a main focus resulted in selecting the clearest examples to support ideas.
3. Uncomfortable with the language of science.	Multiple and varied opportunities to practice using the language of science promoted greater student understanding and comfort in both written and spoken genres
4. Lack of logical flow of information that missed reader expectations.	The clear organization and movement of information/evidence and the use of linguistic devices such as parallel sentence structure, repetition and internal summaries made information easy to follow.
5. Uncertain about the quality and quantity of detail to provide a reader.	*Audience* is at the center of one's talk; data and presentation are "geared" toward them.
6. Not confident about the information	Discussing and presenting material promoted greater understanding of it. Being "ready" for questions after the talk challenged students to know their information. See point #3.
7. Exceeding assigned page limits	Strict adherence to the allotted speaking time forced selection of essential information

The critical thinking process of abstracting and synthesizing complex material into a clear oral form seems to have positively influenced the common problems in student writing described above. Identifying a specific purpose, thesis, main points and essential evidence, and the clear movement of information essential to the oral genre translated into greater clarity in students' writing. The tedious listing of evidence, not well tolerated by a listening audience, characterized many early *written* drafts. This problem in discussing primary literature data appeared as a tendency for students to list evidence in a one-author/one-paragraph style in their writing. However, the oral presentations required students to "talk about" the data--to explain, discuss, and clarify it, thus demonstrating an understanding of the material rather than a simple listing of concepts. Data examples were chosen to accommodate the time limitations. Making the connections for the listener in the oral genre translated into data selections in speaking and in writing that typically defined the focus of an entire section as opposed to simply being mentioned in a paragraph alone. In this process, students also acquired greater expertise and confidence in using the language of science. This deconstructing and reorganizing of information is an important effort toward becoming an "expert" or as Florence and Yore (2004) describe, "gaining control over the knowledge."

The process of organizing an oral presentation includes targeting a message toward a *particular* listening audience, whose characteristics have been defined in the topic assignment. This assignment also ascribed a professional role to the student as a researcher asked to interpret the science for the audience and selecting background material on his/her problem tailored for a specific knowledge level. The necessity of *speaking to a defined audience* (a group of physicians, a local governing community board, or entrepreneurs interested in investment potential) prompted students to reconsider how to organize the quality and presentation of information for their audience, instead of targeting it toward the traditional academic audience, the biology instructor. Thus, the first oral presentations provided a chance for the student to test for an appropriate level of detail and background information. Peer comments after the talk quickly identified gaps in logic, a weak argument or disorganized thoughts. In response to this feedback, in their second presentations, students showed greater attention to the organization of material to *both* enlighten and convince an audience about the credibility of the recommendation for their biological solutions.

The immediate feedback from instructor and peers, particular to the oral presentation genre, is an important component in the critical thinking process. In the cycle of integrating information, the opinions of others contribute toward reevaluation and establishing or reinforcing connections among topic information. As Zull reports, we learn by moving from copying information (sensing information) to integrating and reflecting on that information (Zull, 2002). Confronting a listening audience provides additional signals regarding how the information is presented and what is being presented. Nearly every student expressed in one form or another some version of self- critique immediately upon completion of the first talk. Their statements reflected a reconsideration based on perceived audience reception and reaction, *before* the instructor or peers made any comments. The oral exercise clarified the notion of being sensitive to one's audience, evidenced to the speaker from the listeners' body language, facial expressions or lack of attention. In contrast to a written document, even though encouraged by the writing instructor to write with their "reader's expectations" in mind (Gopen, 2004a, b), a writer is removed from knowing what the reader's reactions are for the most part, and they miss the impact of his/her message provided by a live listening audience.

The oral exercise is initially perceived with dread. Students expressed high levels of uncertainty about developing and delivering a presentation and anxiety about speaking in public. They worried that they would not "sound as if they knew what they were talking about." But as they learned about organization, audience, and the oral communication process and revised their talks in response to peer and instructor input, they learned more about their subject and gained greater confidence in discussing its science. Student communication improves when it is based upon scientific understanding generated by ongoing critical thinking processes, which is challenged by peer and instructor feedback.

> [Individuals who aspire to become experts] must then submit their conversations and text to the scrutiny of their peers and subsequently be able to use peer criticism to refine and reconstruct their ideas. In accomplishing these goals, they are able to situate their work within existing scientific knowledge by addressing conceptual voids and expanding boundaries of canonical science, and to situate themselves within the science community. (Ziman, 2000; Florence and Yore, 2004).

With multiple opportunities to write and talk about science and to revise and practice *speaking like a biologist* (using the biological terminology), the inclusion of instruction in oral communication, improved students' writing and speaking, but equally

promoted their learning of science and critical thinking (Palmerton, 1992).

Many college teachers are reluctant to admit the importance of communication skills or do not understand the field of communication and dismiss its academic and theoretical rigor. Even when instructors realize the importance of communication skills, they often claim that communication assignments and activities "steal" time from more important lab or lecture work and refuse to revise their curriculum to include communication assignments. In addition, even when a professor is willing to be more innovative, he or she may lack the specialized know-how required *to teach* the fundamentals for communicating effectively, thus requiring students to perform an assignment for which they are unprepared.

Given the results of our research, interdisciplinary efforts between communication and science faculty may provide a highly expedient and effective method for undergraduate science students to acquire fundamental communication skills and, in that process, greater knowledge about discipline-specific content since s*peaking* about material is itself an exercise in critical thinking and learning (Bayer et al., 2005). Our experience from modifying this class to include more opportunities for students to talk, write, and visually present scientific material highlights, communication, not only as an area of skill acquisition, but as a method to promote critical thinking and knowledge.

REFERENCES

Bayer, T., K.A. Curto, and C. Kriley. (2005). Acquiring Expertise in Discipline-Specific Discourse: An Exercise with Speaking in the Biological Sciences. *Across the Discipline*s 2: no page, 26 June 2005. www.http://wac.colostate.edu/atd/articles/ bayer_curto_kriley2005. cfm.

Boyer Commission on Educating Undergraduates in the Research University. (1998). Reinventing Undergraduate Education: A Blueprint for America's Research Universities, NY: State University of New York.

Chaffee, J. (1999). Critical Thinking, Thoughtful Writing, Boston, MA, Houghton Mifflin Co.

Cronin, M.W., G.L. Grice, and P.R. Palmerton. (2000). Oral Communication across the

Curriculum: The state of the art after twenty-five years of experience. *Journal of the Association for Communication Administration* 29: 66-87.

Florence, M.K. and L.D. Yore. (2004). Learning to Write Like a Scientist: Coauthoring as an Enculturation Task. *Journal of Research in Science Teaching* 41(6): 637-668.

Gopen, G.D., (2004a). Expectations: Teaching Writing from the Reader's Perspective. New York, N.Y., Pearson Education Inc.

Gopen, G.D., (2004b). The Sense of Structure: Writing from the Reader's Perspective. New York, N.Y., Pearson Education Inc.

Jerde, C. L., and M.L. Taper. (2004). Preparing Undergraduates for Professional Writing: Evidence supporting the benefits of scientific writing within the biology curriculum. *Journal of College Science Teaching* 33 (7): 34-37.

Palmerton, P.R. (1992). Teaching Skills or Teaching Thinking? *Journal of Applied Communication Research* 20: 334-341.

Schneider, A. (1999, March 26). Taking Aim at student incoherence: Spread of speech programs across the curriculum irks some communication professors. *Chronicle of Higher Education* A16.

Zernike, K. (1999, January 31). Talk is, like, you know, cheapened: Colleges introduce classes to clean up campus 'mallspeak.' The Boston Globe, p. A1.

Ziman, J. (2000). Real science: What it is, and what it means. New York: Cambridge University Press.

Zull, J.E. (2002). The Art of Changing the Brain. Sterling, VA, Stylus Publishing, LLC.

APPENDIX

Grade determination

Semester grades were based on the number of points earned out of a total of 330. Several smaller written assignments, worth a total of 85 points, comprised the early part of the coursework. The first, second and final drafts were worth 30, 60 and 100 points respectively. The first and final oral presentations were weighted at 15 and 40 points respectively. Thus, early work did not carry as much grade value as later work.

Summary of Feedback for
Oral and Written Assignments
Fifteen-Week Course

Topic Assignment

↓ Biology instructor's approval of student's topic choice

First draft

↓ Peer verbal and written feedback

First revised draft

↓ One-on-one biology instructor's verbal & graded rubric feedback

Second draft

↓ One-on-one biology instructor's verbal & graded rubric feedback

First oral outline

↓ Workshop by Communication Lab instructor on organizing an oral scientific presentation
Communication Lab instructor & peer feedback on 1st oral outline

Second oral outline

↓ Workshop by Communication Lab instructor on delivering a scientific presentation
Communication Lab instructor & peer feedback on 2nd oral outline, and a brief two-point impromptu presentation by all students

PowerPoint Lab

↓ Instruction in computer lab on creating a PowerPoint presentation
Biology instructor's feedback on slide format and content

First oral presentation

↓ Biology instructor's verbal & graded rubric evaluation
Peer written feedback
Student self-critique of videotaped talk

Final Oral presentation

↓ Biology instructor's verbal & graded rubric evaluation

Final draft