

WALKIN' ON THE MOON: TEACHER GUIDE

Subject: Physical Science

Grade Level: Middle School

Last Updated: November 6, 2008

Case Summary

Did astronauts really land on the moon? An urgent letter arrives in the mail for you and those in your group. David Smith, the CEO of a company developing resorts and hotels on the moon, desperately needs your help. Several members of Congress are planning to cut all future funding to his company because they believe the 1969 moon landing was a hoax and see recreational travel to the moon as unfeasible. As prominent physical scientists, you must testify before a Congressional Committee to help David Smith convince Congress to continue funding his company's efforts to make lunar tourism a reality.

Credits

This case was adapted by Bethany L. Turner (PhD candidate, Anthropology, Emory University, Atlanta, GA) and Katherine K. Shamsid-Deen (teacher, Columbia Middle School, Decatur, GA) fellows of the Emory University PRISM program (<http://www.prism.emory.edu>). Authors may be contacted at blturne@learnlink.emory.edu

This case was adapted from *Was the Moon Landing a Hoax?* (Thompson and Mo 2003).

Thompson, A.L., Mo, S. (2003). Was the Moon Landing a Hoax? Retrieved January 2005 from the PRISM Year 1 Case Archives at the Emory University Center for Science Education, Atlanta, GA.

Learning Objectives

At the end of the case, students should be able to:

1. Describe Newton's first (inertia), second (force = mass x acceleration) and third (action & reaction) Laws and the differences between them
2. Differentiate between unbalanced versus balanced forces, weight versus mass and gravity
3. Explain the differences in gravity and the different conditions on the surface of the moon relative to the earth.
4. Explain how Newton's Laws relate to gravity on earth and on the moon
5. Discuss the historical context of the landmark 1969 moon landing, the astronauts involved and some subsequent advances in space exploration, and common hoax theories regarding the moon landing.
6. Critically evaluate different information sources.
7. Craft an effective scientific argument in the form of congressional testimony.

Georgia Performance Standards

- SCSh1.* Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)
- S8CS7.* Students will question scientific claims and arguments effectively. (NSES Content Standard A)
- Question claims based on vague attributions (such as “Leading doctors say...”) or on statements made by people outside the area of their particular expertise.
 - Identify the flaws of reasoning in arguments that are based on poorly designed research (e.g., facts intermingled with opinion, conclusions based on insufficient evidence).
- S8P3.* Students will investigate relationships between force, mass, and the motion of objects. (NSES Content Standard B)
- Determine the relationship between velocity and acceleration.
 - Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction.
- S8P5.* Students will recognize characteristics of gravity, electricity, and magnetism as major kinds of forces acting in nature.
- Recognize that every object exerts gravitational force on every other object and that the force exerted depends on how much mass the objects have and how far apart they are.

Assessment

To complete this case, students worked in their groups to devise their congressional testimony, which included written statements and a poster for visual aid. The written and poster components were graded for accuracy, inclusion of key concepts, organization and creativity. While the students received group grades, the teacher included facilitator observations and student evaluations of their group members’ participation (see sample **Evaluation** in Student Materials) and effort in her/his assessments.

Implementation Strategy

This case was designed to take place over one 60-minute class session and four 120-minute class sessions. It had two scripted scenes; the second scene includes additional handouts of a Haz Mat substance inventory and the mock transcript of an interrogation. Students worked in groups of 4-5 individuals. This case can be facilitated by two facilitators or even a single teacher, because rather than placing a facilitator with every group, the students spent time brainstorming with their group and then as a whole class.

The brainstorming session described below involved students reading, discussing and taking notes in their groups in 10 minute blocks (totaling about 25 minutes per scene), then reconvening as a whole class to volunteer their observations, questions, hypotheses and learning issues (learning issues are things that students say they need to know or look up to define unknown terms, answer their questions, and/or test their hypotheses) at the end of every 10-minute block. During the group brainstorming, the teacher/facilitators float from group to group, checking progress and helping students with any stumbling

blocks they may have. During the whole-class volunteering time, the teacher/one of the facilitators takes notes on an overhead or with a Smart Board. In this way, students can learn to work as a team while still benefiting from sharing their information as a whole class or even competing with other groups for volunteering, while the teacher can make sure that all students are at the same point in the case at each step.

Implementation Schedule

This case was designed for approximately four days of implementation, although having implemented the case, we would recommend five days for sixth grade (see Case Notes for explanation). This assumes a block schedule, where each class is given approximately 120 minutes, although the first day of the case took place during a 60-minute class session.

- Day 1 (60 min) – Read both letters in groups; filling out box charts, brainstorming and strategizing. Homework: finish box charts.
- Day 2 (120 min.) – Discuss learning issues with group, share ideas and insights from homework (~60 min.). Computer Lab: explore PRISM-Columbia Middle webpage with useful links (~60 minutes). Homework: continue to research learning issues in textbook, online and other resources of choice.
- Day 3 (120 min.) – Compile research findings and discuss in groups (~45 min.); start working on blueprint for poster and outline for testimony
- Day 4 (120 min.) – Work on poster and testimony (allow the group members to divide up tasks based on their individual strengths, i.e. artistic ability, confidence in speaking).
- Day 5 (120 min.) – Group prep for testimony (~20 minutes); testify, in groups, before a “congressional committee” (~10 minutes per group); group evaluation, case wrap-up (~20 minutes).

Case Notes

What Went Well:

1. The students gave positive feedback throughout the case and seemed to enjoy the urgency of the letters. Also, the letters seemed very realistic to them and captured their attention as a result.
2. Normally we provide the students with a customized web page that has facilitator-screened links to useful information in order to guide their research. However, because this is our fourth case of the school year, we decided to give the students handouts with web links and give them more agency and free reign in their internet research. While this did have some pitfalls, such as students having difficulty typing in the addresses correctly, the students were able to find many websites that the facilitators had not seen, including some very interesting hoax websites! This created an opportunity for us to help students critically evaluate the sources they were reading, such as “googling” the site’s authors and looking for their (nonexistent) academic credentials. Many students were quick to appreciate differential credibility between websites.
3. By allowing the students to divide up the tasks involved with writing the testimony and assembling the posters, many students were more motivated to accomplish their tasks

because they were having fun with it. With many groups, this also meant a better quality product than if tasks were simply assigned.

4. For the presentations, assigning one particular component of Congress' argument to each group to testify prevented students from becoming too overwhelmed by their task, and also made it possible for each group to present their case not just to the committee, but to the other groups as well. However, these components were not divided up until AFTER the research activities had been completed, so each group still researched all relevant learning issues.
5. The students were very excited about presenting their findings. When we told them that it would be similar to the dramatized courtroom arguments on TV legal dramas, many students were eager to dress up and testify with flair.
6. As a concept-oriented storyline, this case was useful in helping students to appreciate abstract concepts such as inertia, gravity and force. For more advanced grade levels, making Congress' criteria more specific, i.e. explainable by calculations, would be useful. For sixth grade, this case segues nicely into classroom activities that involve formulas and calculations by providing a conceptual baseline.

What Could Have Been Improved:

1. The pace. We attempted to implement this case over four days, and while Days one and two went extremely well, Day three (poster and testimony assembly) was very mixed: two classes were able to make a great deal of progress, while two classes seemed to unravel completely, seemingly forgetting everything that they had been discussing for the past two days! While we were initially flummoxed by this, we believe that slowing down the pace and adding an extra day (or even two, depending on time) would have eased the pressure on students who are more comfortable moving through their assignments more slowly. An alternative strategy is elaborated in #3.
2. Facilitators should take the extra time to search through as many hoax sites as possible, as some have links to other conspiracy theories, including mob activity and famous murders. While our students did not pursue these links, we realized that these sites have potentially distracting or disturbing information. We are glad that the students had the opportunity to critically evaluate and discard non-scientific websites such as these in a structured environment, but some of the websites took us by surprise despite our earlier research. As such, we would recommend relying on a webquest, or a web page of links as we have done in previous cases, including a few pre-screened hoax websites.
3. At the sixth-grade level, some of the students are still having difficulty with the student-driven nature of PBL despite liking it and liking the case itself. Also, some groups got caught up formulating testimony that were based more on documentation from news sources and less on scientific evidence, despite our repeated emphasis on the latter. We think that spending 45 minutes or so following the group research sessions having a structured, traditional class session on the covered topics could help students infuse their testimony with more purely scientific evidence.

Resources

Assembling the most useful of the following online sources as links on a webpage that the students can access in the computer lab or at home is a very efficient way to structure group

or independent research. Also, the students should be encouraged to utilize their textbooks or other resources.

Science Service (2004) Reach for the Sky. Retrieved November 6, 2008 from <http://www.sciencenewsforkids.org/articles/20041201/TZWorksheet.asp>

Cool Cosmos (California Institute of Technology) (2004) Ask an Astronomer for Kids! Retrieved November 6, 2008 from http://coolcosmos.ipac.caltech.edu/cosmic_kids/AskKids/moon.shtml

Nemiroff, Robert and Jerry Bonnell (2001) Astronomy Picture of the Day: Welcome to the Moon Hotel. Retrieved November 6, 2008 from <http://antwrp.gsfc.nasa.gov/apod/ap010713.html>

Samanna Productions, Inc (2004) Science Friday Kids' Connection: Return to the Moon. Retrieved November 6, 2008 from <http://www.sciencefriday.com/kids/sfkc20040116-1.html>

DreamWeaverStudios (1998) Moonbeam Enterprises. Retrieved November 6, 2008 from <http://www.dreamweaverstudios.com/moonbeam/moon.htm>