CANDLE IN THE DARK:
COMMUNICATING SCIENCE IN A POST-SCIENTIFIC AGE

SCIENCE WRITING (WRTG-31400) SPRING 2019
TR: 9:25 AM to 10:40 AM Smiddy 109

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CLASS TEXTS

- Brown, E. C. and B. Scheller, eds. 1991. *Writing about Science*. 2nd ed. Oxford: Oxford University Press.
- Dawkins, R., ed. 2009. *The Oxford Book of Modern Science Writing*. Oxford: Oxford University Press.
- Montgomery, S. 2003. *Chicago Guide to Communicating Science*. Chicago: University of Chicago Press.
- Penrose, A. M. and S. B. Katz. 2010. *Writing in the Sciences: Exploring the Conventions of Scientific Discourse*. 3rd ed. New York: Longman.

ON SCIENCE, RHETORIC, AND WRITING

"Science and rhetoric apply reason to imagination to better move the will."
~~Sir Francis Bacon (1561-1626)

"But of all other stupendous inventions, what sublimity of mind must have been his who conceived how to communicate his most secret thoughts to any other person, though very far distant, either in time or place? And with no greater difficulty than the various arrangement of two dozen little signs upon paper? Let this be the seal of all the admirable inventions of man."
~~Galileo Galilei (1564-1642)

"Vague forms of speech have so long passed for mysteries of science; and hard words mistaken for deep learning, that it will not be easy to persuade either those who speak or those who hear them, that they are but a hindrance to true knowledge."
~~John Locke (1632-1704)

"Science prefers the language of artisans, countrymen, and merchants before that of wits of scholars."
~~Thomas Sprat (1635-1713)

“It is impossible to disassociate language from science. To call forth a concept, a word is needed.”
~~Antoine Lavoisier (1743-1794)

“The proper and immediate object of science is the acquirement or communication of truth.”
~~Samuel Taylor Coleridge (1772-1834)

“The five essential entrepreneurial skills for scientific success are concentration, discrimination, organization, innovation, and communication.”
~~Michael Faraday (1791-1867)

“Science is nothing but trained and organized common sense perfectly expressed.”
~~Thomas Henry Huxley (1825-1895)

“In science the credit goes to those who convince the world, not to those to whom the idea first occurs.”
~~Sir Francis Darwin (1848-1925)

“Tolstoy explains somewhere in his writings why, in his opinion, ‘Science for Science’s sake’ is an absurd conception. We cannot know all the facts since they are infinite in number. We must make a selection guided by utility. The same principle applies to good writing.”
~~Henri Poincaré (1854-1912)

“If you can't explain something simply, you don't understand it well. Most of the fundamental ideas of science are essentially simple, and may, as a rule, be expressed in a language comprehensible to everyone. Everything should be as simple as it can be, yet no simpler.”
~~Albert Einstein (1859-1955)

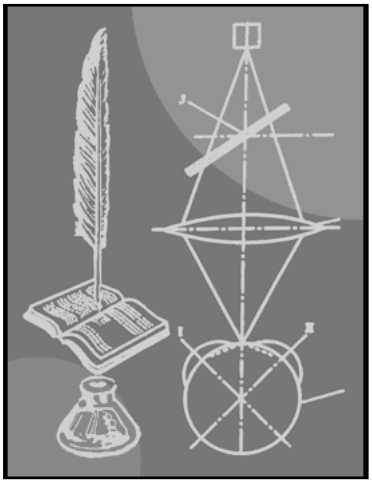
“The aim of science is to discover and illuminate truth. And that, I take it, is the aim of literature, whether biography or history or fiction. It seems to me, then, that there can be no separate literature of science.”
~~Rachel Carson (1907-1964)

“I grew up to be indifferent to the distinction between literature and science, which in my teens were simply two languages for experience that I learned together.”
~~Jacob Bronowski (1908-1974)

“Without writing, the literate mind would not and could not think as it does, not only when engaged in writing but normally even when it is composing its thoughts in oral form. More than any other single invention writing has transformed human consciousness.”
~~Walter J. Ong (1912-2003)

“Thinking is the activity I love best, and writing to me is simply thinking through my fingers.”
~~Isaac Asimov (1920-1992)

PURPOSE



This advanced expository course teaches journalistic and literary scientific writing for general and specialized periodicals. You will learn to communicate scientific facts and theories to professional and sophisticated lay readers through *description*, *analogy*, *narrative*, and *argument*. This course also discusses the technical and scholarly conventions of formal scientific writing, such as research proposals, publishing formats, and APA and CSE citation. Class readings include major humanistic essays from the history of science and articles and features from contemporary popular and scientific publications.

An elective in our major's feature and professional writing concentrations, Science Writing also serves students in communications and the health and natural sciences. Accordingly, the course encourages dialogue, debate, and collaboration between aspiring journalists and creative nonfiction writers and future clinicians, educators, researchers, scientists, and technicians. Our primary focus, therefore, will be institutional science itself, examining its history, organization, politics, and ethics through the lenses of rhetoric and writing:

- What is the relationship between subjective language and objective method?
- Why does poor communication so often create scientific controversy?
- Above all, how do we effectively communicate and promote science in an increasingly irrational unscientific age?

These questions shape academic research, national policy, and public debate and explain why science writing has become America's fastest growing publishing field. This course will initiate you into the craft of this special genre and train you to meet its increasing demand in the new workplace and in emerging media. Professional science writing is a challenging job, demanding creativity, imagination and problem-solving skills. Clarity, always prized in good writing, is essential in demystifying science's technical side. You will learn how to read science, to decode and to translate specialized vocabulary, to use sources, and to interview subjects. Although we will discuss the technical and scholarly conventions of formal science writing, our primary focus will be on journalistic and literary scientific writing.

Science writers, essentially, are *translators*. They interpret and explain often obscure scientific information for the general public. This is challenging and rewarding work. Science is often hard to read. Most people assume that its difficulties are born out of necessity, out of the extreme complexity of scientific concepts, data and analysis. But complexity of thought need not lead to impenetrability of expression; we demonstrate a number of rhetorical principles that can produce clarity in communication without oversimplifying scientific issues. The results are *substantive*, not merely cosmetic: Improving the quality of scientific writing actually improves the quality of scientific thought. As George D. Goben and Judith A. Swan (1990) explain in *American Scientist*, the online magazine of the Scientific Research Society:

> The fundamental purpose of scientific discourse is not the mere presentation of information and thought, but rather its actual communication. It does not matter how pleased an author might be to have converted all the right data into sentences and paragraphs; it matters only whether a large majority of the reading audience accurately perceives what the author had in mind. Therefore, in order to understand how best to improve writing, we would do well to understand better how readers go about reading. Such an understanding has recently become available through work done in the fields of rhetoric, linguistics and cognitive psychology. It has helped to produce a methodology based on the concept of reader expectations. If the reader is to grasp what the writer means, the writer must understand what the reader needs.

Obviously, science is incomplete without the interpretation of its writers; but science also cannot exist without the interpretation of its *readers*. In science as in argument, *context* is everything. Besides learning research and drafting techniques, science writers need to examine science's dialectical relationship to society; review the history and rhetoric of major scientific controversies; and ponder science's political and philosophical meaning.

CONTEXT

This course, therefore, relates science and writing to history, politics, and ethics. The rise of institutional science in the seventeenth and eighteenth centuries, the period known as the Enlightenment, not only transformed Western civilization but created modern prose. If English-speaking readers today value such qualities as *clarity* and *conciseness*, it is because of the linguistic reforms promoted by the London Royal Society, England's first scientific institute, whose motto remains "*Nullius in Verba*" ("On the Words of No One").

Early scientists fought to make writing more accurate and logical. Words, they believed, should relate to solid objects, not airy thoughts. Impatient with traditional rhetoric, they fashioned a new language, accessible to the masses, and reformed conventions of evidence and proof, thus laying the foundation for modern democracy. But as science grew, its prose became more specialized and abstract—with dire consequences for both science and society.

To see how and why this happened, we will trace the history of Western science, from Galileo Galilei, whose telescope abolished heaven, to Robert Oppenheimer, who directed the creation of the first atomic bomb. Along the way, we will discuss and write about such diverse subjects as: science, language and consciousness; the scientific method and landmark experiments and inventions; the culture and community of institutional science and the representation of scientists in biography, journalism, and popular culture; history's great scientific controversies; and science's impact on public policy, social engineering, and the modern academy.

Facing the Postmodern Challenge

The Enlightenment's rationalist tradition, however, faces unprecedented challenges in the postmodern world. Indeed, many contemporary thinkers maintain that we live in a "post-scientific age." They consider science a "narration" or "myth," one "social construction" among many. They particularly question the Enlightenment's most basic premise: an independent, free-standing, knowing subject (the "I") facing an independent, free-standing world.

After the collapse of traditional metaphysics, which had provided Western culture meaning and order for two millennia, 17th-century scientists sought to bridge the gap between the subjective mind and the objective world. Their solution was to extend human reason to produce finer and finer descriptions of the natural world, descriptions whose precision could be enhanced by technological innovations (telescopes, microscopes, atom smashers, computers) that were themselves extensions of human reason. Patience, integrity, and methodical rigor would produce a complete and accurate—down to the last detail—account of the cosmos.

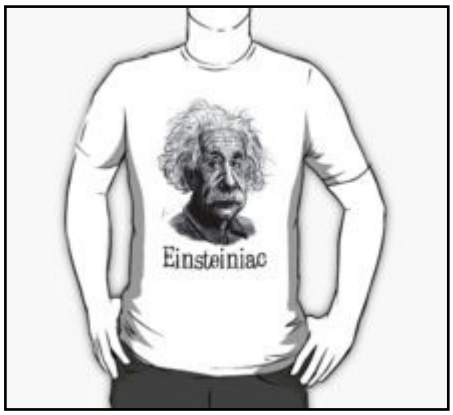
Seventeenth-century scientists believed this Promethean task could be completed within six generations. Contemporary scientists know better. As relativity and quantum physics suggest, absolute knowledge is impossible, not only because all methodological caution is insufficient but because the distinctions that define the scientific project (the "I," the world, and the forms of description or signification that join them) are *too interdependent* to form completely objective knowledge.

This insight does not mean that the world apart from the devices of human conception and perception doesn't exist "out there"; just that what we know of that world follows from what we can say about it rather than from any unmediated encounter with it. This is what Thomas Kuhn (1970) meant in *The Structure of Scientific Revolutions*. After a *paradigm shift*—after one scientific vocabulary, with its attendant experimental and evidentiary apparatus, has replaced another—scientists live in a different world; which again does not mean the world has been altered by our descriptions of it; just that only through our words and symbols can we access something called the world.

This theory may seem new-fangled, but Sir Francis Bacon faced this problem at the dawn of the Scientific Revolution. Everything, he realized, even the framing of experiments, begins with words; and words tend to substitute themselves for the facts they are supposed to report or reflect. While men "believe that their reason governs words," in fact "words react on the understanding"; they shape rather than serve rationality.

"True and false are attributes of speech, not of things," said Thomas Hobbes, Bacon's secretary and a charter member of the Royal Society. Judgments of truth or falsehood are made relative to the forms of predication that have been established in disciplinary and institutional discourse. When we pronounce a judgment—this is true or that is false—the authorization for that judgment comes from those forms (what Hobbes called "settled significations") and not from the world speaking for itself. We know, Hobbes said, not "absolutely" but "conditionally"; human knowledge issues not from the "consequence of one thing to another" but from "the consequence of one name to another."

Building a Third Culture



Scientist and novelist C. P. Snow (1959) anticipated these developments over fifty years ago. In *The Two Cultures and the Scientific Revolution*, Snow compellingly argues that the central problem of modern life is "the disastrous breakdown" between the sciences and the humanities, "a rift based on mutual incomprehension tinged with hostility." This crisis has made scientific communication more urgent and more difficult than ever. As the pace of technological change accelerates, citizens must process and understand more and more scientific information. Unfortunately, the irrationality of postmodern culture and the rigidity of institutional science often prevent this from happening. We live in a society where more people believe in Big Foot than evolution, where Congressional committees conduct witch hunts against climatologists, and where corporations sue science writers for criticizing defective products. If we had deliberately conspired to bring back the Dark Ages, we could not have done a better job to sabotage our civilization.

"We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology," observed physicist and educator Carl Sagan (1995), shortly before his death. "This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces." Fortunately, contemporary scientists and humanists are working to defuse this time bomb. John Brockman (1995), Director of the Edge Foundation, an interdisciplinary think tank, speaks of creating a *third culture* to bridge the sciences and the humanities, while biologist E.O. Wilson (1998) advocates *consilience*, a fusion of all fields of knowledge. The implications of these ideas, however, extend far beyond the university.

As Nobel economist Friedrich Hayek predicted in 1945, a "division of knowledge" (comparable to the division of labor preceding the Industrial Revolution), has created a global civilization based on science, information, and technology. Management theorist Peter Drucker (1993) called this civilization the "Knowledge Society." But for free inquiry to serve an authentic democracy and to create a sustainable culture, scientists must become informed, ethical, and articulate communicators.

"We need to be writing for Congress and the public," Dr. Ruth Kirchstein (2009), Acting Director of the National Institute of Health, told her staff before she died. "We've been too elitist too long. Scientists want their stories in the press, but complain when they are misquoted. You won't get the support you need if others don't understand what you're doing."

For science writers, caught in the crossfire of the culture wars, the stakes have never been higher. Our planet's survival hangs in the balance, and our only weapons are words. "Communicate," said environmentalist David Brower (2000) "and we'll win in the end."

OVERVIEW

This course is divided into ***six*** *sections*, each related to a major scientist.

1. **GALILEO'S COMMANDMENT:** *Galileo Galilei* (1564-1642) was not only a trail-blazing scientist but a major figure in Italian literature. A reader of Ariosto, he transfused into his prose the qualities of that great poet: clear and frank freedom of expression, precision and ease, elegance and humor. Likewise, the best science writers relate the basic elements of scientific communication (definition, classification, description, partition, process analysis, and analogy) to fiction and poetry.

2. **BACON'S METHOD:** Herald of English science and father of the English essay, *Francis Bacon* (1561-1626) proposed a new philosophy based on induction, empiricism, experimentation, and invention. Almost single-handedly, he formulated the scientific method, laid the groundwork for technical communication, and drafted the blueprint for the Industrial Revolution. Bacon's theoretical and rhetorical ideas still influence how science writers describe and explain theories, experiments, and inventions.

3. **NEWTON'S CLUB:** Founded in 1660, the Royal Society of London transformed science into a communal activity. *Isaac Newton* (1643-1727), however, dominated this organization by courting patrons and crushing enemies. Ever since, mentorship, collaboration, and rivalry have defined professional science. Without understanding the politics and dynamics of competing institutions and fields, science writers, whether critical or promotional, cannot draft effective press releases, interviews, and biographies.

4. **DARWIN'S CRIME:** When *Charles Darwin* (1809-1882) published *On the Origins of the Species* (1859), he started a culture war but shrank from battle. Evolution's true champion was *Thomas Henry Huxley* (1825-1895), master of scientific polemic. As we review such controversies as intelligent design, global warming, and the atomic bomb, we will study how contemporary science justifies and explains itself to a sometimes fearful and hostile public.

5. **EINSTEIN'S PATENT:** Successful science writing calibrates research, writing, and marketing. For seven years, *Albert Einstein* (1879-1955) worked at the Swiss Patent Office while pursuing theoretical physics. Reviewing patent applications sharpened his own proposal writing skills. Within a single year (1905), he published four groundbreaking articles on the photoelectric effect, Brownian motion, special relativity, and the equivalence of matter specifically written for *Annals of Physics*. Like Einstein, all science writers must learn to translate an effective proposal into a readable article suitable for a particular journal.

6. **SAGAN'S CANDLE:** Best known as the host of the TV series *Cosmos*, Carl Sagan (1934-1996) believed science was "a candle in the dark in our demon-haunted world." To finish the semester, we will discuss his impact on science writing and the Ithaca community and make a pilgrimage to the Sagan Planet Walk and the Sciencecenter.

REQUIREMENTS

PREREQUISITES

- *Junior standing* (sophomores welcome with permission of instructor); any one of the following: Argument (WRTG 20100) or Technical Writing (WRTG 21300) and two courses in the natural sciences; *or* any level-1 composition course from WRTG 10600 through WRTG 16500 and three courses (at least one above level 1) in the health and natural sciences.

CLASS PARTICIPATION

1) ***Attendance:*** Active attendance is encouraged because class discussion is heavily targeted towards improving your writing. You are entitled to two absences without penalty. Each additional *unexcused* absence lowers your final average by a third of a grade. According to the Department of Writing's policy, any student missing 6 or more classes will be dropped from the course. You are responsible for contacting a classmate to find out about missed work, as well as turning in assignments on time even if you won't be in class.

   Please note the holidays listed in the Undergraduate Catalog's academic calendar. In accordance with New York State law, students who miss class due to their religious beliefs shall be excused from class or examinations on that day. Such students must notify their course instructors at least one week before any anticipated absence so that proper arrangements may be made to make up any missed work or examination without penalty.

2) ***Readings:*** Pay your *$10.00 photocopy* fee for course handouts by the end of Add/Drop period. Carefully read each assignment, more than once if time permits, take notes and review questions. For convenience, hole-punch and keep handouts in a three-ringed binder. Prepare to discuss the content and the craft of each essay.

3) ***Workshops:*** Bring drafts on USB drive or mail to your online campus account. Students without work will be dismissed and marked absent. Be ready to edit and to offer constructive criticism of colleagues' papers.

ASSIGNMENTS

Your final letter grade will be determined by the following . . .

1) ***Exercises (50%):*** These shorter assignments, usually 3 to 5 double-spaced pages (750 to 1,250 words), relate to course readings and class discussion.

    - An *educational brochure*, *review article,* or *book review* based on definition, classification, description, partition, process explanation, or analogy.

    - A *newspaper article*, *technical report*, or *pamphlet* describing or explaining a scientific theory, experiment, or invention.

    - A *press release*, *newsletter article*, or *mailer* promoting a local, regional, national, or international scientific organization.

    - A *newspaper interview*, *magazine feature*, or *condensed biography* on a scientist, inventor, or mathematician, past or present.

    - An *editorial*, *article*, or *position paper* taking a stand on a past or present scientific controversy; critiquing the impact of cultural beliefs, public opinion, or political policy on formal science; or analyzing or offering a solution to a contentious social problem from a scientific perspective.

2) ***Proposal (25%):*** Either for a *research paper*, *journal article* or *science book*, or *grant*. Letter or memo format, 2 to 4 single-spaced pages (1,000 to 2,000 words). You are welcome to work with a peer.

3) ***Collaborative Article and Presentation (25%):*** Partnering with up to three classmates, write a *full-length science article* (15 to 20 double-spaced pages or 3,750 to 5,000 words) for a *specific journal* or *periodical*. The topic should reflect your team's shared research interests. Target a *general* or *professional* audience, include an *abstract*, *footnotes*, and *references*, and follow appropriate layout and format. Before submitting its final draft, your group will give a ten-minute presentation on some aspect of this project.

ALL ASSIGNMENTS must follow APA or CSE format and citation. If not, you will lose points. Fortunately, you may substantially *revise* all work; if necessary, even starting fresh. Except for the final article, revisions are due within *one week* after receiving your corrected first draft. Please avoid handing in revisions on days when other first-draft assignments are due.

EXCELSIOR

Like future editors, academic mentors, and employers, I expect only the best from you. Dealing with human lives and human discoveries, scientific communications can neither afford nor tolerate fuzzy thinking, sloppy writing, or slipshod ethics. Hence these grading criteria:

- **D** work is *substandard*. Poor effort, empty thinking, weak writing. The assignment is underwritten, incomplete, or riddled with careless mechanical errors.
- **C** work is *competent*. Minimum effort, standard thinking, conventional writing. While the assignment is complete and glitch-less, it lacks originality, invention, and creativity.
- **B** work is *good.* Genuine effort, sound thinking, solid writing. The assignment takes risks, holds promises, but still needs improvement.
- **A** work is *excellent*. Enthusiastic effort, original thinking, distinguished writing. The assignment demonstrates expertise and style and balances creative and analytical thinking.

POLICIES

1) ***Format:*** All formal assignments must be *word-processed*, *double-spaced*, and *printed* on good paper. Include name, title, section, and date, number all pages, and observe APA or CSE conventions. Any assignment not following this format will be rejected.

2) ***Deadlines:*** Meeting deadlines is essential in scientific research. The grade of late papers will be lowered by *one third* for each overdue day. Except in cases of serious illness, any assignment later than one week will receive an F. *Revisions* are due a week after receiving evaluated first drafts.

3) ***Plagiarism:*** This is not a course in scientific espionage. A plagiarized paper receives an F and its "author" will be expelled from the course.

4) ***Resources:*** First, schedule regular appointments at the *Writing Center* (Smiddy 107), an ideal forum for young writers. During the week at convenient hours, you may consult with trained student and faculty tutors about your drafts.

   Second, in compliance with Section 504 of the Rehabilitation Act of 1973 and the American Disabilities Act, reasonable accommodations will be provided to students with documented disabilities on a case-by-case basis. Students must register with the *Office of Academic Support Services* (110 Towers Concourse) and provide appropriate documentation to the College before any academic adjustment will be provided.

WRITING INTENSIVE REQUIREMENT, ICC, AND THE E-PORTFOLIO

THE COMMITTEE FOR COLLEGE-WIDE REQUIREMENTS (CCR) has designated this course as "*Writing Intensive*" (W) within the Integrative Core Curriculum (ICC). If you entered Ithaca College in 2013 or later, you are required to take at least one W course and to upload appropriate artifact(s) to your ePortfolio on Taskstream to demonstrate your achievement of the Student Learning Objectives (SLOs) listed below.

Writing Intensive courses build on your ability to use writing both as a process for *making meaning* within a *specific subject area*, as well as for participating in *ongoing conversations* within a *particular academic or professional community*. Upon completion of a Writing Intensive course, you will be able to:

1. Develop and articulate content knowledge and critical thinking in a specific academic discipline or related profession through frequent practice of informal and formal writing.

2. Demonstrate understanding of audience expectations, genres, and conventions appropriate to communicating in a specific academic discipline or related profession.

3. Compose one or more documents totaling at least 3,000 words through multiple stages of writing, including brainstorming, drafting, integrating sources, and revising comprehensively after receiving substantial, formative feedback on drafts.

Science Writing meets these three objectives and can provide you with many appropriate artifacts for Taskstream, the ePortfolio and assessment system for the Integrative Core Curriculum (ICC). This system is easy to use. On the Taskstream homepage, you will view two Directed Response Folios (DRF) programs, an icon for ICC, and one for Academic Writing 10600. The ICC DRF will include a marker for you to upload artifacts for the Writing Intensive Requirement. I would be happy to make recommendations for your ePortfolio.

STUDY TIPS

By necessity, this advanced course is both *reading*- and *writing intensive.* To practice their trade, science writers must immerse themselves in the language and culture of institutional science. Science writing, after all, is the art of *translation*. Like any exchange student in a foreign country, therefore, strive for *conversational fluency* rather than native proficiency. Being a science writer doesn't require you to become a biologist or a physicist, any more than being a food or music critic requires you to become a gourmet chef or a concert pianist.

To manage your workload, therefore, *skim* course readings and *highlight* technical information but *concentrate* on rhetorical construction and formal organization. For further context and orientation, *consult* abstracts and *browse* the science section of online periodicals. Above all, follow Sir Francis Bacon's advice in "Of Studies":

- ***Cultivate your mind:*** Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse; but to "weigh and consider."

- ***Follow your appetite:*** Depending on your interests, *taste* some readings*, swallow* others*,* but *chew* and *diges*t "only a few." Choose texts and topics that feed your curiosity.

- ***Consult abstracts and reviews:*** Some texts should be "read by deputy and extracts made of them by others." Reserve this strategy, however, for "less important arguments and meaner sort of subjects."

- ***Integrate your learning:*** As Bacon observed, *reading* makes a *full* mind; *conversation* a *ready* mind; *writing* an *exact* mind.

"Science is a human endeavor like any other," states author and editor Natalie Angier (2002). "Sure, it has its insiders who are possessive of their trade and expertise and use jargon like porcupines use their quills, smugly and defensively. Yet with a little effort, just about anybody can become reasonably literate in science. It's well worth doing."

EXPLORE AND EXPLAIN

SCIENCE," Carl Sagan observed, "involves a seemingly self-contradictory mix of attitudes: On the one hand it requires an almost complete openness to all ideas, no matter how bizarre and weird they sound, a propensity to wonder. But at the same time, science requires the most vigorous and uncompromising skepticism, because the vast majority of ideas are simply wrong, and the only way you can distinguish the right from the wrong, the wheat from the chaff, is by critical experiment and analysis."

Maintain the same balance over the semester. Consider this course an *experiment*, a *working hypothesis*. Like all viable linguistic constructs, it promises to be grounded in *curiosity*, *patience*, *rigor*, and *humility*, the four cornerstones of the scientific method and scientific writing. The two are interchangeable. As Scott Montgomery (2003) reminds us: "Science exists because scientists are writers and speakers. There are no boundaries, no walls, between the doing of science and the communication of it."

Like science, writing is ***recursive***, a *process* more than a product, moving from brainstorming and outlining to drafting and revision and then cycling back. Also like science, writing relies on critique and collaboration. For each written assignment, peers will workshop your draft in class on days marked as "workshop." Instructor feedback will be given prior to due date as well as on submitted drafts. This process will sharpen your thinking and improve your writing. Indeed, you will learn that writing itself is a way of thinking.

From the technical to the expressive, the best science writing engages our mind and pleases our senses. How could it be otherwise? Both science and writing seek to explore and explain the cosmos and our place in it. To connect these two forms of inquiry, Galileo (1632) performs a wonderful thought experiment in the *Discourse Concerning the Two Chief World Systems*:

> A ship leaves Venice bound for Alexandretta: imagine on the ship a pen that traces the course in a constant line that stretches across the Mediterranean. (Fancy a pen the size of the ship's rudder drawing its line on a sea of paper; or else a very long strip of paper that crosses the Mediterranean and unrolls on the deck of the moving ship under a little pen that leaves its slender wake of ink.) This line will be a perfect arc of a circle, even if sometimes more curved, sometimes less, as the vessel more or less fluctuates.

So hoist sail! Somewhere, something incredible is waiting to be known. Sharing that knowledge, Carl Sagan argued, is the joy of science writing. "Communicating not just of the findings but of the methods of science," he said, "seems to me as natural as breathing. After all, when you're in love, you want to tell the world."

CALENDAR

GALILEO'S COMMANDMENT: **"Fundamentals of Science Writing"**

"Science knows only one commandment: contribute to science!"
~~Bertold Brecht, *The Life of Galileo* (1605)

JAN 22: BACK TO BABEL: The End of Science
Course orientation and introduction.

Handouts:
- John Horgan, "The End of Science"
- Reactions from Eshan Masod, Ron Westrum, and David Hoffman

JAN 24: WORDS AND THINGS: The Poetics of Science

Penrose and Katz, *Writing in the Sciences*:
- Ch. 1: "Science as a Social Enterprise," 3-24.

Montgomery, *Communicating Science*:
- Ch. 1: "Communicating Science," 1-9.
- Ch. 2: "Scientific Communication," 10-25.

Bowen and Schneller, *Writing about Science*:
- Lewis Thomas, "Vibes," 129-33.
- Howard Evans, "In Defense of Magic: The Story of Fireflies," 113-28.
- Marion C. Diamond, "The Impact of Air Ions," 239-47.

Dawkins, *Modern Science Writing:*
- Richard Fortey, "Trilobite!" 82-84.
- Steven Pinker, "The Language Instinct," 103-05.
- Peter Medawar, "Science and Literature," 179-83.
- Claude Shannon and Warren Weaver, "Communication Theory," 297-305.
- S. Chandrasekhar, "Truth and Beauty," 349-52.

Handouts:
- Italo Calvino, "Science and Literature."
- Jerome Groopman: "The Three Pillars of Science Writing"
- Sam Dragga and Beth Tebeaux, "Presenting Technical Information."

JAN 29: FOUND IN TRANSLATION: Writing for a General Audience

Penrose and Katz, *Writing about Science*:
- Ch. 8: "Communicating with Public Audiences," 198-223.
- Ch 9: "Ulcer Bug Case Study," 229-65.

Montgomery, *Communicating Science*:
- Ch. 3: "Reading Well," 26-35.
- Ch. 8: "Review Articles and Book Reviews," 99-109.
- Charles Gillispie, "E.O. Wilson's *Consilience*" (*handout*).
- William Weed, "106 Science Claims and a Truckful of Baloney" (*handout*).

Bowen and Schneller, *Writing about Science*:
- Michael Faraday, "Chemical History of a Candle," 7-20.
- J. B. S. Haldane, "On Being the Right Size," 21-26.
- Lewis Thomas, "Germs," 134-39.

Dawkins, *Modern Science Writing*:
- Edward O. Wilson, "The Diversity of Life," 143-48.
- Peter Medawar, "Four Reviews," 183-87.
- Lewis Thomas, "Seven Wonders," 219-25.

EXERCISE 1: ENGAGE THE READER

Galileo," observes Italo Calvino, "used language not as a neutral utensil but with a literary awareness, with a continuous commitment that is expressive, imaginative, and even lyrical." The best science writing engages its readers through elements and techniques from fiction and poetry.

To stretch your literary muscles, write an *educational brochure*, *review article*, or *book review* on any scientific, medical, or technical subject. Try one of the following prompts:

- ***The Five Senses*:** Base your topic or approach on sight, sound, taste, touch, or smell. For pointers, study Lewis Thomas's "Vibes" or Richard Fortey's "Trilobite!" Educate the reader through the senses so your writing vivid but informative.

- ***Language and Consciousness:*** Like Steven Pinker, use biology, chemistry, or physics to explain or meditate on some aspect of human consciousness or language. For further examples, consult other examples in *Modern Science Writing*: Colin Blakemore (86-89), Richard Gregory (89-96), or Nicholas Humphrey (96-103).

- ***Case Study:*** Using our ulcer bug exercise as a model, summarize a case study from *Writing for the Sciences*. Educate a general audience about: predatory algae (Ch. 10), the geology of Delphi (Ch. 11), Kepler's supernova (Ch. 12), or Hurricane Katrina (Ch. 13).

Target a particular *audience* and concentrate on a specific *purpose*. Research the facts, select the best details, and employ a fitting style. *Pattern* your information, *conceptually* and *visually*. Apply a *rhetorical form* outlined by Sam Dragga and Beth Tebeaux: definition, classification, description, partition, or process explanation. Divide your piece into *labeled sections* and include *graphics*, if appropriate.

Unlike technical writing, good science writing should read like *creative nonfiction*, so remember Jerome Groopman's three principles: *argument* (create an overarching theme), protagonists (embody and articulate that theme through characters and voices), and cinema (paint a mental picture for the reader). 3 to 4 pages (750 to 1,000 words), APA or CSE format (*Writing in the Sciences*, 142-48).

JAN 31: WORKSHOP

Montgomery, *Communicating Science*:
- Ch. 4: "Writing Well," 36-54.
- Ch. 5: "Writing Very Well," 55-67.
- Ch. 9: "Graphics and Their Place," 113-37.

BACON'S METHOD: **"Theory, Experiment, and Invention"**

"Science is an edged tool, with which men play like children, and cut their own fingers."
~~ Sir Arthur Stanley Eddington, *New Pathways in Science* (1925)

FEB 05: DRY LIGHT: Theory and Experiment
First draft of Exercise 1 due.

Montgomery, *Communicating Science:*
- Ch. 10: "Technical Reports," 138-45.
- Karin Knisley, "Writing Lab Reports" (*handout*).

Bowen and Schneller, *Writing about Science*:
- Bertrand Russell, "Space-Time," 50-56.
- George and Muriel Beadle, "The Mendelian Laws," 319-31.

Dawkins, Modern *Science Writing*:
- R. A. Fisher, "Genetic Theory," 18-22.
- Steve Jones, "The Language of Genes," 48-53.
- Jacob Bronowski, "The Identity of Man," 176-78.
- Lewis Wolpert, "The Unnatural Nature of Science," 232-33.
- Richard Feynman, "The Character of Physical Law," 247-48.

- Albert Einstein, "What is the Theory of Relativity?" 314-16.
- Brian Greene, "The Elegant Universe," 336-42.
- Stephen Hawking, "A Brief History of Time," 342-46.
- Steven Weinberg, "Dreams of a Final Theory," 357-62.

Handouts:
- James Hogan, "Sir Francis Bacon and *The New Organon*."
- Karl Popper, "Science as Falsification."
- Roald Hoffman, "Why Buy that Theory?"
- Steven Weinberg, "Can Science Explain Everything? Anything?"

FEB 07: ENGINES OF PROGRESS: Invention, Industry, and Technology

Penrose and Katz, *Writing in the Sciences*:
- Ch. 2: "Exploring Technology in Scientific Communication," 25-52.

Montgomery, *Communicating Science:*
- Ch. 14: "The Online World," 183-98.

Bowen and Schneller, *Writing about Science:*
- Isaac Asimov, "Organic Synthesis," 38-49.

Dawkins, *Modern Science Writing:*
- Oliver Sachs, "Uncle Tungsten," 214-19.
- Alan Turning, "Computing Machinery and Intelligence," 305-13.

Handouts:
- John Lienhard, "Industrial Revolution."
- Virginia Postrel, "The Design of Your Life."
- Nick Gillespie, "World-Changing Tools."
- John Seabrook, "How to Make It."
- Clifford Stoll, "The Curious History of the First Pocket Calculator."
- Marshall McLuhan, "The Four Laws of Media."

EXERCISE 2: REPORT THE FACTS

Sir Francis Bacon's *New Organon* (1620) established the inductive method and foresaw the experimentation and innovation embodied in the Scientific and Industrial Revolutions. Gathering and reporting facts elegantly and accurately was essential to Bacon's project.

Accordingly, research and write a *newspaper article*, *technical report*, or *pamphlet* on a scientific theory, experiment or invention. Discuss its content, context, impact, or significance. Follow these guidelines:

- ***Theory:*** As we saw in our discussion of genetics and relativity, science communicators can take a *technical* or *philosophical* approach when writing about a scientific theory. They can define its terms, describe its elements, and draw useful analogies or discuss its social, cultural, and institutional implications within its field or in the history of ideas.

- ***Experiment*****:** A similar pattern exists here. Some science articles, whether written for a professional or general audience, concentrate on *method* and are organized like *technical* or *lab reports*. Others, more interested in *results* and *implications*, read more like *history* or *sociology*. Choose the approach that works best for you.

- ***Invention*****:** This category also includes *industrial products* and *scientific equipment*. Whatever your subject, go beyond simple description, partition, or process explanation. As Clifford Stoll shows in his history of the pocket calculator, *good story-telling* is also essential, not to mention *theoretical analysis* and *cultural criticism*. To challenge yourself, brainstorm your topic using Marshall McLuhan's four laws of media.

4 to 5 double-spaced pages (1,000 to 1,250 words), APA or CSE format. Experiment with layout and design and, if necessary, include tables, charts, or equations.

FEB 12: WORKSHOP.

NEWTON'S CLUB: **"The Community of Institutional Science"**

"One could not be a successful scientist without realizing that, in contrast to the popular conception supported by newspapers and mothers of scientists, a goodly number of scientists are not only narrow-minded and dull, but also just stupid."

~~James D. Watson, *The Double Helix* (1968)

FEB 14: ROYAL SOCIETIES: Promoting Science
First draft of Exercise 2 due.

Montgomery, *Communicating Science*:
- Ch. 15: "Dealing with the Press,"199-211.
- Phil Kolin, "On News Releases" (*handout*).

Bowen and Schneller, *Writing about Science*:
- Keith Tinkler, "Geomorphology," 95-100.
- Richard Feynman, "Physics: 1920 to Today," 205-21.

Dawkins, *Modern Science Writing*:
- Sydney Bremer, "Theoretical Biology in the Third Millennium," 40-48.
- James Watson, "Avoid Boring People," 226-29.

Handouts:

- National Academy of Sciences: Mission Statement; Act of Incorporation (1863); Amendments (1870, 1884, 1914); Federal Advisory Committee Act (1997); Organizational Chart and Revised Constitution (2008).
- American Institute of Biological Sciences: Ethics Statement (2002)
- Chet Raymo, "The Old Sciences Have Starring Roles."
- Leonardo Cassuto, "Big Trouble in the World of Physics."
- Jennifer Couzin, "Aging Research's Family Feud."
- Kathryn Szumanski, "From Monastery Garden to Modern Genetics."

EXERCISE 3: PROMOTE AN ORGANIZATION

Founded in 1660, the London Royal Society became the model for the National Academy of Sciences (NAS) and the Smithsonian Institution. Despite the myth of the solitary genius, science is a *corporate* enterprise. Powerful organizations define disciplines and standards, police and referee their members, and justify their activities to the public.

Since public relations is essential to institutional science, write a *press release*, *newsletter article*, or *mailer* promoting a local, regional, national, or international scientific organization.

- ***Press Release:*** Follow Phil Kolin's models in your handout: include a *masthead* (organizational logo and contact information); a *slug* (short, punchy headline); a *lead* (opening sentence catching the reader's attention and summarizing the story); and a *body* (supporting paragraphs substantiating the lead). Whenever appropriate, end with a call to action or invite feedback. 2 to 3 double-spaced pages, AP style (500 to 750 words).

- ***Newsletter Article:*** If possible, study the in-house publication of your scientific organization and replicate its layout. If not, create your own design using appropriate desktop publishing templates. 2 to 3 double-spaced pages (500 to 750 words).

- ***Mailer:*** Either a *letter* or a *brochure*. Make this piece *legible, attractive*, and *tasteful*. Using headings, subheadings, bullets, bolds, and italics, "chunk" your message and guide your readers. Subtly integrate the organizational logo and graphics into the text.

Whether announcing a convention, advertising an event, or raising money, avoid what Natalie Angier calls "gee-whiz" science writing. Instead, write like an educator and a journalist. No fluff. Simultaneously appeal to the organization's members and the general public.

FEB 19: ON GIANTS' SHOULDERS: Collaboration, Conflict, and Celebrity

Bowen and Schneller, *Writing about Science:*

- Gerald Holton, "Johannes Kepler's Universe," 332-55.

- James Watson, "Finding the Secret of Life," 140-52.
- Stephen Jay Gould, "False Premise, Good Science," 101-10.

Dawkins, *Modern Science Writing*:
- Freeman Dyson, "Disturbing the Universe," 157-61.
- Max Perutz, "A Passion for Crystals," 168-71.
- Barbara and George Gamow, "Said Ryle to Hoyle," 172-73.
- Stephen Jay Gould, "Worm for a Century," 200-11.
- Francis Crick, "What Mad Pursuit," 229-31.
- George Gamow, "Mr. Tompkins," 317-22.

<u>*Handouts:*</u>
- Tim Folger, "On Interviewing Scientists."
- Sherwin B. Newland, 'The Man or the Moment?"
- Jennet Conant, "The New Celebrity."
- Keith Davis, "Inside Outer Space."

EXERCISE 4: PROFILE A SCIENTIST

If I have seen a little further," Isaac Newton wrote to Robert Hooke, "it is by standing on the shoulders of Giants." This statement seems like a compliment but is actually an insult. Hooke, Newton's rival, who argued with him over the property of light, was a stunted hunchback.

Ambition and rivalry define and deform scientific research. "In *fame of learning*," Francis Bacon remarked, "the flight will be slow without some feathers of ostentation." Like it or not, spite and ego (what Bacon called "vainglory") are the varnish of science. They make its ideas shine as well as last. For this reason, science writing often profiles and exploits strong personalities.

Write a *newspaper interview*, *magazine feature*, or *condensed biography*, therefore, of a scientist, inventor, or mathematician. (If you prefer, you could write about a science writer.) Your subject can be an important figure from scientific history; a celebrity from contemporary sciences, such as Richard Dawkins or Stephen Hawking; or a science professor from Cornell University or Ithaca College. Review this person's life, career, and ideas and discuss his or her relationship with collaborators and rivals. Your approach may be:

- ***Promotional:*** Write about your subject from the perspective and for benefit of his or her organization. For example, Kathryn Szumanski's profile of Gregor Mendel, the Augustinian monk who founded modern genetics, subtly promotes Villanova University's Mendel Science Center.

- ***Journalistic:*** Find an angle to make your subject timely and interesting. Tell a good story and capitalize on your subject's physical and mental quirks. Jennet Conant's profile of James Watson affectionately caricatures the *enfant terrible* of DNA.

- ***Historical:*** Place your subject within his or her *social* or *cultural* context. If possible, present an old story in a new and provocative way. Stephen Jay Gould, for instance, argues that Charles Darwin's most important work is not *The Origin of the Species* but his final monograph on earthworms.

Obviously, narrative is crucial. Treat your subject like a literary character and employ the techniques of fiction without sacrificing fact. 4 to 5 double-spaced pages, APA, or CSE format (1,000 to 1,250 words).

FEB 21: WORKSHOP
First Draft of Exercise 3 due.

FEB 26: WORKSHOP.

DARWIN'S CRIME: **"Science, Ethics and Public Controversy"**

"Writing about evolution is like confessing to a murder."
~~Charles Darwin, *Letter to Joseph Hooker* (January 11, 1848)

FEB 28: HUXLEY'S BRIEF: Science and Polemic
First draft of Exercise 4 due.

Montgomery, *Communicating Science:*
- Ch. 8, "Debate/Critique," 108-12.

Bowen and Greene, *Writing about Science:*
- Charles Darwin, "Keeling Islands: Coral Formations," 222-38.
- Garrett Hardin, "The Tragedy of the Commons," 286-302.
- Julian Huxley, "Evolutionary Progress," 248-68.

Dawkins, *Modern Science Writing*:
- Helena Cronin, "The Ant and the Peacock," 16-18.
- Robert Trivers, "Social Evolution," 123-27.
- Daniel Dennett, "Darwin's Dangerous Idea," 254-58.

Handouts:
- Robin McKie, "How Darwin Won the Evolution Race."
- Thomas H. Huxley, "The Darwinian Hypothesis."
- Steven Jay Gould, "The Misuse of Darwin."
- Frederick Crews, "Saving Us from Darwin."

MAR 05: OPPIE'S SHADOW: Science and Ethics

Penrose and Katz, *Writing in the Sciences:*
Ch. 3: "Considering Ethics in Scientific Communication," 53-

Bowen and Schneller, *Writing about Science*:
- Rachel Carson, "The Obligation to Endure," 153-60.
- Norbert Weiner, "Moral Problems of a Scientist: The Atomic Bomb," 161-82.

Dawkins, *Modern Science Writing*:
- J. Robert Oppenheimer, "War and the Nations," 161-68.

Handouts:
- *New York Times* and *Ockham's Razor*, "Nazi Science."
- Paul Dombrowski, "Nazi Technical Documents."
- Mark Dowie, "Gods and Monsters."
- Jeremy Bernstein, "Shadows: Robert Oppenheimer."
- Carl Sagan, "When Scientists Know Sin."

EXERCISE 5: TAKE A STAND

At a postwar meeting with President Harry Truman, J. Robert Oppenheimer, nuclear physicist and director of the Manhattan Project, sobbed that "scientists had bloody hands; they had known sin." Oppenheimer's confession ended Western society's dreamy romance with science and began an ongoing public relations nightmare.

Before the bomb, science took the offensive in such public controversies as the 1860 Oxford debate between Thomas Huxley and Bishop Wilberforce or the 1925 Scopes Monkey Trial. After the bomb, science has been on the defensive, facing the wrath of churches, school boards, animal rights activists, and postmodern academics. Critics of science accuse it of atheism, nihilism, elitism, racism, sexism, imperialism, and anthrocentrism—sometimes fairly, sometimes not.

For your fifth exercise, write an *editorial*, *article*, or *position paper* on a past or present *scientific controversy*. Take a well-reasoned stand, pro or con. Whether addressing a *general*, *professional*, or *organizational* audience, choose from three kinds of arguments:

- ***Philosophical*:** Examine a contested *scientific theory*, such as intelligent design or multiple worlds, or a complicated *cultural question*, such as the political legacy of the Scientific Revolution, revisionist interpretations of Galileo's trial, the conflict between science and religion, or postmodern challenges to the scientific method.

- ***Ethical:*** Analyze a specific *moral issue* or *legal case*, such as animal testing, genetic engineering, global warming, or nuclear power; or investigate a *crime* or *atrocity*, such Nazi science, the Tuskegee experiment, or Climategate.

- ***Institutional:*** Question *disciplinary standards* or *procedures* within your field; critique the impact of *public policy* on formal science; analyze or solve a contentious social problem from a scientific perspective. You may summarize the position of a major lobby such as the National Academy of Sciences or offer your own ideas.

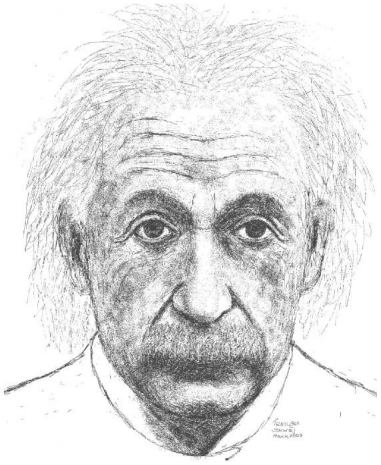
Follow the rules of formal rhetoric. Include an *introduction* with a clear *claim* and good *reasons*, a valid *warrant*, solid *grounds*, and implied *backing*. Concede some points before refuting the opposition. Use induction and deduction, facts and logic, to confirm your position. 4 to 5 double-spaced pages, APA or CSE format (1,000 to 1,250 words).

MAR 07: WORKSHOP.

MAR 12: SPRING BREAK.
MAR 14: NO CLASS.

EINSTEIN'S PATENT: **"Proposing Ideas and Professing Knowledge"**

"The research proposals that are well written get the grants. The funded research that is well written attracts the publishers. The publications that are well written usually get the attention. It's that simple."
~~Paul W. Jennings, *National Science Foundation Newsletter* (November 1998)



MAR 19: THE NEW ATLANTIS: R & D Society
First draft of Exercise 5 due.

Penrose and Katz, *Writing in the Sciences*:
Ch. 4: "Writing Research Reports," 175-97.

Montgomery, *Communicating Science:*
- Ch. 11: The Proposal," 29-40.
- Phil Kolin, "Successful Research Proposals"
- Brian Holloway, "Writing Proposals and Grants" (*handouts*).

Handouts:
- Fred Guterl, "Pondering the Future's Future."
- Gina Kolata, "Stem Cell Science Gets the Limelight."
- Ian Parker, "The X Prize."
- Sample Article and Book Proposals.

PROPOSAL: SELL AN IDEA

Francis Bacon's *The New Atlantis* (1625) proposed a society based on scientific research and technological innovation and devoted to continuous material improvement and to increased health and longevity for its citizens. In many ways, twenty-first century America has fulfilled Bacon's dream, but it still expects its scientists and inventors to propose constructive change.

Accordingly, the ability to pitch ideas—whether in the classroom or the lab—is a crucial skill. Your next assignment, therefore, will be a *proposal* for a *scientific project*. This project should reflect your scholarly or professional interests while appealing to a specific target audience's needs and values. Choose from the following proposal topics:

- ***Research paper:*** Create a *six-week plan* for a *30-page term paper* for an advanced science course at Ithaca College or Cornell University. Research and narrow your topic, which should have a practical application. If necessary, interview the course professor. Using Phil Kolin's format, include headed sections for *purpose* and *overview*, *areas of investigation*, *research methods* and *sources*, *timetable, request for approval*, and *contact information*.

- ***Journal article* or *science book:*** Submit a *query* or *treatment* to a newspaper, magazine, or textbook editor, a nonfiction publisher, or a literary agent. Research and follow submission guidelines. Establish a *context* for your proposed manuscript. Summarize its *contents,* describe its *slant* and *appeal*, identify *potential readers*, evaluate the *competition*, and highlight *benefits* for your targeted venue. If necessary, discuss *marketing*.

- ***Grant:*** Secure *internal* or *external funding* for scientific research. Research and learn your targeted institution's submission guidelines. If none exist, follow Brian Halloway's advice. First, address the Six F's: *field*, *function*, *framework*, *fallout*, *format*, and *finance*. Next, design the most appropriate layout. Formats vary, but most research grants include a *summary*, *purpose*, *rationale*, *methodology*, *budget*, *timetable*, and *credentials*.

Format your proposal as a *memo* or *letter*: 2 to 4 single-spaced pages (1,000 to 2,000 words), APA or CSE citation, if appropriate. Print the *first page* on *organizational stationery*.

MAR 21: WORKSHOP.

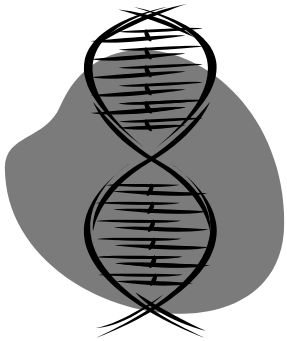
MAR 26: WORKSHOP.

MAR 28: THE ADVANCEMENT OF LEARNING: Writing the Scientific Article
First draft of Research Proposal due.

Montgomery, *Communicating Science:*
- Ch. 6: "The Review Process," 29-40.

- Ch. 7: "The Scientific Paper," 78-98.

Bowen and Schneller, *Writing about Science:*
- James Watson and Francis Crick, "Molecular Structure of Nucleic Acids," 356-60.



Handout:
- Horace Freeland Judson, "The Stuff of Genes."

WORKSHOP.

APR 02: Penrose and Katz, *Writing in the Sciences*:
Ch. 4: "Reading and Writing Research Reports," 91-129.
Ch. 5: "Reviewing Prior Research," 130-48.

Dawkins, *Modern Science Writing*:
- Francis Crick, "Life Itself," 229-31.

WORKSHOP.

COLLBORATIVE ARTICLE AND PRESENTATION: PROFESS KNOWLEDGE

Ever since the Library of Alexandria, institutional science has dedicated itself to collecting and disseminating information for universal consumption. "Science," Carl Sagan said, "connects us with the insight and knowledge, painfully extracted from Nature, of the greatest minds that ever were, with the best teachers, drawn from the entire planet and from all our history, to instruct us without tiring, and to inspire us to make our own contribution to the collective knowledge of the human species."

Partnering with up to three classmates, research and write a *full-length science article* for a *specific journal* or *periodical*: 15 to 20 double-spaced pages, APA or CSE citation if appropriate. The article's topic should reflect your team's shared research interests. Target a *general* or *professional* audience, include an *abstract*, *footnotes*, and *references*, and follow the publication's *format* and *layout*. Graphics should enhance rather than detract from your text.

Before submitting its final draft, your group will give a *ten-minute presentation* on some aspect of this project. This may take the form of a talk or lecture with audio-visual aids, an interactive website, a podcast, or a video. For pointers, consult Ch. 13 of *Communicating Science* (169-82) and Ch. 6 of *Writing in the Sciences* (149-74) and study clips from Jacob Bronowski's *The Ascent of Man* (1973), Carl Sagan's *Cosmos: A Personal Journey* (1980), and Al Gore's *An Inconvenient Truth* (2006).

APR 04: WORKSHOP.

Handouts:

- John Confer et al, "Winged Warbler Habitat Differentiation" (Original Draft).
- John Confer et al, "Winged Warbler Habitat Differentiation" (Revised Draft).
- *The Onion*, "Intensive Five-Year Study Shows Five Years is a Long-Ass Time."

APR 09: Montgomery, *Communicating Science*:

- Ch. 13: "Oral Presentations," 169-82.

Penrose and Katz, *Writing in the Sciences*:

- Ch. 6: "Preparing Conference Presentations," 149-74.

WORKSHOP.

APR 11: WORKSHOP.

APR 16: WORKSHOP.

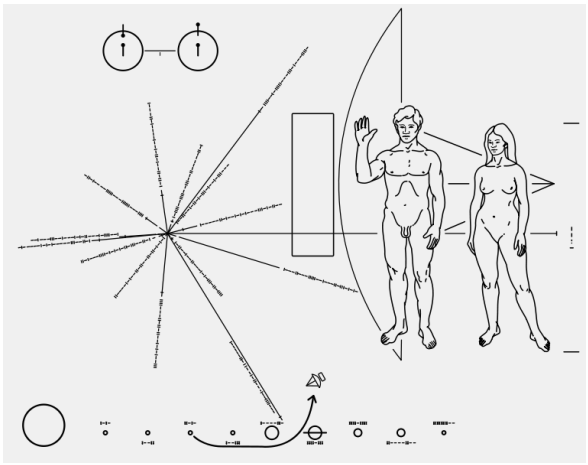
APR 18: WORKSHOP.

APR 23: ORAL PRESENTATIONS
Working draft of collaborative articles due.

APR 25: ORAL PRESENTATIONS.

"In the demon-haunted world we all inhabit by virtue of being human, science may be all that stands against us and the growing darkness."

~~Car Sagan, *The Demon-Haunted World* (1996)



APR 30: COURSE EVALUATIONS
Collaborative article due.

MAY 02: ENVOY: Science and Democracy

Dawkins, *Modern Science Writing*:

- James Jeans, "The Mysterious Universe," 3.
- Albert Einstein, "Religion and Science," 235-38.
- Carl Sagan, "The Demon Haunted World," 239-46.
- Carl Sagan, "Pale Blue Dot," 394-95.

Handouts:

- Barbara Ehrenreich, "Science, Lies, and the Ultimate Truth."
- Richard Feynman, "The Value of Science."
- Carl Sagan, "Science and Hope."

EXAM WEEK SAGAN PILGRIMAGE

Field trip to the Planetary Walk and Sciencenter.