Designing Craters: Creating a Deep Impact

Cratering on the Comet

TEACHER GUIDE

BACKGROUND INFORMATION

One of the reasons that cratering was chosen for the focus of this set of activities was that the problem of designing an impactor has proved to be truly fascinating (at least to the author!). Deep Impact needs a crater of a certain minimum size in order to be able to determine the composition of the interior of the comet. Yet, to accurately predict how large a crater we will get, we need to know the composition of the interior of the comet. Also, not everything about cratering is completely understood, so while having the exact conditions on the comet would certainly take us closer to being able to predict what will happen, it would not provide us with an exact script.

Photograph of comet Hale-Bopp taken by Principal Investigator Michael A'Hearn

Scientists must make estimates given what we know about comets already, what we know about cratering already, model events in the lab and come up with a plan for the mission. Both comet and cratering scientists hope to learn from the results. This is an important part of science for students to understand - that science is done by people like them, using what information they have to make predictions, and learning what they can from how reality either matches or plays out differently from their predictions.

This activity is designed to serve as the assessment for the module. The first part of this activity is designed to be discussed in groups, so that the students can pool together their information about comets, while thinking through the application of what they have learned about cratering to the specific case of cratering on a comet. You can, however, choose to have this part of the assignment done individually or allow the students to discuss their ideas in groups and then have them write up their answers individually.

The second part of the assignment, designed to be done individually, assesses two aspects of students' learning: 1) what the student learned about cratering throughout the module, and 2) what they learned about how science is done. Students may need to be encouraged to write as complete an answer as possible. Answers may vary widely.

NATIONAL SCIENCE EDUCATION STANDARDS ADDRESSED

(View a full text of the National Science Education Standards.)

Grades 5-8

Science As Inquiry

Abilities necessary to do scientific inquiry

- Develop descriptions, explanations, predictions, and models using evidence.
- Communicate scientific procedures and explanations.

Grades 9-12

Science As Inquiry

Abilities necessary to do scientific inquiry.

- Formulate and revise scientific explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Communicate and defend a scientific argument.

MATERIALS

For the teacher:

- Student assignments and journal entries for the module to date
- "Scoring Suggestions" for use in evaluating both Parts 1 and 2 of "Report to the Deep Impact Team"
- "Appendix E: Communicating with the Deep Impact Team" (optional)

For each student:

- "Report to the Deep Impact Team, Part 1" & "Part 2"
- Comet information collected by the students and recorded on their "Comet Research" handout (assigned in the first section of the module)

PROCEDURE

1. Have the students meet again with their groups, with the information they have researched about comets. Return any earlier assignments (and hold off collecting the recent writing assignment, "Thinking about Scientific Modeling") for them to use as they file their final reports.

2. Hand out "Report to Deep Impact Team, Part 1." The students will pull together all of the thinking they have done so far in this unit to figure out how they might answer the goal question.

3. Assign "Report to the Deep Impact Team, Part 2." This is an individual assignment in which the student will explain what he or she has learned over the course of the module about cratering as well as learning about inquiry, modeling and other scientific processes.

4. Collect reports. If you choose, submit reports to the Deep Impact team (s*ee Appendix E: Communicating with the Deep Impact Team).*

Student Anticipations

Following are some example paragraphs from the pilot trials in five different ninth grade classes. These are student responses to the science process question in "Report to the Deep Impact Team, Part 2." *(Looking back over your work for this project, have your ideas about how NASA missions are planned or how science is done in general changed? If so, how?)* These paragraphs are from 6 papers chosen at random by one of the pilot teachers.

Note: The wording of the question has been changed slightly since the pilot trials to encourage students to be more specific about their suggestions for conducting a science inquiry. It is now being asked as a separate question.

"Over the last three weeks my idea about NASA missions has changed a little. I knew they got to sit down and think stuff up but I didn't know they had so much fun experimenting. I think I've learned that science is more thinking recording data, and experimenting instead of studying and going by what happened in the past. If I had to outline for someone how to do a scientific inquiry, I would say remember to record and compare all data and try to imagine your experiments full scale."

Student Anticipations - Continued

"Yes it changed it big time! I used to think all they did was nothing. But now I see they have to work hard on what they do. I've learned that it's very hard to put a lab together but it also can be lots of fun."

"This has changed my ideas about how NASA missions are planned and worked out. I did not know that NASA did lab to see what would happen before they went on their missions."

"No this hasn't changed what I though on NASA missions are planned because I have done something like this before which explained NASA's techniques to me. I have learned a scientific inquiry needs to be done slowly and you need to take time with it and try to be neat."

"What we did in class are like what scientists do because we talked with each other. They do the same thing. We talk with each other because we want to find out what the other people did to. "

"Yes, because now I know that science is not just read out of a book. I would tell the person (conducting a science inquiry) to give details and explain all your answers."