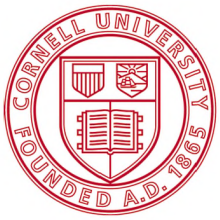

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Science Education Across Media

Assignment Sequence from STS-109: "Images of Science"
Submitted for the Spring 2001 Knight Assignment Sequence Prize

Day 1

- For class, the assignment is to bring in a science textbook.
- Group work: "What is a textbook?" Taking an anthropological "stranger" stance, students in groups of 4 or 5 generate a written list of features key to "textbookness."
- In-class discussion – Using groups' lists of textbook features, unpack how each functions to construct a particular learning process, and create a specific image of science. Points to emphasize include:
    - Role of textbooks in science education (Kuhn 1-pg. handout)
    - Teleological image of science created both by structure of chapter, and by ordering of chapter-then-problem set
    - Structural features of textbooks

Day 2

- Film for Day 2 – an episode each of *Bill Nye the Science Guy* and *Mr. Wizard*
- In-class writing – Half of the class spends 10 minutes writing a brief explanation of why *Bill Nye* was a better program than *Mr. Wizard.* The other half of the class argues that *Mr. Wizard* was better than *Bill Nye*. "Emphasize both the merits of the better show, and the drawbacks of the worse one."
- Class debate. Points to make sure to raise:
    - *Mr. Wizard*'s image of science as a process to be performed
    - *Bill Nye*'s image of science as punchy information to be learned
- In-class writing – "Write a counter-argument, claiming the opposite of what you'd previously argued. What points do you think the other side missed?"
- Class debate.
- At-home writing – Assignment 7 – "Science TV pitch."

Day 3

- Reading for Day 3 - Russell, Tom, and Hugh Munby. "Science as a Discipline, Science as Seen by Students and Teachers' Professional Knowledge." *Doing Science: Images of Science in Science Education.* Ed. Robin Millar. London: The Falmer Press, 1989. 107-25.
- In-Class writing – Brainstorm about the best science teacher you ever had. List characteristics, memories, and impressions.
- In-Class discussion – What makes a good science teacher? What images of science should be conveyed by grade-school teachers? What about university teachers?
- At-home writing – Write a cover letter (no more than one page) in which you outline your proposal for Assignment 8. Indicate the sorts of sources you'll draw

from and offer examples of why your proposal is valid. Consider this the cover letter that will convince the head of the NSF to read your full report. Bring 4 copies to the next class.

Day 4

- In-class group work – Split into groups of 3 or 4. Each student reads their letter to the rest of the group, followed by a ten-minute question-and-answer period in which the other students offer counterarguments. After each Q&A, the other students spend five minutes writing a short memo indicating why they are/are not persuaded. Repeat for each student.

Assignment 7 – Science TV Pitch

You're in charge of developing a new science television show for one of the major networks. The show has to qualify as "educational" to fulfill FCC guidelines, but beyond that you've been given free rein. You have a maximum of three pages in which you can pitch your show to the network executives.

Lay out your goals for the new program, and describe how the show you propose will meet them. What do you want the show to do? What will an episode be like? Keep in mind the issues raised by our discussion of Mr. Wizard and Bill Nye, but your show doesn't necessarily have to follow in either mold.

Remember, you're trying to convince the execs to produce your show, so be as persuasive as you can be.

Assignment #8 – Science Education

The National Science Foundation has come to you with a dilemma: they have $10 million dollars earmarked for "improving science education," and don't know where it would be best spent.

Write a 4-5 page paper advising the NSF how to proceed. Keep in mind our discussions of print, television, and classroom teaching, though your final proposal need not address any or all of these particular media. No matter how you argue the money should be spent, be careful to explain *why* you feel you're right, and what your goals are - reinforcing the status quo, or changing it? If changing it, how and why?

Be sure to back up your argument with citations from other experts (bureaucrats really like papers with citations), as well as your own experiences and observations. Consider possible objections others might raise, and address them in your paper. Remember, you have a chance to make a positive impact on the state of U.S. science education – be persuasive!

Josh Greenberg

From legitimate to fringe

Assignment Sequence from STS-109: "Images of Science"
Submitted for the Spring 2001 Knight Assignment Sequence Prize

One of the most prominent themes of the course, and a core theoretical stance from Science & Technology Studies, is that "science" is a social construct rather than an objectively existing entity. Fundamentally, then, it doesn't just matter whether we know what science *is* but also how it is *represented.* There is no true nature of science that's distinct from how we talk about it, and the boundary between "good" science and "bad" science is the product of rhetoric and social negotiations.

Now, that's all well and good for a relativist graduate student in a theoretically trendy discipline, but how does one get this idea across to a class that, frankly speaking, is almost entirely composed of undergraduates in science and engineering (one of the consequences, I suppose, of listing a FWS with the word "science" in the title)?

This assignment sequence comes relatively late in the course. For the first month, students assemble a toolkit of different ways to analyze images of science: science as progress; science as gendered; science as pure; the "two cultures." Then, they spend several weeks trying their hands at unpacking the constructions of science in varying forms of science education, from educational TV shows to textbooks. By the time we hit this sequence, the students seem generally comfortable with analyzing texts, and I want to shake them up a little, to get them to see that they can actually *use* the rhetorical tactics that we've been analyzing.

The trajectory of this sequence is to move from scientific writing farther and farther from "real" science, all the while analyzing the ways in which language is used in different contexts and different forms to create images of science. This tacitly makes the relativist point that scientific writing is no different from "pseudoscientific" or nonscientific writing, while also getting students to think more critically about various sentence-level and structural aspects of their own writing.

Day 1 – Scientific Writing

I start class by handing out an excerpt from an article in *Science* magazine (see attached, "Chemical Analysis of Polar Stratospheric Cloud Particles"). I ask them to read it over, and then after about 30 seconds tell them to stop. I ask them what's going through their minds at that moment, how they feel about what they're reading.

Inevitably, they complain that the excerpt is boring and confusing. I ask them to read the rest of the excerpt, then we launch into a discussion of *why* the excerpt is boring and confusing. By focusing the discussion on sentence-level analysis, we tackle some of the

standard features of scientific writing (elaborate sentence structure, jargon, etc.) and the impression that their use conveys to the reader.

Ultimately, someone mentions the use of the passive voice (if nobody does so, the simple question "Okay, so who's actually *doing* the experiment" leads there pretty quickly), and we get into the ways in which using the passive voice removes the agency of the subject, and how in this case passive constructions create an image of scientists as unobtrusive and neutral. This leads into Assignment 9 (see attached), in which I want the students to play with the passive voice for themselves.

(Note on Assignment 9: One reason I really like this assignment is that it forces students who've been told for years ***not*** *to write in the passive voice to consider that passive constructions have a certain rhetorical function, which can at times even be useful. Also, it's kind of like forcing someone to smoke a whole pack of cigarettes at once, to make her lose their taste for them.)*

Day 2 – Science Journalism I

We start class with volunteers reading aloud their passive voice papers, and recapping the previous day's discussion.

Next, we discuss the dilemmas of science journalism described by Dorothy Nelkin, focusing on the difficulties of sourcing and grappling with complex subject matter. Finally, I give a short lecture on inverted-pyramid newswriting.

Day 3 – Science Journalism II

The class is structured as a press conference. Students are handed a press release and are shown a videotape of an actual press conference from 1989 at which the first successful cold fusion reaction was announced to the public.

(Note on Assignment 10: The goal here is to simulate as closely as possible the actual experience of covering a science news story. Students are forced to rely solely on the press release and conference to play out Nelkin's analysis of science journalists, who often have to write stories on complex issues with nothing more than a press release as a guide. In addition, they're put on a short deadline.)

Day 4 – Fringe Science

The reading for today (from *Wired* magazine) is essentially the story of how the scientific "breakthrough" which students have just written about was eventually discredited. I offer the students the opportunity to rewrite the lead of their news stories if they like, and then ask everyone to read aloud their lead (both old and new version, if revised). This leads into a discussion of why they framed the story as they did, and how they feel about the fact that in the eyes of the general community, their sources are seen as frauds.

We compare the tone of the *Wired* article with that of the news stories they wrote, discussing the similarities and differences in the images of cold fusion presented.

Day 5 – Pseudo-science

For class, students have watched the series premiere of *The X-Files*, and read an article outlining a debate between Richard Dawkins, an Oxford biologist who claims that the show misrepresents science, and Chris Carter, the creator of the show, who claims that Dawkins is entirely mistaken.

This leads to Assignment 11, in which students are asked to write an editorial taking a specific stand with regard to the Dawkins/Carter dispute, and to be as argumentative as they like.

(Note on Assignment 11: The goal here is to get students consciously arguing a point of view, in the most argumentative genre of writing possible. In addition, I've found that some students are more comfortable making a strong argument when writing from a perspective other than their own, so it works well to allow them a free choice of authorial voice.)

Assignment 9 – Active/Passive Voice

Part 1 – Write no more than a page (250 words) describing your day – what you did, where you went, who you saw.

Part 2 - Keeping every detail, rewrite your page entirely in the passive voice. Feel free to make your sentences as convoluted as you need to, but there should be no active constructions in the final product.

Bring one copy to class for discussion.

Assignment 10 – Science Journalism

You're a journalist, covering a breaking news story at the University of Utah. You've been given a press release (attached), and will be present at a press conference hosted by the university.

Based on these sources, *and these sources alone* (no outside sources), write a 500-700 word news story. Use inverted-pyramid style, as discussed in class. Remember, you're on deadline – stories must be e-mailed to me by 5 pm tomorrow.

Chemical Analysis of Polar Stratospheric Cloud Particles

The important role of polar stratospheric clouds (PSCs) during the development of the south polar ozone hole was recognized soon after the first publication (1) on large unexpected ozone losses in the lower stratosphere over Antarctica. Initially, the existence of cloud particles at temperatures above the ice point was puzzling; however, thermodynamic considerations (2) as well as laboratory studies (3) revealed that in the H_2O-HNO_3 system stable crystalline hydrates can be formed above the ice point. During the last 10 years the initial concept of two types of PSCs--nitric acid trihydrate (NAT, $HNO_3 \cdot 3H_2O$) and ice particles (4)--has been expanded to explain Lidar and backscatter sonde measurements. Supercooled ternary solutions or amorphous particles composed of nitric acid, water, and sulfuric acid may frequently be present in a temperature range in which solid NAT particles are thermodynamically stable (5). Laboratory studies and model developments of heterogeneous processes have advanced to the point that the phase and the composition of PSC particles as a function of ambient temperatures, gas-phase HNO_3, and water vapor abundances can be predicted (6); however, a detailed chemical analysis of PSC particle composition has never been made (7). The particles exist over a very narrow temperature range (8), and thus the transfer to or capture into an analytical instrument may easily alter their phase and composition.

A PSC analysis instrument has been developed in our laboratory that circumvents most of the potential shortcomings in the transfer of the fragile particles from ambient air into a mass spectrometer system. The instrument consists of an aerodynamic lens that focuses PSC particles into a narrow beam (9, 10), a differentially pumped vacuum system containing two liquid helium pumps, a small particle evaporation sphere, and a quadrupole mass spectrometer for gas analysis (Fig. 1). The main goal of the experiment was a quantitative analysis of condensed water and nitric acid contained in PSC particles (11)...

Until the later part of January 1998, lower stratospheric temperatures above Kiruna, Sweden, were too high for PSC activity to occur. After January 20 a cooling trend started and lee wave-induced PSC activity was predicted across the Scandinavian mountains (13). The balloon was launched on 25 January 1998 at 0:30 UT from the Swedish launch facility ESRANGE near Kiruna. A backscatter sonde (14) and temperature (15) and pressure sensors were also part of the balloon payload. Using the backscatter sonde signals to identify the presence of PSC layers, the balloon operators were able to raise or lower the balloon and gondola by opening a valve or dropping ballast to keep the experiment within the altitude range of 20 to 23.5 km. Mass spectrometer measurements were performed between 2:00 and 4:00 UT during which time the balloon was located inside the Arctic polar vortex.

(Excerpt from Schreiner, J., Voigt, C., Kohlmann, A., Arnold, F., Mauersberger, K. & Larsen, N. (1999) *Science* **283**, 968-970)

Assignment 11 – Editorial

You're writing an editorial for one of the major daily newspapers about the recent flap between Richard Dawkins and Chris Carter. Taking the dispute as a jumping-off point, argue your perspective on who's right, who's wrong, and whether there's a place in society for "pseudo-science" shows like *The X-Files*.

You can write from anybody's perspective, from a UFO nut to a respected physicist, as long as you make clear in your piece who you are, and how you feel about these shows. Take a strong stand and be vicious if you like, but be sure to cover your bases – anticipate any expected counter-arguments, and write persuasively!