

Cases for Teaching Responsible Communication of Science

Arsenate Bacterium Press Conference: Discussion version

In December 2010, Felicia Wolfe-Simon [FWS] presented a press conference, organized by NASA's Astrobiology Unit. Astrobiology is the study of possibilities for life on other planets. But since we do not know of any biological systems on other planets, astrobiologists investigate the *possibilities* for life on other planets. Sometimes this involves the study of unusual or *extremophile* organisms that thrive in conditions of extreme heat, cold, or pressure, or in the presence of substances that would usually be toxic or deadly. At the press conference, FWS introduced the bacterium GFAJ-1, which, she claimed, was able to use arsenic in place of phosphorus in the basic structure of its DNA. This was a stunning claim that promised entirely to change our understanding of life on earth, and the possibility of life on other planets. Her experimental design involved placing GFAJ-1 in an arsenic-rich-phosphorus-poor environment to see whether it would survive and grow. It did.

Shortly after the press conference, significant questions were raised about FWS's research. Rosie Redfield, a Canadian researcher who runs an internet blog discussing research in biological sciences, posted a detailed critical discussion of FWS's work, including arguments that specifically identified where she thought things had gone wrong. Eventually Redfield analyzed the DNA of GFAJ-1 using liquid chromatography-mass spectrometry, and found that she could not detect any arsenic. Redfield and others regarded this as a "clear refutation" of the central claims made in FWS's paper. Over time, a growing consensus of scientists concluded that GFAJ-1 did not substitute arsenic for phosphorus. Instead, it was capable of *tolerating* arsenic. FWS's experimental design, they argued, was faulty since she had not eliminated trace amounts of phosphorus in the original trials.

While it can be embarrassing, it is not unusual for initial findings to be disproven by subsequent investigation. Unless the problematic findings are the result of scientific misconduct, researchers whose findings are disconfirmed by later tests just move on to the next project. In this case, however, the scientific community responded to the disconfirmation of FWS's work with harsh condemnation that threatened to be a career-endingly disaster for FWS herself.

Your task in this case is to view and evaluate the press conference at which FWS introduced her work. You should identify the things that were done well, and things that were done less well. Note that this press conference was not selected as an example of what *not* to do: FWS clearly does some things very well. As you watch, you should identify both what went well, and what might have been improved.

Background Preparation: Watch FWS's presentation at the press conference either in class or at home. It's available from 2:45-9:45 on this video:

<https://www.youtube.com/watch?v=JVSJLUIQrA0>

As you listen, write down in a list what you believe FWS did well, and what she might have done better. Your instructor may also assign you the task to do some web-research to find responses to FWS's press conference and her research, and to bring in excerpts from three different responses from press or blog sources available on the web.

Question for Discussion

Since it is not uncommon or reprehensible for published scientific results to turn out to be questionable or false, why was condemnation of FWS so harsh? The hypotheses below offer an opportunity to consider alternative explanations. You should not feel limited to the explanations posed here, however. Further, these hypotheses are not mutually exclusive: it is possible that several of them (or none of them) provide the best explanation for the response of the scientific community to the arsenate bacterium press conference and aftermath. Quotations on this handout are from scientists who were asked to address this question.

Hypothesis 1: Her study was not just flawed, but flawed in ways that suggest incompetence or misconduct. The response of her critics reflects their disapproval of her misconduct, not the failure of the study itself. (Not a communications issue.)

“I am an expert on phosphoral transfer, familiar with chemistry of phosphorous and arsenic. This article *made no sense*. I immediately went on line and saw that the data presented in the article did not support the conclusions. Most people focused on the inadequate techniques used to analyze the DNA, but I focused on the statistical data. People focused on techniques for DNA analysis, I was focused on how the bacterium could grow on Arsenic. Statistical data were not interpreted correctly, and the most likely result was that the As was contaminated with phosphate. I was able to confirm this in a simple experiment in my laboratory.” (A)

“I found the article in original before review. The table of data added [in response to reviewer critique] did not actually help her case! In response to technical comments, she had summarized data and did weird manipulation of standard deviations to make the numbers agree. If you look at the original—numbers plus standard deviations don’t agree. In revision she *doubled* the standard deviations for no statistically acceptable reason to make the numbers agree! It seems trivial, but why did she do this to make the numbers agree? She could have left out the whole point! It’s indicative of trying to fit in everything with a story rather than looking at the evidence to come to a conclusion.” (A)

“Good science emphasizes negative and then tests them. They didn’t think about controls from the start! Then after they regarded control considerations as objections to respond to.” (B)

Hypothesis 2: The strong negative response reflects that other people in the scientific community regarded this finding to have been hyped from the start.

“People are unwilling to back down, and this is at every level and an institutional failure as well. NASA *trumpeted* this and they’ve never backed down. People who should have known better continue in their positions without consequences. The first strategy people use is to sweep under the table. Unless they’re forced to confront it by some outside agency, they won’t.” (A)

“It came across very strongly that the goal of the press conference was to convince everyone that they had this super exciting result. It was a sales job. The tone of the paper was a problem too: a sales job. It was not written by people who were appropriately skeptical of result. Tons of flaws with the paper, I documented most in blog post. Cumulatively, you’d say ‘Wait I don’t think we should believe any of this!’ It was improbable from the start.” (B)

Hypothesis 3: *She could have avoided these negative repercussions by responding differently to the criticism she received. (How should she have responded?)*

“She felt she *couldn't* back down. And maybe her senior advisors fostered this attitude: If you read Paul Davies Wall Street Journal article, he felt that she thought this was her whole career in science. (“*At every step, the experimental results might have shot down her big idea, spelling the probable end of a promising scientific career.*” –Paul Davies, *WSJ* 2010) That’s incredibly dangerous for anyone to think that they must get a particular result or your career is over. If I need to get a result or my career is over, I’m gonna get that result.” (A)

“FWS said in a statement that “The only appropriate place to discuss was in the peer reviewed literature.” Though they had been blogging before this. Refusal to engage got the backs up for everyone else.” (B)

“It usually takes about a month from SciExp to print, but in this time it took six months. I thought because authors were squabbling about whether to retract. But no, they said they were right about pretty much everything. But since they had refused to engage, others wrote technical comments that were peer reviewed and published eight of them along with the article, and a rebuttal from the authors. They wrote a *rebuttal*. It *should* have been a response to the critique! The authors basically denied all the criticisms. The authors should have said “OK this point maybe this one yes this one maybe....” they should have engaged as scientists, but they did not.” (B)

“She was interviewed AFTER those came out, and they maintained that the data didn’t address the main points of the paper. It’s the last I think anyone has heard from them, but they maintain that they were right—something like “There was nothing in these data that fundamentally change our opinions...”” (A)

“The science has to come first! Your mother might, you might want to bolster up your science to promote your career. FSW shot herself down—big public mistake. The right response is to say “Shit I made a big public mistake! This is terrible! I’m embarrassed! I overlooked things I should have been careful of! I need to go back to the lab and do more...” If she had done that, people would have said” She’s doing the right thing.” Instead, she stonewalled. Would not consider the possibility that she was making a mistake. If you can’t admit a mistake, your scientific judgment can’t be trusted. She fell in love with her hypothesis. She had some data that kinda supported it. It’s as if everything in the paper was to Bolster, not to test. A good scientist goes for the weakness. They propped up the weaknesses and tiptoed away from them. Her inability to admit error was the thing that put her career at risk.” (B)

“Grad students should be brave—they should practice admitting mistakes. If you’re not making mistakes, you’re not working hard enough at being a scientist. If they’re doing good science, they will be making mistakes. But they should be afraid of *covering up* mistakes, not making them.” (B)

Hypothesis 4: *The response she received was informed by, or exacerbated by the fact that she is a woman. The over-the-top response is the result of sexism.*

“There are different pressures on women than on men in terms of how you present, how you look confident. She was doing what men do all the time—always making claims beyond

what they've done. Women are more circumspect because we are more likely to be called out. I sense that in the press conference she was trying to be a strong woman scientist." (B)

"Would it have been different if she were a guy? No. The critiques were based on the science. There was a comment in SCIENCE where someone said "Are they being mean to her because she's a junior woman scientist?" Response was "Crazy! A guy would have been nailed." (B)

"The issue of gender was there. I don't think she was harmed by that." (B)

Hypothesis 5: FWS received bad and inadequate advice, from senior mentors and collaborators who were involved, with her, on this project.

"I think she was failed by institutions and mentors. In our world, especially with on line, there is going to be some unfair hostility generated, but there was also a huge amount of unfair laudatory expressions on line. It's one of those things that come with the new way that the public sphere operates—there will be both lavish praise and lavish criticism. I contacted Paul Davies, and he was completely dismissive. I was trying to see whether he would act in her interest, but no. How can these institutions not examine this!?! Paul Davies has continued to advocate positions in biology that are just irresponsible—its just h is mode! I think he is largely to blame for this fiasco and he has largely escaped from any sort of consequences. If he were to accept more of the responsibility, I think FSW would have been better off. Everyone just hoped it would go away." (A)

"Her co-authors let her down. Senior scientists have an obligation to help juniors not to make mistakes. Many of the other authors were seniors... only two ever said a word about the paper aside from the rebuttal. One was Paul Davies. He was a bad influence. The other was her supervisor Oremland—he should have taken more responsibility to make sure paper was correct before it was published, should have encouraged self-criticism. Instead, he stood by her said "I think we're right" but he also distanced himself from the work a bit too. He trusted her judgment too much. She may not be easy to work with—strong personality, hard to argue with. Good qualities! But maybe they helped her dig her hole deeper. They treated it as if their job was just for their technical contribution and they had no other contribution. When problems crop up, you're then obligated to contribute to the resolution. You can't just wash your hands of the mess." (B)