

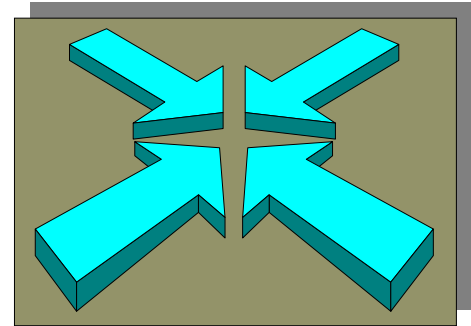
NASA's Deep Impact Mission: Decision Making

The Decision

TEACHER GUIDE

BACKGROUND INFORMATION

In a written forum, students prepare written statements for the data observation strategy they personally agree with. On the same page, students will support a position statement that advocates additional viewpoints. As a large group discussion, the class comes to an agreement on which observation strategy is best at this time, knowing that as more information or circumstances come into play, this can change. Students determine the method for coming to a consensus.



The National Science Education Assessment standards call for achievement data to focus on the science content that is most important for students to learn. Over the course of this module, students have been given opportunities to reason scientifically, use science to make decisions and take positions on issues, and communicate effectively about science. The standards go on to say that assessment processes include all outcomes for student achievement and should probe the extent and organization of this achievement. The statements that students write not only support the “knowledge” that they have learned, but also take into consideration how the students have utilized the knowledge and decision-making processes. The final activity of this module will allow for students to demonstrate their full understanding and ability as well as reflect on their experiences and how they might apply these processes in the future.

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

[Science As Inquiry](#)

Abilities Necessary to do scientific inquiry.

Think critically and logically to make the relationships between evidence and explanations.

Recognize and analyze alternative explanations and predictions.

Communicate scientific procedures and explanations.

Use mathematics in all aspects of scientific inquiry.

[Science and Technology](#)

Understandings about science and technology.

[Science in Personal and Social Perspectives](#)

Risks and benefits.

Science and technology in society.

[History and Nature of Science](#)

Science as a human endeavor.

Nature of science.

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

Grades 9-12

[Science As Inquiry](#)

Abilities Necessary to do scientific inquiry.

Formulate and revise scientific explanations using logic and evidence.

Recognize and analyze alternative explanations and models.

Communicate and defend a scientific argument.

[Science and Technology](#)

Understandings about science and technology.

[History and Nature of Science](#)

Nature of scientific knowledge.

LIFE SKILLS STANDARDS

Thinking and Reasoning

[Applies decision-making techniques](#)

Secures factual information needed to evaluate alternatives.

Predicts the consequences of selecting each alternative.

Makes decisions based on the data obtained and the criteria identified.

LANGUAGE ARTS STANDARDS

Writing

[Uses the general skills and strategies of the writing process](#)

Drafting and Revising: Uses a variety of strategies to draft and revise written work.

(View a full text of the McREL [Compendium of Standards and Benchmarks for K-12 Education](#).)

MATERIALS

For each student:

- [Peer Review Checklist](#)

PROCEDURE

1. Tell students that this assessment is a written composition in which they need to decide which combination of observation strategies they most agree with, based on the evidence collected during the research phase and the information presented. Give the following general instructions:
 - The length of your statement should be between 1-3 pages.
 - Introduce your position on the collection combination that represents the best use of resources while meeting the science objectives of the Deep Impact mission.
 - Provide one or more reasons for your position.
 - Provide support for the reasons—evidence from the research and debates.
 - Write a conclusion that drives home the point you are making.
2. Once students have completed their written composition, collect the papers for use as a peer review. Distribute the peer review checklist to be used by the peer reviewers. Have the peer reviewers write

Teaching Tip

In using a peer review process, you may want to have the students place a distinguishing symbol in place of their name, so that the compositions can be reviewed anonymously and returned to the writer.

their name at the top of the checklist and staple the checklist to the composition to be returned to the teacher and then the author.

3. Allow time for the original writers to read the comments and respond to them. This may necessitate some re-writing of the material. In some cases the original writers may disagree with the comments and not want to include them. This is fine as long as they can justify this on their paper.

Teaching Tip

Explain to students that the number of checked items: per category does not indicate that the category is more important than others. Communicate to students which items are most important.

4. Have the students repeat this process by having the students write another composition that supports a position statement that advocates other viewpoints. This should have the same requirements as those stated above in procedure 1.
5. Repeat the peer review process, allowing time for the students to react to peers' comments before submitting the final draft of both compositions to the teacher.
6. Explain to students that after the mission planners have completed their research, listened to opposing viewpoints, and considered alternatives, a decision on how to move forward must be made. Instruct students to work in their small groups to generate a short summary of the different scenarios that have been written about in the first part of this lesson. Once groups have had a chance to develop their summary, have a representative share the scenario summaries. During this sharing out time, have a volunteer record these summaries onto the board or overhead. As a large group, synthesize the list such that commonalities from all of the various scenarios are combined until there is a workable list of 3-5 to choose from.
7. Hold a discussion with your class to determine how this decision should be made. Provide the following list of possibilities:
 - The principal investigator makes the decision.
 - The science team makes the decision.
 - The engineering team makes the decision.
 - The mission planners take a vote and the outcome is the position of a simple majority of the voters.
 - The mission planners take a vote and the outcome is the position of a predetermined majority of the voters.
 - The mission planners vote to eliminate all but the top two choices; a second vote is taken, and the outcome is the position of the majority.
 - The decision must be unanimous.
 - A group is elected or appointed to represent the mission planners; this group uses one of the above methods.
8. Ask the class if any of these possibilities need clarification. If so, provide this before asking the small groups to discuss each of the above decision-making strategies. On a sheet of paper they should list the strengths and weaknesses of each of these methods and determine which one should be used.
9. Once each group has completed a list and has made a decision about how to decide, hold a vote with each group registering one vote for one of the decision-making methods.
10. Based on this decision, make the decision on how to move forward for this mission. Your students may be interested in learning how the Deep Impact team made this decision and following the mission as progresses toward Comet 9P/Tempel 1.

RESOURCES

<http://www.cgocable.net/~rayser/peereval.txt>

Peer editing check sheet by Lynne Cattafi

<http://www.cgocable.net/~rayser/writing.htm>

Lesson Plans: Literature, Writing, Poetry & Library Skills, Outta Ray's Head