CASE TEACHING NOTES
for
"Life on Mars: A Dilemma Case Study in Planetary Geology"

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INTRODUCTION

This case deals with the question "Was there past life on Mars?" The matter received sensational attention when a group of scientists associated with the National Aeronautics and Space Administration (NASA) decided to hold a press conference on August 7, 1996. At the press conference, they revealed evidence favoring the presence of life on Mars 3.6 billion years ago. These findings were publicized days in advance of *Science* magazine's report published on August 16th. NASA's approach was largely unprecedented and generally condemned by the scientific community.

This conflict sets the stage for the case. It has several elements: scientific, ethical, and personal. First, it deals with the basic science of the "discovery," how we know or say we know something. Second, the case touches on ethical questions and problems created by going public prematurely. Third, it encompasses a personal story (fictional) of a young scientist who is skeptical about the evidence and must mull over his personal involvement in a press conference that he feels is premature.

The events of the case are real but the conversation is fictional.

BLOCKS OF ANALYSIS

Many scientific issues cutting across several disciplines are embedded in this case. These will be emphasized differently by different instructors. Nevertheless, the case allows extensive opportunities to address questions like the following (answers given in the detailed case analysis).

1. What is the evidence ALH84001 is a meteorite from Mars?
2. What evidence exists about the age of ALH84001?
3. What is the evidence that ALH84001 harbors fossils (i.e., past life)?

It is highly unusual to hold a press conference before data are published. Such an event is typically condemned. Students can get a better appreciation for the arguments involved in releasing data in a public forum by discussing the case with practicing scientists. Students should be able to think of some arguments, both pro and con, for giving a press conference before publication (see detailed case analysis).

The dilemma feature of the Mars case involves Michael King and his role in the press conference. Scientists reading this case have various opinions as to what Michael should do and this ambiguity is ideal for a case. Students should consider some of the personal concerns that Michael might have with respect to participating in the press conference and the impact it might have on his career (see detailed case analysis).

Detailed Case Analysis

Detailed case analysis is provided in a separate file that is password-protected. To access this information, go to the detailed case analysis. You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our password policy and then apply online or write to answerkey@sciencecases.org.

CLASSROOM MANAGEMENT

Discussion Method

To teach this case in 90 minutes requires that students come prepared. They must read the background literature in the references or on the Internet to be able to discuss the science involved. It is reasonable to begin the class discussion by asking students to write down a single sentence that encapsulates the major scientific claims made. By asking a few students to read their sentences, the instructor can write on the blackboard the list of claims and have the class discuss the evidence enumerated. Closure to this section can be reached by asking the class to rank the level of certainty for each claim on a scale of 1 to 10.

The issue of the prepubliction press conference can be considered next, followed by Michael's personal dilemma. The latter may be approached by first listing his concerns, then his options, and finally discussing the possible consequences of his choices. As class ends, ask the students to choose the best option and vote by a show of hands. It might be useful to point out that in the real press conference a real skeptic who was a member of the NASA team did participate by pointing out problems with the interpretations.

Small Group Method

If the case is taught using small teams of students, as in Problem Based Learning, the case might be covered in parts of three classes. In the first session, teams would read the case and identify the scientific issues. Students would then divide the work and seek information for the next session. In the second session, teammates would share information. They would clarify the science and summarize the evidence in a report. For example, teams could write the key assertions and give the evidence why the NASA scientists believe what they do. Next, a general class discussion with the entire class summarizing the points might be appropriate. Before leaving the second class, the students might then spend a brief time identifying the ethical and personal issues at stake for Michael. To research this they might each leave with the goal of interviewing scientists about the case. The third session would focus on the sharing of their views in the small groups with a final general discussion and/or paper.

REFERENCES

- Folk, Robert L., 1993. "SEM Imaging of Bacteria and Nannobacteria in Carbonate Sediments and Rocks,"*Journal of Sedimentary Petrology*, Vol. 63, No. 5, September 1993, p. 990-999.

- Folk, Robert L., 1996. "In Defense of Nannobacteria," *Science*, Vol. 274, 22 November 1996, p. 1288.

- Harvey, Ralph P., and McSween, Harry Jr, 1996. "A Possible High-Temperature Origin for the Carbonates in the Martian Meteorite ALH84001," *Nature*, Vol. 382, 4 July 1996, p. 49-51.

- Kirschvink, J.L., Maine, A.T., and Vali, H., 1997. "Paleomagnetic Evidence of a Low-Temperature Origin of Carbonate in the Martian Meteorite ALH84001," *Science*, Vol. 275, 14 March 1997, p. 1629-1633.

- Mckay, David S., Gibson, Everett K. Jr., Thomas-Kerprta, Kathie L., Vali, Hojatollah, Romanek, Christopher S., Clement, Simon J., Chillier, Xavier D. F., Meechling, Claude R., and Zare, Richard N., 1996. "Search for Past Life on Mars: Possible Relic Biogenic Activity in Martian Meteorite ALH84001," *Science*, Vol. 271, 16 August 1996, p. 924-930.

- Marti, K., Kim, J. S., Thakur, A. N., McCoy, T. J., and Keil, K., 1995. "Signatures of the Martian Atmosphere in Glass of the Zagami Meteorite," *Science*, Vol. 267, 31 March 1995, p. 1981-1984.

- Sillitoe, Richard H., Folk, Robert L., and Saric, Nicolas, 1996. "Bacteria as Mediators of Copper Sulfide Enrichment During Weathering," *Science*, Vol. 272, 24 May 1996, p. 1153.

- Valley, J.W., Eiler, J.M., Graham, C.M., Gibson, E.K., Romanek, C.S., and Stolper, E.M., 1997. "Low Temperature Carbonate Concretions in the Martian Meteorite ALH84001: Evidence From Stable Isotopes and Mineralogy," *Science*, Vol. 275, 14 March 1997, p. 1633-1638.

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