

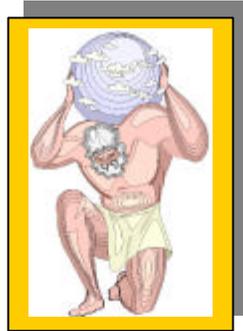
Exploring Origins

To Catch A Star

TEACHER GUIDE

BACKGROUND INFORMATION

In the same way that scientific theories build upon prior theories, NASA missions attempt to stand “on the shoulders of giants.” The Genesis mission is no exception. Numerous past NASA missions, and the technological advances made as a result of those undertakings, inform the scientists and engineers who lead the Genesis effort. In this activity, students will explore the technical areas of the Genesis mission in detail. They will extend their understanding of “heritage” from the *Origins of the Solar System* by investigating the current technology being used and comparing it to previous NASA missions that have used the same or similar technology in the past.



STANDARDS ADDRESSED

Grades K-4

Science-

[Science and Technology](#)

[History and Nature of Science](#)

Grades 5-8

Science-

[Science and Technology](#)

[Science in Personal and Social Perspectives](#)

[History and Nature of Science](#)

Grades 9-12

Science-

[Science and Technology](#)

[History and Nature of Science](#)

MATERIALS NEEDED

- 2 large sheets of newsprint/poster paper for class tables
- Technical Information Criteria Sheet

PROCEDURE

1. Use the information available on the Genesis Web site to introduce the Genesis project. As a class, visit the sections of the Genesis Web site titled [The Science](#) and [The Mission](#). Discuss with your class the important aspects of the mission that they learned from the Web site. Summarize this information on a class chart that can be hung in the room for future reference.
2. Divide the class into five groups. Each group will be the Expert Group for one of these technical areas: a) Deployment/Propulsion Systems, b) Re-Entry Technology, c) Contamination Control, d) Analytic Techniques, and e)

From Another Angle

Stay in context with the module while utilizing sound research techniques and multiple learning strategies in conjunction with the approach taken in step #2.

For information on guiding students in the important and often overlooked skill of conducting Internet research, science educators should refer to [Facilitating Student Research on the Internet](#) in the [Food for Thought](#) section of the Genesis Web site.

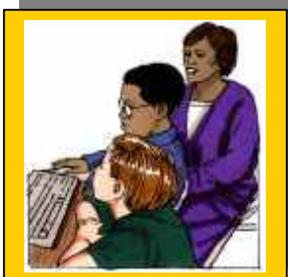
Use multiple intelligences:

Ask students to construct a pictorial collage depicting the mission events and progress in a technical area of their choice.

Sample Collection Systems.

Figure 1

3. Display the **Technical Criteria Guide** (see Figure 1) to assist each group in becoming the experts on their assigned aspect of the Genesis technology. Ask the students to conduct research to find the information requested on the guide.
4. Ask each group to prepare a one-page Fact Sheet on their technical area. Each member of the group needs to have a Fact Sheet copy. Group members will be sharing this information with the other members of the class. The students will also be filling in their information on a whole-class table.
5. Students may begin their research for each of the technical areas by consulting the Web sites, books, or other materials found in the [Student and Teacher Resources](#). Historical background information that led to and formed the development and planning for the Genesis mission can be found at numerous Web sites, many of which are sponsored by NASA. The accompanying figure provides just a brief beginner's list of potential research resources on the Internet. Each of the listed sites contains links to other sites of value that exist on the Web. Printed books, articles, etc. also provide valuable information, and are available at the library (see *Student and Teacher Resources* for additional items of interest). Note that student development of research skills is an important goal of this activity, and students should not simply be supplied with numerous sites from which they can obtain information. See [Facilitating Student Research on the Internet](#) for information on structuring and monitoring student research projects that utilize Internet resources.



Technical Criteria Guide

In your Expert Groups, you must find the following information in order to become experts in your technical area. After you find this information, summarize it on a one-page Fact Sheet to share with the members of the other Expert Groups.

1. *General Description of Your Technical Area*

Include the purpose of your technical area, how your area has been used in society in general and in the space program specifically, and some specific information about the historical development of your area.

For example, if your technical area were telecommunications, you would explain that the purpose of telecommunications is to enable information to be sent from one location to another. You would discuss the personal, business, and industrial uses for telecommunications. You would also explain the ways that telecommunications has been used in the space program to communicate with satellites, space shuttles, and other spacecraft. Historically, you might mention the development of the telegraph, telephone, fiber optics, and microwave communication technologies.
2. *How is your area addressed in the Genesis mission?*

Present a detailed description of the information relating to your technical area within the Genesis mission.
3. *How has your area been addressed in previous NASA activities?*

You must give at least one example of a mission or activity where the technology is the same as is being used by Genesis and at least one example of a mission or activity where the technology is different than is being used by Genesis. Explain the differences in the technologies that you describe.

6. As the information collection begins to grow, and students begin to encounter specific discrepancies or areas where additional or unavailable material is needed, they should be encouraged to submit questions through the [Contact Us](#) link on the Genesis Web site.

Teachers should monitor the questions to assure relevance and clarity, and should also refrain from making this a required or blanket assignment for each student. The questions will be compiled into a "question clearinghouse," from which certain questions will be selected and answered by mission scientists at partner institutions (the Jet Propulsion Laboratory, Lockheed Martin Aeronautics, the Los Alamos National Laboratory, the California Institute of Technology, and the Johnson Space Center). If they wish, teachers may submit the questions their students propose.

A notification will be sent via e-mail when a question is received. Not all questions will be answered. The questions selected and respective answers will be posted in the future on the FAQ section of the Genesis Web site.



7. Construct a whole-class table on a large sheet of newsprint that the students will complete as they investigate their technical area. An example of a possible chart is included in this teacher's guide (see *Figure 2 below*).

Figure 2

Technical Area

NASA Mission/ Activity	Deployment/Propulsi on Systems	Re-Entry Technology	Contamination Control	Analytic Techniques	Sample Collection Systems
Apollo 11, 12, 14, 15 16			Curation of samples		Aluminum arrays in Solar Windfoil Experiments
Deep Space 1	Delta 7326 rocket				
Giotto					Electrostatic concentrator
Lunar Prospector	Hydrazine monopropellant thrusters				
Magellan	Hydrazine monopropellant thrusters				
Mariner 2, 6, 7	Hydrazine monopropellant thrusters				
Mars Pathfinder		SRC separation			
Meteorite program			Curation of samples	Mass spectrometry Neutron Activation Analysis	
Pioneer 10, 11	Hydrazine monopropellant thrusters				
Stardust	Hydrazine monopropellant thrusters	SRC separation			
Genesis	Delta 7326 rocket Hydrazine monopropellant thrusters	Heat shield SRC separation Helicopter retrieval	Cleanroom cleaning of payload, tools Curation of samples	Mass spectrometry Neutron Activation Analysis	Ultrapure Si, Al, Ge, Au/Pt Electrostatic Concentrator

Form new groups each consisting of five (or more) students, at least one student from each Expert Group, using a jigsaw technique,. Allow the students to share their information with each other in their new groups, using their one-page Fact Sheet (see *step #4*) to assist them. These new groups will be the project groups for the culminating activity.

Teachers should note that the jigsaw technique is a cooperative learning strategy where students are placed in two different working groups for different learning tasks. The members in the first set of groups become familiar with or “experts” on a topic. Each of the second set of groups is comprised of one member from each of the original groups, who is then responsible for sharing topical expertise with the other members of the new group. When dividing students into groups, it is important that each of the second groups have at least one member from each original expert group.

STUDENT AND TEACHER RESOURCES

<http://spaceart.com/solar/eng/history.htm>
History of Space Exploration.

<http://www.hq.nasa.gov/alsj/frame.html>

Apollo Lunar Surface Journal. From this page one can also search the NASA Headquarters History Web, but informational documents retrieved will primarily be connected to the Apollo missions.

<http://www.ksu.nasa.gov/history/history.html>

Kennedy Space Center.

<http://seds.lpl.arizona.edu/nineplanets/nineplanets/history.html>

Chronology of the Solar System.

<http://seds.lpl.arizona.edu/nineplanets/nineplanets/origin.html>

The Origin of the Solar System.

<http://spacelink.nasa.gov/Instructional.Materials/Curriculum.Support/Space.Science/Planetary.Probes/>

NASA Spacelink. This site has some great history on some of the past NASA missions concentrating on Earth's origins.

<http://www.hq.nasa.gov/office/pao/History/history.html>

NASA Office of Policy and Plans. From this page, you can click "Publications" to get great printed materials, or go straight to: <http://www.hq.nasa.gov/office/pao/History/publicat.htm>

You can click "Search" on this page, or go straight to NASA "Search the NASA Headquarters History Web" at:

<http://www.hq.nasa.gov/office/pao/History/search.html>

<http://www.gps.caltech.edu/genesis>

Genesis Web site at the California Institute of Technology.

<http://www.gps.caltech.edu/genesis>

<http://www.gps.caltech.edu/genesis/genesis3.html>

http://cass.jsc.nasa.gov/library/LISTS/mmm_file.html

Links to the partners participating in the Genesis mission.

Baird, A., (1994). *The U. S. Space Camp book of rockets*. NY: Morrow Junior Books.

Butterfield, M., (1994). *Look inside cross-sections: Space*. London: Dorling Kindersley.

Graham, I., (1998). *The best book of spaceships*. NY: Kingfisher.

Hawkes, N., (1995). *The fantastic cutaway book of spacecraft*. Brookfield, CT: Cooper Beech Books.

Moche, D. L., (1995). *Astronomy today*. NY: Random House.

Stott, C., (1997). *Space exploration*. Eyewitness Books. New York: Alfred A. Knopf.