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Teaching Scientific Writing in the Two-Year College

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> …I do assert that every scientific text must be read, that it is writing, not some privileged verbal shorthand that conveys a pure and unvarnished scientific truth.
>
> — David Locke in *Science as Writing*

It is by now common knowledge that young scientists need more practice in writing and communications skills. However, for a majority of science students, instruction in scientific communications happens either in graduate school or in an upper division course focused on writing in the discipline (WID). Even then, however, "graduate students … feel that the pressure to produce high-quality science writing is not matched with the training necessary to succeed as a professional writer" (Beers et al, 2013). Lower division students have few opportunities to write about science topics or scientific genres other than those that are part of their science coursework. In the freshman English composition sequence, some students may write general research papers or complete reports on scientific topics, but mostly they are taught to write using the conventions of the English or humanities disciplines. Yet, many of the conventions of the English classroom are not used by science communicators; they are sometimes inhibitors to later academic and professional success. In fact , sometimes "English teachers strongly encourage students to write poorly by giving better grades to indirect, complex, wordy, and inflated writing than to direct, simple, concise, and understandable writing …[they] encourage what they claim to deplore and discourage what they claim to admire" (Moore, 1993, p. 217). Similarly, "though writing and composition courses are virtually a universal part of education today, very rarely do these general composition courses address the special aspects of writing a scientific article, essay, or lab report" (Porush, 1995, p. 5). Other science students suffer the failings of the mimetic tradition of learning science writing, where they learn poor writing "by imitation" (Day, 1998), or are

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forced to "pick up good composition and style by reading the publications of others (Hoffman, 2014, p. 1).

ENG114: Scientific Writing introduces Virginia community college students to the conventions of science rhetoric in the Composition II slot. Intended as an option to the ENG112 or ENG125 course that most VCCS students currently take, it fulfills the VCCS Composition II requirement for all certificate and degree programs. This course evolved from a "special topics" ENG112 I taught for a number of semesters: "Writing, Literature, and Science." It is ideally suited to support a local honors program or a Science-English learning community. Through carefully selected reading and writing assignments, the content of ENG114 can be adapted to particular scientific, technological, or medical fields, and it can also be adapted to support writing certificate programs or workforce development offerings.

The purpose of ENG114 is not to make masterful scientific communicators out of its students, no more than ENG112 is intended to make masterful rhetoricians. Rather, it is intended to fit the student into a developmental cycle, reflecting the spiral curriculum, whereby the student can encounter the principles of scientific rhetoric at a level of sophistication commensurate with their general level of science education. Consequently, when students go on to more sophisticated rhetorical tasks later in their academic and professional careers, they will be more successful communicators of science. In this way, ENG114 responds directly to the call within all scientific and technical domains for improved communication and writing skills among students because, as Day (1998) so famously wrote in perhaps the most influential scientific writing guide ever, "many good scientists are poor writers." This observation has since been echoed by numerous voices. Valiela (2001) writes, "we must admit that scientists as a group write murkily (p. 102); Duke University's online "Scientific Writing Resource" begins by stating that "scientists have a reputation for being poor writers." This statement is ironic given, as Plaxco (2014) argues, "writing the clearest, easiest to read papers possible is the one-and-only goal," and Yore et. al. report that scientists "were very skeptical of science papers where the writing was poor." Meanwhile, and most recently, Hoffman (2014) writes that "Without good communication, scientists stand little chance of publishing their work or moving up in their career path" (p. 1).

The target population for ENG114 is primarily those students who intend a career in professional science or science-writing, but ENG114 can be integrated into the Certificate in Professional Writing currently offered at a number of VCCS colleges, or it can serve as the foundation course for a new Certificate in Scientific Writing such as the one I hope to develop at my institution, Northern Virginia Community College. Importantly, because English is the international language of science, a version of this class could easily be marketed on a global scale to scientific English users. Finally, a version of this course could be taught for dual enrollment in a secondary science magnet school.

A REVIEW OF THE COURSE OBJECTIVES

The ENG114 course content summary (Appendix A) stipulates a number of specific rhetorical goals, and at first glance these may seem overwhelming to both students and teachers. However, these goals are embedded in the production of writings in the composition environment, and once the student learns the literary conventions of scientific writing, the class becomes no more difficult to complete than any other writing process composition course. Further, the "science and engineering students who seek to minimize the amount of writing they do by avoiding courses which require lots of it" (Porush, 1995, p. xxii) may find the same critical tasks, now translated into a scientific context, suddenly comprehensible, relevant, and do-able.

The following discussion of each of the Course Objectives reflects the ways in which my class has evolved in the last few years.

A. Compose Typical Scientific Prose

The first objective of ENG114 is for students to learn and practice the conventions of written scientific prose, known as "plain style." The language of science reflects the literary values of the scientific community. Scientific prose style is termed "typical," and **that writing is best that most closely conforms to the plain style standard and the conventions of scientific genres.** In effect, scientific writers try to sound the same, and they do so for very important scientific reasons: Typical prose ensures uniformity and fewer errors in misreading or misinterpretation. Plain style establishes an international standard, a global language, allowing scientific knowledge to migrate across languages and scientific fields with greater accuracy and fewer mistakes. Over time, plain style has evolved to serve the process of scientific study and publication, stressing objectivity, transparency, and precision. Plain style also contributes to the functionality, storage, and retrieval of scientific knowledge in the modern day, and our database Boolean searches are made easier because of it. In short, all of the unique conventions of plain style exist to remove or minimize ambiguity in a scientific communication, to preserve scientific meaning over time, and to make it accessible and retrievable by current and future users.

The conventions of plain style are simple, but it usually takes the average writer a little bit of practice to unlearn the habits of English prose and to develop confidence with it. Briefly, the key to typical scientific prose is limiting each sentence to the expression of *one* thought, using the present tense and the active voice as much as possible. Sentences should be as succinct as possible, and writers need to limit the use of scientific and technical terms. Gopen and Swan's "The Science of Scientific Writing" (2003) remains the seminal discussion of the essential elements of scientific prose syntax. Instructors developing this course should take care to select a writing handbook or guide that includes a healthy discussion of Plain Style, with examples and exercises if possible. The Appendices also includes a list of Background Readings that treat the conventions of plain style.

The primary purpose of plain style is to ensure that a scientific message will be *read the same* by every reader and that the science communicated within the message is reproducible. This *principle of one meaning* in scientific prose is almost exactly opposite the basic assumptions of a typical English class, and many of the historic

problems in the communication of science can be traced to this simple component: Scientific writing seeks uniformity and objectivity. Rhetoricians may continue to debate this point, and many insightful books are written on the limitations (or impossibility) of such thinking; however, these arguments have not really changed the expectations of scientific editors or the readers they serve.

The practical fact is that science has evolved a completely different, in many ways opposite, set of literary values to those that are taught by the English Academy. The chart below illustrates these differences, with the caveat (of course) that this chart is meant to show a general orientation of science to writing and argumentation. It is not meant to be read as a prescriptive rule because scientific writing is still created by individual human beings, and "typical" scientific prose is a standard that each practitioner seeks to emulate, with the consequent result that not all writers understand what they are doing or necessarily do it very well. I use this chart to explain differences to my students, and throughout our discussion I emphasize how these traits are not oppositional, but complementary.

Traditional "English" Literary Values	**Traditional "Scientific" Literary Values**
Truth is subjective	Truth is objective
Style is individual and unique	Style is communal and governed by conventions of discourse
Language is literal and figurative: includes differing levels of objectivity, as well as metaphor, poetic language, and diction	Language is literal: Plain Style
Forms are creative and evolve quickly	Forms are prescribed and evolve slowly
Rhetorical creativity is unlimited	Rhetorical creativity is limited
The purpose of literature is to entertain, and to create understanding between human beings, and thereby improve society	The purpose of literature is to disseminate knowledge among human beings, so that it can be used to create more knowledge, and thereby improve society; and it can entertain

B. Compose Typical Scientific Documents

As instructors of composition know, students master writing forms best when we arrange assignments that mimic the authentic conditions and purposes of actual messages. A large number of scientific writings are inherently functional; they are designed to enable and manage scientific study within complex institutions such as the Environmental Protection Agency (EPA), the National Science Foundation (NSF), or large and often multinational science industries and corporations. Other messages are inherently mechanical; they are designed to establish objective knowledge in the context of ongoing research or work, or to be integrated into larger rhetorical constructs (theories) or goals. Most important are those writings whose purpose is to establish new knowledge, to persuade other scientists to agree with new claims that result from scientific processes or to convince or communicate new knowledge to various audiences.

ENG114 students need to be taught that in scientific writing, genres are much more prescriptive than they are in other contexts, and writers are given almost no choice in the arrangement of arguments: they must meet the exact requirements

of publications in order to be accepted, and those writings that fail to meet those requirements simply "do not count." Again, good scientific reasons support these demands, and they are all related to caretaking the integrity, reproducibility, and ability to research published scientific knowledge. The ENG114 Course Content Summary lists a variety of scientific genres for which instructors can usefully design interesting and creative writing assignments and projects.[1]

C. Audience Awareness

One of the most important skills that scientific writers need to develop is adjusting their language to their intended audiences. Thus ENG114 requires that student writers practice this task, which in science rhetoric is sometimes called "translation." A scientific writer has to be able to explain a complex scientific idea in a form intended for the common reader, the average non-scientist, or even for scientists from other fields than that within which the current writing is located.

For this objective, instructors need to design a sequence in which the writer first produces writing intended for a narrow scientific audience. Once students have produced a scientific writing, such as the research report or scientific article, the next step is to require them to "translate" that work into a different genre intended for a non-scientific audience. For instance, instructors can ask students to

- translate the report into a children's book, intended for a reader of 7-8 years old.
- rewrite the report as a magazine article for a general audience
- produce the paper as a scientific poster and make a presentation that mimics the conditions of a scientific conference
- produce the paper in some atypical media: a Youtube™ video, a play, a graphic novel, etc.

D. Rhetoric of Science

ENG114 should facilitate discussion of the ways in which language is intertwined in the act of knowledge creation, in scientific method, and in the global "scientific enterprise"; students should learn that cognitive processes govern how human beings create, process, store, and transmit knowledge and meaning through language, and that a greater control of these cognitive processes will improve not only their scientific careers, but also the quality of the science they eventually produce.

Usually I accomplish this objective with a basic literary essay, "The Nature of the Science Paper." This assignment is designed to help the student to continue to develop the basic thesis-driven discussion of a claim; it is also meant to allow students to explore their own personal relationship to scientific study. I ask them to

[1]Appendix C includes two exemplary writing assignments to illustrate the approach my class takes to fulfilling the CCS. Instructors may freely borrow and adapt these assignments to fit the needs of their local science writing environments. Individual instructors should consider the goals and emphases of their respective college needs when designing their courses, and instructors should select scientific-rhetorical tasks that meet the interests and demands of their local scientific, technical, or medical communities.

define the "nature" of science personally and to offer a reasoned discussion of that interest and meaning. In preparation for this paper, we read a number of personal writings by scientific writers, many of which focus on the role that language plays in their scientific lives, and we discuss these in depth. Essays such as Edward O. Wilson's "Life is a Narrative," readings taken from "Natural Science," by Lewis Thomas, or Samuel Scudder's "Take this Fish and Look at It" all resonate with science students, and help then to, as Porush (1995) urges, to "reconnect writing to [their] vision of science" (p. 3). I also include readings such as "What's Right About Scientific Writing," by Gross and Harmon, Locke's "Voices of Science," and Huxley's classic "The Method of Scientific Investigation," each of which explores the rhetorical and reasoning dimensions of scientific argument and thinking.

E. Written Scientific Argument

ENG114 requires that students produce a scientific article because it is the dominant genre in science, and publication in peer-reviewed science journals is an important aspiration of researchers. Through publication, a scientist both contributes knowledge to human society and makes his or her mark in the field. The conventions of the professional article vary from discipline to discipline, but in general they all are variations of the basic IMRAD (**I**ntroduction, **M**ethod, **R**esults, and **D**iscussion) paper. The production of the IMRAD paper exercises the student in scientific thinking, and demonstrates how science and writing are inseparable. Finally, this assignment supports a critical aspect of scientific writing and thinking: it is argumentative.

Instructors can design tasks that identify problems, hypothesize, test, and then report on findings that relate to local conditions of science, technology, or medicine that prevail at their colleges. In completing this assignment, students are being asked to complete all the rhetorical components of scientific knowledge building.

Here is that rhetorical sequence of scientific knowledge construction:

a. Students perceive a particular phenomena

b. Students form a hypothesis about some aspect of the phenomenon

c. Students design and conduct a study of that hypothesis

d. Students compile and interpret the results of that study

e. Students make a claim based upon their original hypothesis and study results

f. Students collaboratively produce a research article arguing that claim

g. Students publish the article

h. Students present the study in an oral setting

In my class, students achieve this goal with the IMRAD Assignment. A little more than halfway through the semester, I require students to self-select research teams of three to four members. These teams must then conduct a scientific study of some question they discover in relation to a set of rhetorical parameters I impose upon

their work. Students must then design the study, conduct the research, analyze the results, and answer their question. Then, they must compose a collaborative IMRAD paper, mimicking the conditions of a scholarly journal. These articles are published through our class Blackboard site, and they are read by future students of the class. For the Final Exam, I convene a scientific "conference," and each team presents their IMRAD study using a scientific poster. They discuss their study and findings, and they respond to audience questions.

Though the questions the students examine may seem trivial, they are nonetheless real, and students invariably approach them with a level of enthusiasm that is hard to produce with mass-marketed lab exercises. Student teams have studied questions such as

- the percentage of passersby who stumble on a particular crack in the sidewalk on campus
- the likelihood that a passerby will pick up litter and deposit it in a trashcan, in relation to the distance between the litter and the receptacle
- the average time it takes a driver to find a parking space on campus
- the most unsanitary bathroom door handle: a comparison between facilities used by men and those used by women
- the number of smokers who ignore the "no smoking within 50 feet of the entrance" sign in front of the library

The point of these studies is that they are authentic, and that students conceive of the questions themselves, thus affirming the central value of individual interest and imagination that both instigates and permeates the scientific process.

F. Collaboration and Research

The nature of science in the modern age is collaborative. Increasingly, collaborative scientific teams are international, multilingual, and multicultural. Consequently today's young scientists need more practice in forming serious research teams, working together, and producing collaborative products.

Instructors are encouraged to design a long-term collaborative research and writing project that mimics, as closely as possible, the communication challenges of real scientists. For example, I find that this goal is accomplished with the IMRAD project. I use Blackboard to establish a set of Group Pages, which gives the research teams autonomy and privacy, while still allowing me oversight. Then, I require students to use those Group tools as they would in professional scientific situations. I set benchmarks for the groups and require regular written progress reports, all mimicking the basic professional communication processes of science teams in the modern scientific enterprise.

Additionally, it is important that ENG114 incorporate a "research paper" to satisfy graduation and transfer requirements and that it remain a course equal to the "Composition II Research" requirement. Students in ENG114 must, therefore, complete a researched and documented paper. I accomplish this task by teaching the

"Scientific Report," but instructors may also accomplish it by teaching a "Literature Review" paper or a traditional research paper on a scientific topic. I usually do this paper in the first half of the course, and I integrate plain style prose instruction into this assignment in order to avoid teaching this topic in isolation.

Another course objective is to introduce students to APA style. Instructors will most likely wish to do this in the first half of the class during the research writing assignment. Again, instructors should be careful to select a handbook that includes a solid review of APA style, as well as apparatus that can be incorporated into course design. In science, it is easier to see that documentation is not simply about avoiding plagiarism. Documentation is a functional element of a scientific argument, for it not only demonstrates the authority and knowledge of the researcher, it also connects the current scientific writing to other related questions, continuing and furthering an ongoing scientific study. A Review of Literature section is not merely a summary of previous knowledge: it is a physical connection between this particular claim and other similar or related claims, narrowing focus and furthering the social argument between disparate writings. It is an integral part of the scientific argument, and this connection is cemented through the process of documentation which enables the social recall of pre-existing scientific claims of truth.

G. Scientific Presentation

Science professionals are constantly called upon to present information to various audiences in live settings, and commonly the young scientist-graduate student will participate in their first scientific conference as a poster presenter. Students will also be required to produce presentations for their future science classes. To help students be more successful, it is important that the basic principles of presentation are covered, and that students be given the opportunity to practice these skills. Similar to the previous goal of collaboration, this goal is best accomplished as part of a larger project. I generally accomplish this goal in my Final Exam, which requires the Research Teams to present their IMRAD findings.

RECOMMENDATIONS

I generally teach ENG114 as a portfolio course; this methodology encourages the group of writers to revise their work with greater attention and success. However, the syllabus (Appendix B) reflects a traditional "modes" approach, which many teachers may find useful as a basic class to learn from and then adapt to their own methods. In addition, I include sample assignment sheets for two writing projects (Appendix C).

Perhaps the best text available to support ENG114 is Marilyn F Moriarity's *Writing Science Through Critical Thinking* (1997.). The best scientific writing handbook is *The Mayfield Handbook of Technical and Scientific Writing* (although currently out-of-print, it can be found online). However, most handbooks have solid apparatus supporting APA documentation style, and some also include discussion of Plain Style. Instructors also have the option of a technical writing handbook to support the class; however, it is important that they distinguish between "technical writing" and "scientific writing." Thomas Pearsall's "Elements of Technical Writing," is perhaps

the best technical writing primer available, and noteworthy alone for modeling the very principles it instructs. The best guide of purely functional aspects of scientific writing is the new "Scientific Writing and Communication," by Hoffman. This text gives ample illustration of Plain Style and the most common scientific genres, but it lacks the broader rhetorical elements that are central to ENG114.[2]

The sample syllabus anticipates that instructors would wish to build their own reading lists, reflective of the types and topics of scientific writing they are interested in. The "Background Readings" section offers a number of suitable readings to support the class. In most cases, I do not provide students copies of these readings but instead provide just the APA citation. Students then practice APA mastery, as well as gain familiarity with research techniques and college library assets.

I must note a current, and hopefully temporary, caveat: ENG114 has struggled to make since its adoption. Ironically, the Guaranteed Admission Agreements have had the effect of dissuading students from registering for this class because it is not currently listed in these agreements. Consequently, students hesitate to register for the class because they fear it will not satisfy required articulation requirements. I recommend that English faculty work close with science colleagues to build student interest and participation, particularly through the use of learning communities.

Student responses to ENG114 have been greatly encouraging; sample, anonymous responses are shared below:

> "I improved in several areas over the course of the semester. My ability to write using plain style improved the most. I also developed a new understanding of the differences between science writing and scientific writing. My writing further developed as I was introduced to the different types of professional writing, including memos and proposals. I also grew as a writer and a scientist by conducting a scientific study and writing the IMRAD report… All in all, I made a lot of progress in this class…I feel more confident in my writing abilities with all the new skills I developed this semester. I also feel better prepared for writing in the workplace now I know more professional types of writing. I had a very positive experience with the class."
>
> "I have not enjoyed a class such as this in a long, long time. I absolutely love science, and I absolutely love writing. What a great mix in my world!

[2] Instructors who are new to the field of scientific rhetoric will find good theoretical foundation by reading Allan Gross, David Locke, and Charles Bazerman. Of course, Stephen Kuhn is necessary as well. Porush's, *A Short Guide to Writing About Science*, is not only a good introduction to the actual writing conventions and processes of scientific writing, it could also be used as a student text. Similarly, Barass' *Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students* is also good for the same purposes. An instructor new to teaching scientific writing should work through Penrose and Katz' Writing in the Sciences: Exploring Conventions of Scientific Discourse. This excellent text, intended for graduate science students, is great background for scientific writing and it includes many useful strategies and ideas that can easily be adapted to the lower-division compositional setting. Similarly, the short and sweet "A Guide to Writing in the Sciences," by Gilpin and Patchet-Golubev, can easily be used as a complete course.

… I never once would have thought it difficult to translate hard scientific fact into narrative which the public can understand. I now know different. I have also found that narrative can be highly entertaining while teaching scientific fact at the same time. This is a great plus in my mind."

"I actually really enjoyed [this] class and have already recommended it to a few people. I find the course very interesting and appreciate that by taking it now, it gives me a leg up with others who haven't had the opportunity to take it. I love looking at things from different perspectives. [This] class [does] exactly that. I will always remember how you explained that the Periodic Table of Elements is a poem. I also enjoyed the classes when we sat in a circle and got to interact with each other. In just about all my other classes, I barely speak to anyone … I am happy I stayed with the class and know I gained more knowledge that makes me a more well-rounded student."

"This class was an interesting and informative lecture that allowed my English skills to grow. The assignments that were given to me, especially the Nature of science Paper, gave me time to reflect on what I understand to be science and how it should be interpreted. The class has given me the opportunity to take a step back and look [at] what I want to pursue in the scientific field. I had originally started the class believing that I would end u a general surgeon, but after this semester I have shifted my emphasis more towards psychology. I wrote my "Science of X" paper on experimental psychology and I have become interested in the field. This class in a way has changed my future."

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Appendix A: The VCCS Course Content Summary

NOVA COLLEGE-WIDE COURSE CONTENT SUMMARY
ENG 1XX – SCIENTIFIC WRITING (3 CR.)

Course Description

Develops rhetorical expertise in the conventions of scientific argumentation and writing through reading scientific literature and composing scientific writings. Introduces plain style and common genres of scientific writing, Develops the ability to communicate scientific knowledge to diverse audiences. Guides the student in achieving typical voice, tone, style, audience, and content in formatting, editing, and graphics. Lecture 3 hours per week.

General Course Purpose

The purpose of this course is to prepare the student to write for the professional sciences.

Course Prerequisites/Co-requisites: ENG 111 or its equivalent.

Course Objectives

I. Compose Typical Scientific Prose

Upon completing the course, students will be able to:

- employ conventions of plain style scientific prose
- employ APA style documentation
- control use of scientific and technical terminology
- control use of graphics and equations

II. Compose Typical Scientific Documents

Upon completing the course, students will be able to:

- identify standard scientific genres
- compose standard scientific genres
- produce 15-20 pages of finished, graded text, including at least one documented essay.

III. Audience Awareness

Upon completing the course, students will be able to:

- evaluate the needs of diverse science audiences, both professional and public
- tailor prose appropriate to each audience
- translate written scientific knowledge between various audiences

IV. Rhetoric of Science

Upon completing the course, students will be able to:

- describe the role of writing and communication in the conduct of modern science
- explain the writing process as it relates to the conduct of science
- demonstrate an appropriate personal writing process through the production of various science related documents
- demonstrate rhetorical control over claims of scientific truth
- identify common fallacies of scientific reasoning

V. Written Scientific Argument

Upon completing the course, students will be able to:

- Establish a research question and form a hypothesis
- design and conduct a study to test the hypothesis
- employ scientific reasoning to evaluate the hypothesis and construct a claim
- compose an IMRAD style article to communicate the results
- conform to the conventions of written scientific argumentation

VI. Collaboration and Research

Upon completing the course, students will be able to:

- describe the collaborative nature of scientific communication
- develop ease and familiarity with shared writing projects
- successfully produce a collaborative scientific writing
- demonstrate the ability to locate and retrieve outside sources
- demonstrate ethical and accurate use of outside sources
- compose a text of a minimum of 1,000 words that incorporates documented research

VII. Scientific Presentation

Upon completing the course, students will be able to:

- compose a scientific poster and/or slideshow
- present the results of a scientific study in a public setting

Major Topics to be Included

- Science Rhetoric
- Conventions of Scientific Discourse, including Plain Style, control of scientific terminology, use of passive voice, and claim qualification
- Common Scientific Genres, such as:
  - Memo
  - Study Proposal
  - Progress Report
  - Lab Notebook, Field Journal, etc
  - Lab Report
  - Scientific Article: IMRAD
  - Scientific poster
  - Scientific Presentation
  - Personal Essay
  - Science Essay for non-scientific audience (translation)
  - Research Essay
  - Review of Literature
- Collaborative writing
- Scientific Reasoning, including Quantitative Reasoning
- Oral presentation
- Writing as Process and Science as Process
- Nature of Science
- APA Style Documentation

Other Topics that may be included

- History of Scientific Communication
- Peer Review Process and Publication
- Science Fiction
- Scientific Illustration and Visual Rhetoric
- Science Journalism
- Science and Nature Writing
- Medical Writing

Appendix B: Sample Syllabus

Course Description: This Composition class focuses on the literature and rhetoric of science. Develops rhetorical expertise in the conventions of scientific argumentation and writing through reading scientific literature and composing scientific writings. Introduces plain style and common genres of scientific writing, Develops the ability to communicate scientific knowledge to diverse audiences. Guides the student in achieving typical voice, tone, style, audience, and content in formatting, editing, and graphics.

As well, this course continues to develop college writing with increased emphasis on critical essays, argumentation, and research, developing these competencies through the examination of a range of texts about the human experience. Requires students to locate, evaluate, integrate, and document sources and effectively edit for style and usage. Lecture 3 hours per week.

Course Goals: ENG114 will…

1. help students understand that writing is a process that develops through experience and varies among individuals.
2. teach students to understand and apply rhetorical principles in order to improve the quality of their writing.
3. develop students' ability to analyze and investigate ideas and to present them in well-structured prose appropriate to the purpose and audience
4. develop students' ability to locate, evaluate, use, and document information to support their thinking and writing
5. Introduce and exercise principles of scientific rhetoric including scientific prose style, scientific argumentation, typical scientific genres and audiences, and APA style documentation

Requirements:

3 Memos	75 pts
Summary	25 pts
Summary/Response Paper	100 pts
Nature of Science Paper	100 pts
Fantastic Description Paper	100 pts
Science of X Paper (Research)	100 pts
Final IMRAD Report	100 pts
Final Exam	100 pts
2 Tests	100 pts
	800 pts

1. **3 Memo writings:** these are short writings meant to emphasize this common professional communication tool.
2. **Summary:** a paragraph summary of an article from our textbook.
3. **3 Papers:** students will write three 2-3 page essays on scientific topics.
4. **Research Paper:** students will complete a 1,000 word researched essay on an approved science topic
5. **IMRAD Report:** a collaborative scientific study completed at the end of the semester. Students who fail to complete the IMRAD report with their research team will Fail this class.
6. **Final Exam:** the final exam is a professional, collaborative science poster presentation. Students are required to present their projects to the class. Any student who misses the final exam FOR ANY REASON will receive a "0" on the final exam.
7. **Two Tests:** 50 points each. Administered on BB.
8. **Extra Credit:** Students earn 40 extra credit points for using the NOVA Writing Center. Students may earn this bonus once throughout the semester. To earn this bonus, simply take any rough draft of any paper to the writing center for a writing conference. Be sure to get a slip from the tutor to prove you have used the writing center and staple it to your final draft.

Appendix C: Two Sample Assignments

ENG114: Scientific Writing
The Nature of Science (NOS) Paper

For this paper, I would like you to **write an essay to explain and discuss your own definition of Science**. Answer the question: what is the "Nature of Science" to you?

In part, this paper is your personal understanding of Science, and in part this paper is in response to the readings assigned in this class. So, think about "Science" for yourself for awhile: you might begin by asking what these readings say about the nature of Science? Or, how these other opinions fit into your own, personal understanding of Science? You should consider what we have learned about the role of language and communication in the Nature of Science. You should consider the ways in which you personally see Science, and how you envision yourself, and your own personal goals and desires, in relation to Science. Here is your opportunity to really say what it really "means" to you.

You are also free to use any other outside resources that you wish. There are many definitions and discussions of "the Nature of Science" available online, and these might be useful for you to look at in writing this essay.

This paper should be no more than three, double spaced pages. You should take care to begin with a clear definition and discussion of your view of Science, and then organize your following points into unified and limited paragraphs. **Be sure to incorporate reference to our assigned readings,** as well as any other evidence you wish to bring into your discussion. As always, with college writing, be sure to document accurately and ethically using APA. Attach a separate Works Cited Page to cover your sources.

Finally, since this is an English class, you should take care to apply those principles of good essay writing that you learned in English 111 to this assignment. I want to see a clear thesis, solid paragraph development, and control of standard English in this paper. You should produce a solid rough draft of your essay in time for in-class critique, and then you should spend some serious time revising it.

A 5-6 slide Powerpoint outline of your paper is due in class on: _____.
You will have 3 minutes to review the outline of your paper to the rest of your classmates: be sure to bring this saved to a thumbdrive to save time in class! I suggest you review the sample PPT posted to our Blackboard and that we reviewed in class today.

Here's a simple Writing Plan to help you organize your essay:

Thesis: Your personal definition of the Nature of Science (NOS)

Introduction Section:

- Review what some other writers have said about the Nature of Science
- Perhaps summarize one or two of the readings we have done on this topic
- End with your definition of the Nature of Science

Body Section:

- Develop coherent reasons why you think what you think about the Nature of Science
- Each reason should be developed in its own paragraph, and these reason should be written as topic sentences of particular paragraphs
- Include your own personal experience as well as evidence from the readings to support your reasoning

Concluding Section:

- Of course, you should not simply repeat your points here; rather, use the conclusion to emphasize the most important aspects of Science to your reader…do not just repeat what you have written before

Requirements:

- Incorporate points we've discussed and read about to illustrate or support your definition
- Follow APA format and rules of Documentation for any sources you choose to integrate
- Apply the principles of clear and direct, organized writing we have been practicing
- Clear thesis and paragraph organization throughout the essay
- Unified and coherent paragraphs; good topic sentences
- Mature and thoughtful discussion of the topic; show familiarity with the assigned readings on this topic

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ENG114: Scientific Writing
Paper: The Beginner's IMRAD (Collaborative Project)

For this paper, your research team is going to conduct a simple experiment, and then write a basic "scientific article" following the structure known as **IMRAD** – which stands for **I**ntroduction, **M**ethod, **R**esults And **D**iscussion. This is a collaborative assignment, and all members of the research team must participate in the creation of your team's article. You will use the observation notes and data that your research

team discovers, as well the "prewriting" worksheet (see examples), to develop your paper. You MUST write your report based upon these notes.

IMRADS produced by previous Teams in this class are available on our class Blackboard site. Be sure to review these to get ideas and familiarize yourself with the assignment.

Your team IMRAD must exactly conform to the following requirements:

1. 1500-2000 words, standard APA format for presentation of all figures and documentation of sources
2. must conform to IMRAD conventions
3. ***rhetorical tasks:*** state a question, establish context, propose a hypothesis, design and conduct a test of that hypothesis, record the results, and discuss/argue the hypothesis in relation to the study results
4. submit a paper copy, AND email a .pdf version to aschuhart@nvcc.edu
5. be sure to meet all the benchmarks for this assignment. Failure to meet any Benchmark with affect your overall grade.

Benchmarks:

Select Research Teams TODAY:

IMRAD Proposal DUE:

Study Design DUE:

Data sets DUE:

Progress Report DUE:

Rough Draft DUE:

Final Draft DUE:

Parameters of the IMRAD Study. This study must:

1. be approved by me in advance. Your team must submit the "IMRAD Study Proposal" Memo and meet with me to discuss your proposal before you can begin!
2. identify some perceived problem or challenge or phenomenon on the NVCC-Annandale campus
3. be conducted totally and completely and only on the Annandale campus of NVCC during normal hours
4. be "passive": Researchers are only allowed to observe and gather data on normal behaviors or common phenomena
5. no possible human subject may be interviewed or surveyed in any direct way.
6. data must be able to be gathered within one 10-day period

7. not infringe upon the privacy or rights of any subject or participant
8. be of interest to students, faculty, or administration of NVCC-Annandale
9. all members of the research team must participate in all facets of the study: design, data collection, and report writing

Follow this plan: (Be sure to compare your paper to examples of professional articles. Yours should look like the examples.)

I. Title and Writer

II. Abstract: this is the short summary of the report. See the examples from "real" research articles.

III. Introduction: In this section of the paper, you must clearly state your subject and explain the reasons why you chose this subject. You must state a question that you had about your subject: something you wanted to answer when you began your observations, or something that occurred to you while in the process of observation. You should also discuss what you expected to find out about your subject when you began your observation.

IV. Methods: In this section, you should accurately and concisely describe your process of observation. Here, explain how you went about "studying" your subject…what is known as your "protocol", that is, the exact sequence of steps you followed in building your observation. What did you observe? How often? For how long? What did you use **to observe**? How did you record your data?

V. Results: In this section, you explain what you found out about your subject when you observed: this is the "data," the facts about your subject that you uncovered through study. Here, you should avoid all judgments, opinions, and evaluations of the "data." Just explain, in clear unambiguous language, the actual data. (This is also the section where you should insert your data tables, figures, or graphs that you build through observation.)

VI. Discussion: In this section, you should begin by comparing what you found out about your subject to what you had expected to find at the start of the observation. What do you conclude from this comparison? Then, you should move to discussing the significance and value of the knowledge you have discovered through observation. You can "theorize" about what your study tells us about your subject; you could "predict" something about your subject in the future. The point here is to extend your study into other areas…to use the information to make some greater claim or connection, beyond this particular observation. Try to answer the question: **"What does this study mean?"** … *this is when you "create new knowledge."*

Appendix D: Recommended Background Readings

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