Writing in the Technical Disciplines

Technical disciplines include, but are not limited to, those known by the acronym STEM (Science, Technology, Engineering, Mathematics). Notably, many of the same issues that arise while incorporating writing into STEM disciplines frequently arise in other disciplines, especially those that have their own specialized, technical content, such as health, law, business, psychology, or economics.

Common Challenges:

- Faculty may feel assigning and grading (additional) writing takes too much time and effort.
- Faculty may feel expertise in writing instruction is a prerequisite for writing-intensive pedagogy.
- Faculty may feel writing to be irrelevant to technical subject matter and not appropriate for the learning processes necessary to master this material.
- Faculty may feel that instructing students in those modes of writing specific to their disciplines should be something covered in specialized writing classes, rather than throughout the curriculum.
- Students enrolled in classes in the technical disciplines may be more resistant than others to the inclusion of written assignments.

Research Has Shown:

- Students who are more closely engaged with the course material through their writing tend to improve their performance and their retention of key concepts.
- Proficient writing skills are demanded by a variety of jobs which students from technical disciplines will occupy upon graduation, thus many stress the importance of improving writing skills, technical and otherwise, as an essential element of undergraduate eduction in the technical disciplines.
- Faculty across the technical disciplines, many beginning from similar positions of hesitancy or skepticism, have been pleasantly surprised by the results they have seen when employing the writing-to-learn techniques promoted by WAC.
- There is a wide variety of flexible writing assignments that may be adapted to widely differing teaching goals and learning contexts, including journal writing, reflective “free writing,” and simulating peer review and other real life situations.

Suggestions:

As shown by the extensive bibliography that follows, many professors in the technical disciplines have incorporated WAC/WID techniques as an integral part of their courses. The following suggestions were culled from the reports of their experience.

<u>Think backwards from your goals</u>
Writing should primarily serve the objectives of your class. First identify the goals of your particular classes; then think of ways writing can help you achieve them. This ensures that the writing components you decide to add to your curriculum will never seem like a superfluous or artificially imposed requirement, either to you or your students. This principle is particularly important to keep in mind for classes where it may not be immediately obvious that writing would play a beneficial role. WAC/WID techniques suggest that no matter what the field of study, writing should seamlessly fit the course objectives and draw on the creativity of the instructor. Although no ready-made formulae will work in all contexts, it may prove helpful to refer to others’ experience of what worked and what did not work in their courses.

<u>Minimal Marking</u>

Contrary to popular belief, you need not be a writing expert to assign or evaluate student writing. As writing plays the role of tool for comprehending course content, it need not be extensively marked for grammar or correct usage. Instructors need not correct each error. A simple mark at the end of each line containing errors puts the responsibility on the students to identify and correct their errors. Other "minimal marking" techniques, such as self-editing or peer-editing exercises, also save time in grading, by having students identify their own or their peers' mistakes before submitting the assignments. Students are frequently able to catch their own errors simply by they review their work. For more information on minimal marking, see [LINK TO MATT'S PAGE ON GRADING]. If you do mark errors, studies have shown that focusing on one or two types of error or global patterns of error are the most effective ways of aiding students' writing. For more, see [LINK TO MAGGIE'S PAGE ON CONSTRUCTING ASSIGNMENTS].

Free Writing Exercises

In-class "free writing" assignments at the beginning and end of class sessions create a continuous feedback loop between the students and instructor. They can be useful to instructors for judging student progress; for addressing some specific theme or topic; for allowing students to ask outstanding questions about the lectures, labs, or readings, that can then be addressed all at once; and for discovering areas in need of greater attention. They are also likely to enhance class discussion or retention of class material. While it is not a requirement that these exercises be individually corrected or graded each time, they could be counted for part of the class participation component of the grade, especially in large courses. Such assignments can also act as a vehicle for eliciting class participation from otherwise quiet students. For more on silent students, see [LINK TO RACHAEL'S PAGE ON SILENT STUDENTS].

Scaffolding/Sequencing

"Scaffolding" or "sequencing" refers to breaking down major written projects or "high-stakes" assignments into their component parts that are completed in stages or in the form of lower-stakes assignments. Students typically are required to hand in drafts or segments of a larger project well in advance of the final due date. This serves to spread the work out over the course of the semester for both the students and for instructors, thus easing the work that inevitably piles up at the end of a semester. Self-editing and peer-review exercises can be incorporated in these steps to further reduce workload. Students obtain a better familiarity with each step of the process, allowing for greater reflection and leading to more polished finished products. Be sure to show models of good writing in your discipline, particularly high-quality student work, as well as cases of what to avoid.

Journal Writing

Journal writing or lab notebooks can have many purposes. Coordinating journals with laboratory work gives students an ongoing opportunity to reflect on their practical experiences over the course of the semester. Coordinating journals with textbook reading and class lectures can reinforce technical conceptual knowledge or supplement the use of formal equations by requiring students to translate them into verbal understanding. Reflection on practical and conceptual knowledge through writing has been shown to aid in retention of abstract knowledge. Journals can also double as preparation tools for tests that feature short answer questions and concept identification.

Genre Writing

Sometimes learning-to-write approaches, within which the purpose of assignments are geared to students' learning the stylistic conventions of specific disciplines are contrasted with approaches that stress writing-to-learn exercises that use writing as a general means of reinforcing students'

comprehension of the course material. Genre writing could combine the best of each approach. Written assignments that mimic the different genres that graduates of technical fields frequently encounter in their careers can serve as an effective way of making learning-to-write exercises double as writing-to-learn ones. By presenting their ideas for different audiences, students reinforce and enhance their comprehension of the class material. Students might, in addition to lab reports or other normal assignments, report their findings in the form of a journal article, a popular science article, a letter to the editor, field notes, a series of emails, mock proposals and grant applications, letters of intent, memos to supervisors containing their data analysis and interpretation, or letters to government agencies summarizing a body of research.

Further Reading (organized by field):

GENERAL SCIENCE

Alred, Gerald J., Charles T. Brusaw, and Walter Oliu. 2008. *Handbook of Technical Writing*, 9th Ed. Boston: Bedford/St. Martin's Press.

Standard guide to the conventions of writing in all technical fields. “[N]early 400 entries provide guidance for the most common types of professional documents and correspondence, including reports, proposals, manuals, memos, and white papers. Abundant sample documents and visuals throughout the book demonstrate effective technical communication, reflecting current practices for formatting documents and using e-mail. In addition, advice on organizing, researching, writing, and revising complements thorough treatment of grammar, usage, style, and punctuation to provide comprehensive help with writing skills. This edition has been thoroughly revised to include expanded advice for analyzing the context of different writing situations, using and integrating visuals, and dealing with ethical concerns in technical writing.”

Bazerman, Charles. 2000. *Shaping Written Knowledge: The Genre and Activity of the Experimental Article in Science*. WAC Clearinghouse Landmark Publications in Writing Studies: http://wac.colostate.edu/books/bazerman_shaping/
Originally Published in Print, 1988, by University of Wisconsin Press, Madison, WI.

This book, written by one of the pioneers of the Writing in the Disciplines movement, can be downloaded in whole or in part from the WAC Clearinghouse Web site: “In *Shaping Written Knowledge*, Charles Bazerman traces the history and character of the experimental article in science, calling attention to the social and rhetorical forces that shaped its development. Truly a landmark in writing studies, this book provides a broadly interdisciplinary exploration of an important genre and offers insights that extend far beyond its immediate focus of study.”

Brillhart, L.V. and M.B. Debs. 1981. “Teaching Writing--A Scientist's Responsibility.” *Journal of College Science Teaching* 10(5): 303-304.

Authors discuss “the importance of teaching writing in college science classes by evaluating written lab reports, editing, and critically grading papers that students write. Also presents a structured method to teach lab report writing.”

Carter, Michael, Miriam Ferzli, and Eric N. Wiebe. 2007. “Writing to Learn by Learning to Write in the Disciplines.” *Journal of Business and Technical Communication* 21(3): 278-302.

“The traditional distinction between writing across the curriculum and writing in the disciplines (WID) as writing to learn versus learning to write understates WID's focus on

learning in the disciplines. Advocates of WID have described learning as socialization, but little research addresses how writing disciplinary discourses in disciplinary settings encourages socialization into the disciplines. Data from interviews with students who wrote lab reports in a biology lab suggest five ways in which writing promotes learning in scientific disciplines. Drawing on theories of situated learning, the authors argue that apprenticeship genres can encourage socialization into disciplinary communities."

Day, Robert. 1995. *Scientific English: A Guide for Scientists and Other Professionals*, 2nd Ed. Phoenix, AZ: Oryx Press.

"Day has designed a guide to general scientific style, grammar, and usage. He also includes an list of the style manuals that are appropriate to the various disciplines and a chapter on sensitivity to certain language usage. The appendixes contain lists of words to avoid and problem words and expressions.

Etkina, Eugenia and Kathleen Andre Harper. "Weekly reports: student reflections on learning." *Journal of College Science Teaching* 31(7) (May): 476-80.

The authors discuss weekly reports, which are conceived as a "structured journal, approximately a page in length, in which students reflect on their learning by answering three specific questions: 1) What did I learn this week and how did I learn it? 2) What questions remained unclear? 3) If I were the professor, what questions would I ask my students to find out if they understood the material." They offer examples of these weekly reports and recommendations drawn from their experience using the technique. They stress the feedback that is established circuit that is established. "Similar to portfolio assessment, weekly reports determine what students know as opposed to tests that reveal what students do not know."

Feldman, Susannah, Virginia Anderson, and Luz Mangurian. 2001. "Teaching Effective Scientific Writing." *Journal of College Science Teaching* 30(7): 446-449.

"Successful scientific communication depends not only on the presenter's ability to convey information effectively, but also on the recipient's ability to interpret and evaluate the information to use it appropriately." The authors discuss how they teach student's to read, understand, and evaluate primary scientific research and communicate this. They offer two exercises they use in their Towson University Transition Course, which addresses common problems such as with logical presentation, discipline-specific conventions, plagiarism, and the mechanics of writing."

Guilford, William H. 2001. "Teaching Peer Review and the Process of Scientific Writing." *Advances in Physiology Education* 25(3): 167-175.

"[E]ven after completing undergraduate composition courses, students have difficulty translating their writing skills to biomedical classes. . . . Yet it has been estimated that a typical engineer spends as much as one-third of each day writing." Author recounts his experience implementing an extensive semester-long peer review exercise that is unique in that it mimics the entire journal publishing process. Included are a flowchart of how he organized the process, a rubric that makes explicit the criteria for manuscript review, surveys of student attitudes to the process, and extensive discussion on the benefits and limitations of such a in-depth procedure.

Henderson, LaRhee and Charisse Buising. 2000. “A Peer-Reviewed Research Assignment for Large Classes.” *Journal of College Science Teaching* 30(2): 109-13.

“Introduces a writing exercise students work on in collaborative groups. Aims to enhance students' scientific research paper writing skills and provide experience working in collaborative groups. Presents evaluation criteria for peer-group evaluation of a poster presentation, intra-group evaluation of peer performance, and peer-group evaluation of a research paper.”

Holliday, William G. 1992. “Helping College Science Students Read and Write.” *Journal of College Science Teaching* 22(1): 58-60.

Textbooks act as the fulcrum for most science classes, but are less frequently made the explicit focus of a science education, despite the fact that students may exhibit difficulties adjusting to this specific form of knowledge transmission. The author “provides practical, research-based suggestions for improving reading and writing skills of college science students. He describes characteristics of skilled science readers, explains how to select reading materials that make sense and explains what teachers can do to improve reading and writing assignments.”

Jerde, Christopher L. and Mark L. Taper. 2004. “Preparing Undergraduates for Professional Writing.” *Journal of College Science Teaching* 33(7): 34-37.

The authors begin from the observation that the ability to write effective scientific papers is insufficient even among advanced majors. They present the findings from their quantitative study of predictors of good science writing. They found that "the number of English composition courses taken, the year of study and use of the Writing Center did not significantly enhance our students' scientific writing ability." Quick to point out that "this does not indict...English composition courses or resources such as the Writing Center," they note that the only factor that seems to account for good science writing is prior experience with scientific writing. Therefore, they recommend incorporating writing directly into specialized science classes.

Johnson, Marie and Mark Smith. 2008. “Designing Appropriate Scaffolding for Student Science Projects.” *Journal of College Science Teaching* 38(2): 24-29.

"In an effort to teach our students some of these non-textbook realities [of scientific methods] and to expose them to the professional practice of science, we have designed a hands-on, semester-long, open-ended group science research project for both science and nonscience majors." The authors document their efforts, over ten semesters teaching an environmental science course, to employ scaffolding by creating a semester-long series of assignments. The course includes "in-class exercises and discussions, preparatory homework and lab events, and three well-calibrated milestones" that lead up to a final report. The course is thus designed to build up students' familiarity with actual scientific practice. They also detail how they overcame their initially disappointing results.

Kalman, Calvin, Mark W. Aulls, Shelley Rohar and John Godley. 2008. “Students' Perceptions of Reflective Writing as a Tool for Exploring an Introductory Textbook.” *Journal of College Science Teaching* 37(4): 74-81.

The authors present reflective writing as a solution to a common problem of textbook comprehension. While the concepts of physics are often highly abstracted from personal experience, textbook assignments often only present students with opportunities for

numerical problem-solving. "Writing-to-learn" exercises engage students with the conceptual foundations of physics presented in the textbooks better familiarizing them with concepts prior to encountering them in the classroom. A model is provided as well as interview responses from students.

Keys, C. 1999. “Revitalizing Instruction in Scientific Genres: Connecting Knowledge Production with Writing to Learn in Science.” *Science Education* 83(2): 115-130.

“This article explores the history and theoretical paradigms associated with writing to learn in science, including the debate surrounding the teaching of traditional scientific genres that has received attention in Australia and the United Kingdom. It is asserted that unique features of writing in traditional scientific genres, such as experiment, explanation, and report, promote reflection and the production of new knowledge, especially through the formation of meaningful inferences for data. The author presents sample data illustrating the potential for meaningful learning associated with writing in communicative genres, considers the limited potential of creative writing for developing scientific understandings, and recasts a description of scientific genres in light of contemporary classroom practices.”

Kroen, William. 2004. “Modeling the Writing Process: Using Authentic Data to Teach Students to Write Scientifically.” *Journal of College Science Teaching* 34(3): 50-3.

The author “describes a series of assignments that model the process of writing a manuscript for publication. While students learned to gather and interpret data, they also improved their writing skills and became more critical readers,” through peer review exercises, as well as exposure to published journal articles.

Koprowski, John L. 1997. “Sharpening the Craft of Scientific Writing.” *Journal of College Science Teaching* 27(2): 133-5.

The author “describes a writing-intensive ecology course designed to foster the development of writing and critiquing skills early in the semester and immerse students in the peer-review process toward the end of the course. By critiquing other scientific papers, students gain insight into the effectiveness of their own writing while also increasing their sense of ownership of the review process.”

Liss, Julie M. and Stephanie D. Hanson. 1993. “Writing-to-Learn in Science.” *Journal of College Science Teaching* 22(6): 342-5.

The authors suggest that “writing-to-learn projects in science courses have been slow to take root, possibly because of the tradition of using rote memorization for learning science. [They examine] variables that will influence the success of writing-to-learn in science education in colleges, including students' attitudes.”

McMillan, Victoria and Deborah Huerta. 2003. “Eye on Audience.” *Journal of College Science Teaching* 32(4): 241-5.

“In our team-taught science writing courses, we use a series of assignments aimed at specific ‘real-life’ audiences and designed for different venues. Once students understand how to look at the specific needs and expectations of their readers, they can make informed decisions about all aspects of their writing, from aims and format to tone and diction.” The article includes examples of their assignments.

Miller, Martin G. 1999. “Writing Abstracts on a Central Theme.” *Journal of College Science Teaching* 28(6): 397-400.

“The relatively broad scope of most abstracts tends to demand more synthesis than most other short writing assignments; the short length imposes strict standards for concise, well-defined writing.” Author requires students to write and revise multiple assignments of 250-350 words about individual course topics. When these are later combined, they have the added benefit of drawing out the links between the different aspects of a course that may have topics that otherwise seem to have relation to each other.

Moore, Randy. 1993. “Does Writing About Science Improve Learning About Science?” *Journal of College Science Teaching* 22(4): 212-217.

“Moore experimented with ‘writing to learn’ in four sections of his biology class. Each section had a different amount of writing assigned and differing levels of feedback on assignments. Moore concludes that merely writing without guidance and instruction on the principles of writing in the discipline only reinforces poor writing skills. He makes a convincing argument that only the students provided with such guidance improved significantly in their writing and testing.

Moskovitz, Cary and David Kellogg. 2005. “Primary Science Communication in the First-Year Writing Course.” *College Composition and Communication* 57(2): 307-334.

Some writing proponents promote writing to learn activities in the natural sciences, others stress the importance of learning to write within the different disciplines, especially for majors taking upper division courses. These authors make the case for including scientific readings in first year writing courses as part of general eduction. They argue that what they call primary scientific communication (PSC) should be included as class content for study by all college students. It fits the general trend toward diversification of composition courses and is no more or less intrinsically difficult than other writing samples that student read. They suggest the only thing that blocks such an expansion of class content is the background of the composition teachers. They suggest ways that this can be done and address challenges that implementation of their proposal may present.

Paradis, James G. and Muriel L. Zimmerman. 2002. *The MIT Guide to Science and Engineering Communication*, 2nd Ed. Cambridge, MA: The MIT Press.

This guide covers the basics of scientific and engineering communication, including defining an audience, working with collaborators, searching the literature, organizing and drafting documents, developing graphics, and documenting sources. The documents covered include memos, letters, proposals, progress reports, other types of reports, journal articles, oral presentations, instructions, and CVs and resumes. Throughout, the authors provide realistic examples from actual documents and situations. The materials, drawn from the authors' experience teaching scientific and technical communication, bridge the gap between the university novice and the seasoned professional.

Porush, David. *A Short Guide to Writing About Science*. 1995. New York: HarperCollins.

“Using examples and illustrations from chemistry, physics, mathematics,computer science, and engineering, this helpful guide gives readers simple step-by-step procedures for keeping lab notebooks and writing lab reports, formal research papers, and science essays.”

Reynolds, Julie and Steven Vogel. 2007. “Precisely! A Writing Exercise for Science and Engineering Classes.” *Journal of College Science Teaching* 36(5): 30-33.

"Science teachers undoubtedly tell students about the importance of precision in collecting data and analyzing results; what is less commonly emphasized is the need for precision in writing." The authors present an exercise for science and engineering classes that stress "linguistic precision" is stressed as a requirement for successful scientific communication and for facilitating reproducibility of results. They focus on teaching the conventions of scientific writing and the importance of writing for an audience that lacks prior knowledge of the subject.

Rice, Richard E. 1998. "‘Scientific Writing’--A Course to Improve the Writing of Science Students.” *Journal of College Science Teaching* 27(4): 267-272.

Author recounts his experience as an instructor in a three-course writing sequence for science majors. He discusses assignments, classroom activities, grading rubric, and student impressions of the class.

Seals, D.R. and H. Tanaka. 2000. "Manuscript Peer Review: A Helpful Checklist for Students and Novice Referees.” *Advances in Physiology Education* 23(1): 52-58.

“The ability to contribute consistent, fundamentally sound critiques is an essential element of the scientific peer review process and an important professional skill for investigators. Despite its importance, many students and junior scientists do not have an adequate working knowledge of how to effectively critique research manuscripts. Part of the problem, in our view, is that novice referees often lack a comprehensive understanding of the basic issues that should be considered in evaluating scientific articles. Specifically, they tend to overemphasize certain limitations (usually methodological), while missing other key points related to the scientific method that should be weighed much more heavily. In our journal club and graduate courses we have been using a ‘‘checklist’’ to help graduate students and postdoctoral fellows critically analyze original research papers. In this article we present these guidelines in the hope that they will serve as a helpful resource for students and other novice reviewers when critiquing scientific manuscripts.”

Schulte, Bruce A. 2003. “Scientific Writing and the Scientific Method: Parallel ‘Hourglass’ Structure in Form and Content.” *The American Biology Teacher* 65(8): 591-594.

The author draws a parallel between scientific writing and the structure of scientific method (the “hourglass” of the title), claiming this is a good way to teach scientific writing. The middle of the hourglass are the methods and results of the experiment or observation. The top bulb of the hourglass signifies the space of hypothesis formation about the subject under study and the place of this subject matter in relation to what else we know from previous findings. This is what is contextualized for the reader in the introduction of the paper. The bottom bulb signifies the discussion of the findings and its implications for further research.

Wilkinson, A.M. 1985. "A Freshman Writing Course in Parallel with a Science Course." *College Composition and Communication* 36(2) (May): 160-165.

The author describes a first-year composition course designed by writing faculty, in conjunction with an introductory biology course, to teach students to write as scientists, rather than about science, which is the usual focus when composition classes include

scientific writing. The writing class was independent but drew on the material the biology class. The author details the writing assignments and concludes by weighing the advantages against the disadvantages.

Winsor, Dorothy A. 1990. “Engineering Writing/Writing Engineering.” *College Composition and Communication* 41(1): 58-70.

This article should be approached with skepticism, but might be instructive to some. The author accepts the view, prevalent in the humanities and the social sciences, that considers writing as generating knowledge, and contrasts this to the view in the sciences and engineering disciplines that considers writing mainly as transmitting knowledge. The author’s attitude to writing in the technical disciplines could be a typical one among writing instructors. Humanists may be more prone to seeing writing as primary, as much of the work done in the humanities consists of the reception and generation of texts. In the technical disciplines, reading and writing is considered secondary to the work performed, a way of reporting on the content and findings of that work. In addition to illustrating a difference between the “two cultures,” reading this article as one view of the issue might also spark dialogue on the purpose of reading and writing in different contexts.

BIOLOGY AND ENVIRONMENTAL STUDIES

Cannon, Robert. 1990. “Experiments with Writing to Teach Microbiology.” *The American Biology Teacher* 52(3) (March): 156-158.

“I am convinced that students are learning more about Microbiology, Virology and Immunology, because they are spending more time thinking about the discipline through their writing.” Author discusses his experiences, both positive and negative, using writing assignments in three different biology classes. Assignments included journal writing, research papers, and book summaries, in addition to term papers. He talks about his contact with the WAC program at his campus; his initial hesitancies about evaluating writing and the expected time commitment; and responses from his students.

Carlson, Catherine A. 2007. “A Simple Approach to Improving Student Writing: An Example from Hydrology.” *Journal of College Science Teaching* 36(6): 48-53.

“Ultimately, teaching students to write scientifically is teaching them to think scientifically.” Author relates her experience using writing in her hydrology class, stressing the importance of writing as a method for teaching students to ask and answer scientific questions and as well as to communicate their results. Her method adapts the series of “wh- questions” (who, what, when, where, why, and how) journalists use to report their findings to a scientific context.

Eisen, Arri. 1996. “‘Disease of the Week’ Reports: Catalysts for Writing and Participation in Large Classes.” *Journal of College Science Teaching* 25(5): 331-33.

The author describes an assignment devised to incorporate writing into a large introductory biology class. The ‘Disease of the Week’ reports allow students to develop skills in scientific writing and gain an appreciation of the role of scientific concepts in their lives.”

Franz, Craig J and Margot Soven. 1996. “Writing in Biology: The Senior Project.” *Journal of College Science Teaching* 26(2): 111-114.

The authors describe “the development, implementation, and critique of a strategy to train biology students in writing scientific research papers and writing for a nontechnical audience. The course enables students to see the connection between biology and rhetoric and the importance of developing capacities for generating translations and synthesis of their technical knowledge for the benefit of the public at large.”

Gerdeman, R. Dean, Arlene A. Russell, and Kelly J. Worden. 2007. “Web-Based Student Writing and Reviewing in a Large Biology Lecture Course.” *Journal of College Science Teaching* 36(5) (March/April): 46-52.

"Instructors using peer writing review in undergraduate science courses report improved writing, greater student engagement, application of critical thinking skills, appreciation of the importance of peer review, and practice working on authentic scientific tasks." The authors present statistical data and discuss findings from a study of biology courses which used a web-based assignment called "Calibrated Peer Review." These serve the goals of evaluating student performance and promoting better writing skills for scientists. While recognizing the difficulties in implementing writing and peer review exercises into large lecture classes, the authors point to promising results, especially the improved performance of initially low-performing students, that require only "modest instructor involvement."

Gratz, Ronald K. 1990. “Improving Lab Report Quality by Model Analysis, Peer Review, and Revision.” *Journal of College Science Teaching* 19(5) (Mar/Apr): 292 - 295.

“Gratz argues that the quality of biology lab reports can be improved by choosing models of scientific writing from professional journals for the students to analyze. He then allows students to peer review their classmates’ lab reports. Based upon this review, the students are encouraged to revise their reports before submitting them. Gratz provides guidelines for the peer review with the understanding that it is his responsibility as a teacher to instruct the students on the principles of good, well-organized scientific writing.”

Holyoak, Alan R. 1998. “A Plan for Writing Throughout (Not Just across) the Biology Curriculum.” *The American Biology Teacher* 60(3): 186-190.

“It is...our job as biology faculty to not only teach topical information, but to show students how to think, work and write as biologists. Biology faculty do many of those things well, but they have not traditionally devoted much time or effort to teaching students how to write as biologists.” In response, the authors relate how they created a disciplinary writing program for biology majors in their department. Students who graduate from biology programs may also find themselves in a wide variety of occupations in a number of different sectors, such as private industry, academic research, or government agencies. It thus behooves biology faculty to prepare them for these options.

Jacobs, David, & Rob Moore. 1998. “Concept-Driven Teaching and Assessment in Invertebrate Zoology.” *Journal of Biological Education* 32(3): 191-200.

“Our assumption here was that writing is not simply the transcription of finished thought, but a process that requires the learner to construct and elaborate chains of reasoning. In this context student writing is not only a means of assessing individual student learning,

but also a way of consolidating and advancing such learning." The authors contrast their concept-driven approach that embeds concept understanding in problem-solving contexts with a more common content-driven approach that encourages rote learning and information attrition.

Kirkland, Willis L. 1997. "Teaching Biology through Creative Writing." *Journal of College Science Teaching* 26(4): 277-279.

"Integrating abstract biological concepts into narrative contexts makes science come alive for apprehensive nonmajors."

Kokkala, Irene and Donna A. Gessell. 2003. "Writing Science Effectively." *Journal of College Science Teaching* 32(4): 252-257.

"To teach writing to science students, we designed a collaborative learning community linking students in biology and English courses in author-editor relationships." The authors provide the "theoretical background, pedagogy, process, assessment methods, and findings." They conclude that the students did not only improved their writing, they also became more becoming better acquainted with "the nature of evidence in each discipline."

McMillan, Victoria E. 2001. *Writing Papers in the Biological Sciences*, 3rd Ed. Boston: Bedford/St. Martin's.

"Written by a professional biologist who is also an experienced writing teacher, this comprehensive guide for students writing in biology, zoology, and botany provides detailed instruction on researching, drafting, revising, and documenting papers, reviews, and other forms of writing."

Montavalli, P. P., M. D. Patton, R. A. Logan, and C. J. Frey. 2003. "Promoting Environmental Writing in Undergraduate Soil Science Programs." *Journal of Natural Resources and Life Sciences Education* 32: 93-99.

"The results of this experiment to include environmental writing opportunities in a soil science curriculum suggest that writing may be an important active-learning tool to promote undergraduate student interest and motivation to study soil science." The authors suggest that writing could help attract and retain students in soil science courses, as writing provides an opportunity for students to explore their interests in environmental issues."

Moore, Randy. 1994. "Writing to Learn Biology: Let's Stop Neglecting the Tool that Works Best." *Journal of College Science Teaching* 23(5): 289-95.

In relation to his course, "Writing to Learn Biology," the author "discusses problems associated with poor writing skills among students, means of addressing these problems, and tips for teachers who are considering using writing in their courses."

Pechenick, Jan A. 2007. *A Short Guide to Writing About Biology*, 6th Ed. New York: Longman.

"Providing students with the tools they'll need to be successful writers in college and their profession, *A Short Guide to Writing about Biology* . . . teaches students how to read critically, study, evaluate and report data, and how to communicate information clearly and logically. Students are also given detailed advice on locating useful sources,

interpreting the results of statistical tests, maintaining effective laboratory and field notebooks, writing effective research proposals and poster presentations, writing effective applications, and communicating information to both professional and general audiences."

Tessier, Jack. 2006. "Writing Assignment in a Nonmajor Introductory Ecology Class." *Journal of College Science Teaching* 35(4): 25-29.

Author presents quantitative data that lends support to the idea that incorporating writing assignments into an introductory class enhances student comprehension of the course material. He recounts his experience using reflective writing for an ecology class of non-majors and shows that student showed improved performance in different aspects of the class due to the writing exercises.

CHEMISTRY

Beall, Herbert and John Trimbur. 2001. *A Short Guide to Writing about Chemistry, 2nd Ed*. New York: Longman.

"Emphasizing writing as a means to examining, evaluating, sharing, and refining ideas, *A Short Guide to Writing about Chemistry* helps students get more out of their Chemistry courses and prepares them for work beyond the classroom. This book covers the kinds of readings and writing that chemistry students are called on to do in academic and industrial settings, and in public life. With comprehensive coverage on topics including graphing programs, ACS formats, Science Citation Index, Merck Index, and writing abstracts, this book is a "must-have" for any chemistry student."

Bressette, Andrew R. and Gary W. Breton. 2001. "Using Writing to Enhance the Undergraduate Research Experience." *Journal of Chemical Education* 78(12): 1626.

The use of writing as a tool to achieve active learning in the undergraduate research experience is described. Every student participating in undergraduate research is required to submit a journal-quality paper to our in-house publication, *The Berry College Journal of Chemistry*.

Burke, Barbara A. 1995. "Writing in Beginning Chemistry Courses." *Journal of College Science Teaching*. 24(5): 341.

"Writing assignments in introductory chemistry courses can help relieve students' anxiety about the subject matter. Burke describes writing assignments she has developed for freshman level chemistry courses at her college."

Goodman, Daniel and John Bean. 1983. "Chemistry Laboratory Project to Develop Thinking and Writing Skills." *Journal of Chemical Education* 60(6): 483 - 485.

"This article outlines the method used to produce professional level reports for an undergraduate organic chemistry course. The students are encouraged to use models from professional journals, are involved in the determination of the criteria to be used to judge the most effective reports, and are engaged in selecting the best reports for an in-house publication. After three years of use in the classroom, the authors conclude that the writing task was very effective in teaching students both the rhetorical strategies appropriate to writing reports and in improving their scientific thinking."

Klein, Bill and Besty M. Aller. 1998. “Writing Across the Curriculum in College Chemistry: A Practical Bibliography.” *Language and Learning Across the Disciplines* 2(3): 25-35.

“This article contains not only a comprehensive bibliography oriented specifically toward teaching chemistry at the collegiate level, but also makes recommendations on ways to implement WAC and writing in the chemistry classroom based upon a review of the bibliography’s literature.”

Kovac, Jeffrey and Donna Sherwood. 1999. “Writing in Chemistry: An Effective Learning Tool.” *Journal of Chemical Education* 76(10): 1399-1403.

The ability to solve numerical problems, the authors maintain, does not demonstrate facility with the conceptual foundations of the equations. Writing allows faculty to address challenges that are not well-addressed by lectures, discussions, labs, or problem sets. These include: “(i) providing entry points to the subject for students with varied interests and learning styles; (ii) helping students develop a conceptual understanding of the course material; (iii) developing learning and professional skills; (iv) reintegrating student knowledge by connecting chemistry to a student’s proposed major and to the broader liberal arts; and (v) providing enrichment opportunities for interested students.” The authors also compiled their findings into a handbook that addresses assignment design, strategy and grading.

_____. 2001. *Writing Across the Chemistry Curriculum: An Instructor's Handbook*. Prentice Hall. http://www.pearsonhighered.com/product?ISBN=0130292842

“One of the current challenges facing science educators is that of student writing skills. There is a widespread (and correct) impression that science students cannot write and that they need to learn how if they are to succeed as professionals. Writing-across-the-curriculum programs, offered at a number of institutions, are designed to improve students' rhetorical and writing skills by requiring written coursework in all or most courses (including courses that have traditionally been more quantitative, like chemistry and physics). Designed exclusively for Instructors, this book discusses issues surrounding the implementation of writing-across-the-curriculum programs in physical science, particularly chemistry. For those who are considering or already offering such programs, this book is a rich resource of clear, practical, step-by-step suggestions and other advice.”

Labianca, Dominick A. and William J. Reeves. 1985. “Writing Across the Curriculum: The Science Segment: A Heretical Perspective.” *Journal of Chemical Education* 62(5): 400.

The authors present a dissenting opinion about the implementation of WAC in the core science classes at Brooklyn College. This was written at an early stage of the WAC movement and does not reflect later developments that stressed discipline-specific methods of incorporating writing.

Shires, Nancy Patterson. 1991. “Teaching Writing in College Chemistry: A Practical Bibliography 1980-1990.” *Journal of Chemical Education* 68(6): 494.

“An annotated bibliography designed to aid college chemistry faculty interested in teaching writing skills in their classroom.”

Steiner, Richard. 1982. “Chemistry and the Written Word.” *Journal of Chemical Education* 59(12): 1044.

The author recounts how assignments “contributed to student understanding by requiring students to write summaries of key points and relationships within lecture.”

COMPUTER SCIENCE

Anewalt, Karen. 2002. “Experiences Teaching Writing in a Computer Science Course for the First Time.” *Journal of Computing Sciences in Colleges* 18(2): 346-355.

“The key to a successful experience for both students and instructor is to create assignments that fit the goals of the course, make writing expectations clear, and keep grading consistent and simple.” A beginning professor of computer science reflects on her experience implementing writing in programming courses and addresses the common fears that prevail among her colleagues--lack of time, unsuitability of writing for the curriculum, grading, knowledgeability. She supplies some suggestions for how to design assignments and how to manage the evaluation process. She also mentions some of the students reactions, includes a sample assignment, and a sample rubric.

Becker, K. 2008. “The Use of Unfamiliar Words: Writing and CS Education.” *Journal of Computing Sciences in Colleges* 24(2): 13-19.

“Communication skills are often cited as among the most important skills for Computer Science (CS) professionals, so it may seem somewhat incongruous that other than writing code and associated program documents, CS students are rarely given writing tasks in their CS courses. This paper will examine some possible reasons for why that might be, and what benefits could be realized through providing students with opportunities for more and varied forms of writing. A brief review of strategies used at various institutions is outlined, and a new strategy that has been implemented twice at the author’s former institution is described, where students are asked to produce short, 250-500 word “reading responses” to various assigned readings. The details of the assignment, as well as the intended outcomes will be outlined. The concept proposed in this paper was implemented in two semesters of the same course, and some initial student reactions are outlined with suggestions for further examination and development.”

Dansdill, Timothy T., Mark E. Hoffman, and David S. Herscovici. 2008. “Exposing GAPS, Exploring Legacies: Paradoxes of Writing Use in Computing Education.” *Journal of Computing Sciences in Colleges* 23(5): 24-33.

“The authors conducted a survey of computing educators to better understand their objectives for assigning writing in computing courses, as well as to assess the impact of the Writing Across the Curriculum (WAC) movement on the field. Three general categories of writing are assessed: writing to learn, academic, and professional writing. The present survey’s results, though limited, address the lack of any such data in the literature. The results point to a ‘gap’ between types of writing—particularly between ‘writing-to-learn’ and professional writing tasks. Filling this perceived gap is what the authors define as ‘legacy’ writing. Results further suggest that the WAC movement has had marginal influence on writing in computing education.”

Drexel, Peter and Roy Andrews. 1998. “Writing in Computer Science Courses: An E-Mail Dialog.” *Plymouth State College Journal on Writing Across the Curriculum* 9: 60-68.

Authors describe, in the form of an email exchange, the ways writing has been incorporated into different courses in a computer science department's curriculum. Forms of writing included personal journals or lab notebooks, in which students write ongoing commentary on their experiences; manuals addressed to users for their software projects and documentation of their programs addressed to other programmers, both of which teach students to write about their work from different perspectives and for different audiences and purposes; summaries of journal articles which help teach students to read technical material in their discipline; research papers, which included submitting drafts along the way; and peer review exercises which give students the opportunity to address their peers and "think verbally" about their technical knowledge.

Dugan, Robert F., Jr. and Virginia G. Polanski. 2006. "Writing for Computer Science: A Taxonomy of Writing Tasks and General Advice." *Journal of Computing Sciences in Colleges* 24(4): 74-79.

"Computer science graduates lack written communication skills crucial to success in the workplace. Professional and academic organizations including ACM, IEEE, ABET, CSAB, and NACE have stressed the importance of teaching computer science undergraduates to write for years, yet the writing problem persists. In this paper we provide guidance to computer science instructors who want student writing skills to improve. First, we organize prior work on writing for computer science into a goal-oriented taxonomy of writing tasks. Each task includes a clear, concise, and detailed model that can be used as the framework for a student writing assignment. Second, we provide general advice for incorporating writing into any computer science course. Finally, we discuss the application of our taxonomy and advice to writing tasks in several computer science courses."

Fekete, Alan, Judy Kay, Jeff Kingston, and Kapila Wimalaratne. 2000. "Supporting Reflection in Introductory Computer Science." In *Proceedings of the 31st SIGCSE Technical Symposium on Computer Science Education* (March 7-12, 2000): 144-148.

"Some instructors . . . say 'I have enough trouble getting students to write a loop that terminates correctly; any time available should be spent on improving their knowledge of programming, not on their introspective musing on their own learning process.' However, evidence suggests that reflection actually enhances the technical mastery achieved."

Fell, Harriet J., Viera K. Proulx, and John Casey. 1996. "Writing Across the Computer Science Curriculum," In *Proceedings of the 27th SIGCSE Technical Symposium on Computer Science Education* (February 15-17, 1996): 204-209.

"At our university, as at many others across the country, there is a movement to integrate the common core subjects with the disciplinary studies. While in the past writing has been a domain of English departments, the new trend is 'writing across curriculum'. It is clear that effective written and oral communication skills are critical for the successful computer professional. We present suggestions for writing assignments that complement the main themes of computer courses from introductory to advanced levels. While some of these have appeared in the literature, others are new. We report on our experience with these assignments and reflect on how they enhance the computer science curriculum."

Giangrande, E., Jr. 2009. "Communication Skills in the CS Curriculum." *Journal of Computing Sciences in Colleges* 24(4): 74-79.

"Over the years it has been pointed out that an important skill for computer science majors is the ability to communicate effectively. Unfortunately, for a variety of reasons, computer science students often never acquire these skills. This paper (a) considers some of the reasons why students do not acquire these skills, (b) reviews some approaches that have been proposed to remedy this situation, (c) presents an argument for defining what these skills are in a more comprehensive manner, and (d) describes how these communication skills can be integrated into a computer science curriculum."

Hoffman, Mark E., Timothy Dansdill, and David S. Herscovici. "Bridging Writing to Learn and Writing in the Discipline in Computer Science Education." In *Proceedings of the 37th SIGCSE Technical Symposium on Computer Science Education* (March 1-5, 2006): 117-121.

"Writing in Computer Science education is typically writing to communicate to a professional audience—also known as 'writing in the discipline' (WID). A few Computer Science educators have promoted 'writing to learn' (WTL) for active learning. A gap exists between these two forms of writing that inhibits the general adoption of writing in Computer Science. We propose that 'bridging' informal WTL assignments to formal disciplinary writing as a way of promoting general adoption of writing across all courses, thus improving thinking and writing skills for all Computer Science students. We include examples of assignments that bridge writing to learn and writing in the discipline."

Kay, David G. 1998. "Computer Scientists Can Teach Writing: An Upper Division Course for Computer Science Majors." In *Proceedings of the 29th SIGCSE Technical Symposium on Computer Science Education* (February 26-March 1, 1998): 117-120.

"The author's institution requires all students to take one course that concentrates on writing at the upper division (junior or senior) level. The computer science department offers one such course, taught by computer scientists. It concentrates on communications issues relevant to computer scientists and computer professionals, going beyond traditional 'technical writing' to give students experience in oral presentation, document design, and writing in forms appropriate for various audiences. This course takes advantage of analogies between writing and software development and motivates computer science students to pay more careful attention to their writing."

Ladd, Brian C. 2003. "It's All Writing: Experience Using Rewriting to Learn in Introductory Computer Science." *Journal of Computing Sciences in Colleges* 18(5): 57-64.

"Writing computer programs is writing to communicate with a human and a machine audience. This fact is often lost on students in introductory computer science courses. At St. Lawrence University, an effort has been made to use techniques developed as part of the writing across the curriculum movement such as portfolio evaluation and multiple drafts of written work to improve student outcomes in introductory computer science courses. Motivation and evaluation of the St. Lawrence experience is reported."

Lewandowski, Gary. 2003. "Using Process Journals to Gain Qualitative Understanding of Beginning Programmers." *Journal of Computing Sciences in Colleges* 19(1): 299-310.

"Process journals are informal journals kept by students as they work on a programming project. The goal in using them is to gain qualitative information about the student's problem solving and programming process. This paper presents a qualitative analysis of the journals from a data structures course, categorizing the broad themes found in the journals and the nature of the responses given by the instructor. The goal of this

qualitative analysis is to answer the questions, ‘what sort of information do you see in a process journal and how do you use them in your course?’"

Pesante, Linda Hutz. 1991. “Integrating Writing into Computer Science Courses.” In *Proceedings of the 22nd SIGCSE Technical Symposium on Computer Science Education* (March 7-8, 1991): 205-209.

“Writing can and should be an integral part of computer science and software engineering courses. This paper describes an approach to teaching writing that can be used by instructors of technical courses; it suggests both content and teaching techniques. The paper also discusses how to enlist the aid of technical writers and technical writing teachers.”

Sinha, Neelu. 2006. “Writing Across the Curriculum – An Online Course in Computer Security.” *The Journal of Educators Online* 3(1): 1-26.

The author provides an account of the background, motivations, and objectives for implementing a WAC program in a computer science department, as well as the lessons they gained from their experience, general conclusions, and future plans. She also provides a good review of the principles and methods they used for course design, syllabus building, addressing the problems that arise in the writing process and tools to help facilitate writing as an integral activity in their curriculum. The particular experience she describes is unique as it concerns a computer security class administered online.

Taylor, Harriet G. and Katharine M. Paine. 1993. “An Inter-Disciplinary Approach to the Development of Writing Skills in Computer Science Students.” In *Proceedings of the 24th SIGCSE Technical Symposium on Computer Science Education* (February 18-19, 1993): 274-278.

“This paper describes an inter-departmental solution to the traditionally poorly-written computer science term paper. A student questionnaire identified common anxieties of topic selection, library research, format, and organization, which were addressed in a three-part project that culminated in a final paper. Unique in this solution was the English and computer science collaboration that resulted in non-traditional solutions to traditional problems.”

Zilora, Stephen J. and Lisa M. Hermsen. 2007. “Take a WAC at Writing in Your Course.” In *Proceedings of the 8th ACM SIGITE Conference on Information Technology Education* (October 18-20, 2007): 167-174.

The authors argue that the best way for students to take their writing seriously as an important skill requires professors in information technology to take an initiative in writing education, and not simply place all the burden on the English department. This is especially the case when the specific norms of their discipline cannot possibly be adequately conveyed to the students by English professors. “[P]redicated on the belief that just like programming or any other technical skill, writing requires practice . . . , the authors have devised a support structure to better enable WAC. Specifically, with an English professor serving as a ‘personal trainer,’ a technical professor can learn how to provide formative feedback to his students without needing to be an expert grammarian. Our experience is that this process is both easy to implement for the professors and well-received by students. Students reported that they actually enjoyed the additional writing assignments and the associated feedback.”

ECONOMICS AND BUSINESS

Alred, Gerald J., Charles T. Brusaw, and Walter Oliu. 2008. *Handbook of Technical Writing*, 9th Ed. Boston: Bedford/St. Martin's Press.

> "Nearly 400 entries provide guidance for the most common types of business documents and correspondence, from brochures, press releases, and résumés, to executive summaries, proposals, and reports. Abundant sample documents and visuals throughout the book demonstrate effective business communication, reflecting current practices for formatting documents and using e-mail. In addition, advice on organizing, researching, writing, and revising complements thorough treatment of grammar, usage, style, and punctuation to provide comprehensive help with writing skills. This edition has been thoroughly revised to include expanded advice for analyzing the context of different writing situations, using and integrating visuals, and dealing with ethical concerns in business writing, including plagiarism."

Cohen, Avi J. and John Spencer. 1993. "Using Writing across the Curriculum in Economics: Is Taking the Plunge Worth It?" *The Journal of Economic Education* 24(3): 219-230.

> "The American Economic Association-commissioned report 'The Status and Prospects of the Economics Major' states that in order to reach the central pedagogical goal of helping students learn to 'think like economists,' instructors could integrate the writing across the curriculum (WAC) approach into the teach-ing of economics. In this article, we report on a collaboration between an economist and a writing instructor in using this writing-to-learn approach into a history of economic thought course. The collaboration includes ongoing consultation on designing assignments and feedback to students and two class visits per term by the writing instructor to discuss strategies for reading and writing. The restructured course has yielded much improved student papers, more satisfying educational experiences for students and instructor, and students who are better able to think like economists."

Hansen, W. L. 1993. Teaching a Writing Intensive Course in Economics. *The Journal of Economic Education* 24(3): 213-18.

Simpson, Murray S. and Shireen E. Carroll. "Assignments for a Writing-Intensive Economics Course." *The Journal of Economic Education* 30(4): 402-410.

ENGINEERING

Brillhart, L.V., and M.B. Debs. 1983. "A Survey of Writing and Technical Writing Courses in Engineering Colleges." *Engineering Education* 74(2) (November): 100-113.

> The authors "surveyed 187 engineering colleges on composition/rhetoric courses required of engineering students, required and/or elective technical writing courses, and attitudes toward writing/writing instruction. Results from 108 responding institutions indicate that, although administrators support such courses, course implementation does not always reflect such support. Additional findings are reported and discussed."

Debs, Mary Beth and Lia V. Brillhart. 1981. "Engineering Composition at the Community College." *Teaching English in the Two-Year College* 8(1): 57-60.

"Describes an experimental course in content area writing in engineering taught at Triton College (Illinois)."

Hart, Hillary. 2009. *Engineering Communication*, 2nd Ed. Englewood Cliffs, NJ: Prentice Hall.

"An introductory book covering all aspects of communication for engineers from writing to presenting. The goal of this book is to make writing and other forms of communication part of the problem-solving process. Students will learn to use writing to make sure their engineering work is on track in addition to communicating ideas and results to clients, agencies, and researchers."

Olds, Barbara M. 1998. "Technical Writing Across the Curriculum: Process, Problems, and Progress." *Proceedings of the ASEE/IEEE 28th Annual Frontiers in Education Conference*, Tempe, AZ, Oct. 1998.

The author describes the advent of a very extensive multi-year writing-intensive course of study for all students at the Colorado School of Mines, all of whom are engineering or applied science majors. The WAC curriculum is integrated across the institutions of the college. She discusses the resources they dedicated to the program, along with its goals, guidelines, and assessment.

Paradis, James G. and Muriel L. Zimmerman. 2002. *The MIT Guide to Science and Engineering Communication*, 2nd Ed. Cambridge, MA: The MIT Press.

This guide covers the basics of scientific and engineering communication, including defining an audience, working with collaborators, searching the literature, organizing and drafting documents, developing graphics, and documenting sources. The documents covered include memos, letters, proposals, progress reports, other types of reports, journal articles, oral presentations, instructions, and CVs and resumes. Throughout, the authors provide realistic examples from actual documents and situations. The materials, drawn from the authors' experience teaching scientific and technical communication, bridge the gap between the university novice and the seasoned professional.

Winsor, Dorothy A. "Engineering Writing/Writing Engineering." *College Composition and Communication* 41(1): 58-70.

This article should be approached with skepticism, but might be instructive to some. The author accepts the view, prevalent in the humanities and the social sciences, that considers writing as generating knowledge, and contrasts this to the view in the sciences and engineering disciplines that considers writing to transmit knowledge. The author's attitude to writing in the technical disciplines could be a typical one among writing instructors. Humanists may be more prone to seeing writing as primary, as much of the work done in the humanities consists of the reception and generation of texts. In the technical disciplines, reading and writing is considered secondary to the work performed, a way of reporting on the content and findings of that work. In addition to illustrating a difference between the "two cultures," reading this article as one view of the issue might also spark dialogue on the purpose of reading and writing in different contexts.

MATHEMATICS AND STATISTICS

Isaacs, E. 1997. “Writing to Learn Mathematics.” In Carol Booth (Ed.), *Practical Ideas for Teaching Writing as a Process at the High School and College Level*. Sacramento, CA: Bureau of Publications, California Department of Education.

Reiman, David A. 2001. “Engaging Students Using a Simple Electronic Daily Response Journal.” *Journal of Computing Sciences in Colleges* 17(1): 147-157.

“This paper describes and analyzes a simple mechanism designed to enhance learning by encouraging meaningful class attendance, engaging students inside the classroom, and encouraging critical thinking outside the classroom. A web-based method for a simple journal system is presented that solves some of the logistical problems that occur with paper journals. . . . The daily response journal encourages students to think critically and reflect about their questions, and it promotes discussion that better includes introverted and reflective students. This review time also serves as a focused review of the previous class and provides a nice transition between course topics . . . . [S]tudents found the daily response helpful overall. In particular, this format improved clarification and feedback on difficult concepts, facilitated classroom discussion, fostered an inquisitive attitude, gave them a voice in class, made it easier to ask questions, and stimulated their thinking outside the classroom. This method can be easily employed in a wide variety of settings to promote student engagement in the learning process.”

Samsa, Gregory and Eugene Z. Oddone. 1994. “Integrating Scientific Writing into a Statistics Curriculum: A Course in Statistically Based Scientific Writing.” *The American Statistician* 48(2) (May): 117-119.

“A course in writing and critical appraisal of medical papers that uses statistics is described, and its relationship to the goal of better integrating scientific writing into the statistics curriculum is discussed. It is concluded that writing should play an increased role in statistical education and that this can best be accomplished by distributing exercises in writing and critical appraisal throughout the curriculum. Writing assignments, such as simulated practice in producing components of scientific papers and grants, should reflect students' likely uses of statistics.”

PHYSICS AND ASTRONOMY

Becker, S. 1995. “Teaching Writing to Teach Physics [guest editorial].” *American Journal of Physics* 63(7): 587.

The author “argues that writing about physics forces students to come to grips with the material and with what they do and do not understand. Describes the use of writing in an introductory course. Discusses benefits of a decentralized ‘writing across the curriculum’ program.”

English, Tom. 1997. “Writing to Learn and Journal Applications in the Introductory Astronomy Course.” *Language and Learning Across the Disciplines* 2(2): 18-28.

By incorporating writing-to-learn techniques, such as journal writing, the author revitalized a repeatedly-taught introductory astronomy course, thereby eliciting from his students a more nuanced engagement with the subject matter. This led to improvements in the students’ observational abilities, conceptual understanding, and writing skills. The article

includes examples of the students' journals and a discussion of the instructor's experiences.

RELEVANT GENERAL WAC LITERATURE

Bazerman, Charles and David Russell. Eds. 1994. *Landmark Essays on Writing Across the Curriculum*. Davis, CA: Hermagoras.

Bean, John C. 1996. *Engaging Ideas: The Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom*. San Francisco, CA: Jossey-Bass.

McLeod, Susan H. and Margot Soven, Margot. 2000. Writing Across the Curriculum: A Guide to Developing Programs. WAC Clearinghouse Landmark Publications in Writing Studies: http://wac.colostate.edu/books/mcleod_soven/
Originally Published in Print, 1992, (Newbury Park, California: Sage Publications).

RESOURCES FOR FINDING FURTHER MATERIAL:

The WAC Clearinghouse at Colorado State http://wac.colostate.edu/index.cfm

"The WAC Clearinghouse, in partnership with the International Network of Writing Across the Curriculum Programs, publishes journals, books, and other resources for teachers who use writing in their courses. The WAC Clearinghouse is a Web site that provides access to information about writing and communication across the curriculum. The WAC Clearinghouse supports teachers of writing across the disciplines. This site uses a database to allow members to add and update content on the site. The site is hosted by Colorado State University's Composition Program."

Purdue Online Writing Lab (OWL): http://owl.english.purdue.edu/owl/

"The site has a wide range of resources and links to teacher resources, technical writing/publishing resources and online journals including *The Writing Instructor*."

Writing in Engineering: http://owl.english.purdue.edu/owl/section/4/19/
Writing as a Professional Nurse: http://owl.english.purdue.edu/owl/resource/922/01/
Writing in Psychology: http://owl.english.purdue.edu/owl/resource/670/01/

Technical Writing: Resources For Teaching http://writing.eng.vt.edu/handbook/index.html

This site serves as a guide for faculty to "incorporate writing and speaking assignments into . . . engineering or science courses. Included are resources for the design of writing assignments, the interactive teaching of writing, and the evaluation of writing assignments."

Writing Across the Curriculum at MIT http://web.mit.edu/wac/about.html

“The integration of writing instruction into science and engineering classes has a long history at MIT that began in 1898.”

Compiled by Joshua Howard
CUNY Writing Fellow
2008-2010