Science Modules

Once NASA funds a mission, there are still many challenges to solve. Check out this new module from McREL that covers the challenges of the A/B Phase (beginning phase) of the Deep Impact Mission.

The following classroom materials are available in Portable Document Format (PDF) for your browsing and printing convenience. The files are print-optimized, and should be printed to achieve maximum resolution. Adobe's new Acrobat Reader 4.0 is required to view and/or print. To install the FREE reader, visit the Adobe Web site.

Collaborative Decision Making: NASA's Deep Impact Mission

Peter West

Collaborative Decision Making is designed to engage students in grades 7–12 in activities that focus on collaboration and communication strategies. These activities will strengthen student understanding of and ability to use collaborative processes and communication practices to clarify, conceptualize, and make decisions. Students will compare the risks of varying courses of action that confront scientists and engineers. After the risks are identified, they will gather and convey evidence supporting and refuting the viability of these actions, and reach consensus. The module strategies rely primarily on student investigation into the background information that is necessary to support arguments; make quantitative risk analyses; engage in debate, role-playing, and persuasive writing/communication processes; and practice group decision-making procedures.

Module Planning Guide

Capture the Issue

- Teacher Guide
- Listening Notes Sheet
- Listening Notes Sheet Example

Interview Summary Sheet

- Michael A'Hearn

Captivate

In "Capture the Issue," students are introduced to a problem that mission planners dealt with during the planning phase of the mission. Students read about the problem, "How do we optimize our data collection?" from the perspective of the principal investigator. This introduction not only provides the "hook" for student interest, but will serve as a focus for the entire module. Students read a position statement from the Principal Investigator Dr. Michael F. A'Hearn, Department of Astronomy at the University of Maryland.

Timing is Everything
- Teacher Guide
- Student Planning Guide
- Building a Scenario

Earth-based Observatories
- Strategy Information Sheet

Earth Orbital Facilities
- Strategy Information Sheet

Deep Impact Spacecraft
- Strategy Information Sheet

Deep Impact Ephemeris Data
- Student Spreadsheet

Research

In the activities of this module, the teacher's primary role is Socratic. Through effective questioning, students should become aware of the different data collection methods for the Deep Impact mission.

Working individually, students will gather information on observing options (collecting data from spacecraft using the Deep Impact Spacecraft, Earth-based observatories, and the Hubble Space Telescope). Once students find out about each one, they then work in expert groups to compare the types of information they found. They will synthesize this information in order to make a recommendation to their home group. Students will work in their home groups to collect additional information about aspects of the collection mode they would like to emphasize. They will also identify lesser aspects and note which aspects of other strategies (given constraints) they would like to build into their response scenario. Students will need to defend their scenario based on cost, risk, scientific benefits, and data quality (meeting science objectives).

Curriculum Connections

National Standards Addressed

Science Standards
Grades 5-8
Earth and Space Science
- Earth in the Solar System

Grades 5-8, 9-12
Science as Inquiry
- Understandings about scientific inquiry
- Abilities necessary to do scientific inquiry

Science and Technology
- Understandings about Science and Technology

History and Nature of Science
- Science as a Human Endeavor
- Nature of Science

Science in Personal and Social Perspectives
- Science, Technology and Society
- Risk and Benefits

Mathematics Standards
Grades 6-8, 9-12
Problem Solving

Data Analysis and Probability

Technology Standards

Technology Research Tools

Technology problem-solving and decision-making tools

Student Mission

Student groups will use the information gathered from their research (collected in the second activity on their chosen strategy method) to prepare a presentation and defense that takes into account the risk, benefits, and quality of data (meeting science objectives). The case to be built by each group will include a specific plan with the following three components: 1) observing strategy, 2) specific details for implementing that method, and 3) advantages and disadvantages of that method.

Clarifying the Issues
- Teacher Guide

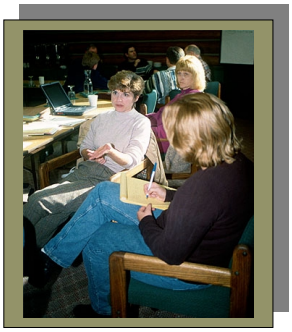
Defend This!
- Student Presentation Guide

What Goes Around Comes Around
- Student Text

Interview Summary Sheets
- Brian Muirhead
- John Marriott
- Karen Meech

Clarify

In "Clarifying the Issues," students read interview summaries from Dr. Karen J. Meech, University of Hawaii, who specializes in Earth-based observations, Brian Muirhead, project manager at the Jet Propulsion Laboratory, and John Marriott, engineer at Ball Aerospace & Technologies Corp. These individuals represent very different work institutions and thus, varying priorities, but must all work together to reach an agreement in order for the mission to be successful. Students build and present a case for a particular observation scenario that is to be used to inform and convince others. In the Student Text "What Goes Around Comes Around," students read about the reciprocal nature of science and technology using the development of the telescope as an example.



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Refining the Issues
- Teacher Guide
- Public Forum Role Sheet

Communicating, Questioning, and Listening
- Student Text

Critiquing Ideas
- Assessment Guide

Refine

Students assume roles of various stakeholders of the mission including scientists, engineers, and the interested public including such as environmentalists, politicians, teachers, students, and others. General guidelines are provided for students to follow for each role, though they are encouraged to build the character of the person they are role-playing. Prior to the debate, students will view or listen to video or audio clips of some of the stakeholders in order to bring additional information into the mix. Students use the information from the presentations in order to prepare for a debate about the data collection methods at a public forum.

The Decision
- Teacher Guide
- Peer Review Checklist

Appendices
- Appendix A: Full Michael A'Hearn Interview Sheet
- Appendix B: Full Brian Muirhead Interview Sheet
- Appendix C: Full Karen Meech Interview Sheet
- Appendix D: Full John Marriott Interview Sheet
- Appendix E: Glossary
- Appendix F: Decision Making Process
- Appendix G: Rule-based Strategy

Decide

In the assessment activity, "The Decision," students prepare written statements for the data collection method with which they personally agree. On the same page, students will support a position statement that advocates other viewpoints. As a large group discussion, the class comes to an agreement on which combination of data collection 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, and one upon which all students can agree.

Curriculum Connections

National Standards Addressed

Assessment Standard B
- Achievement and Opportunity to Learn Science must be Assessed

Assessment Standard C
- Assessment Tasks Are Authentic

This science module, *Collaborative Decision Making: NASA's Deep Impact Mission*, was developed by educators at:

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