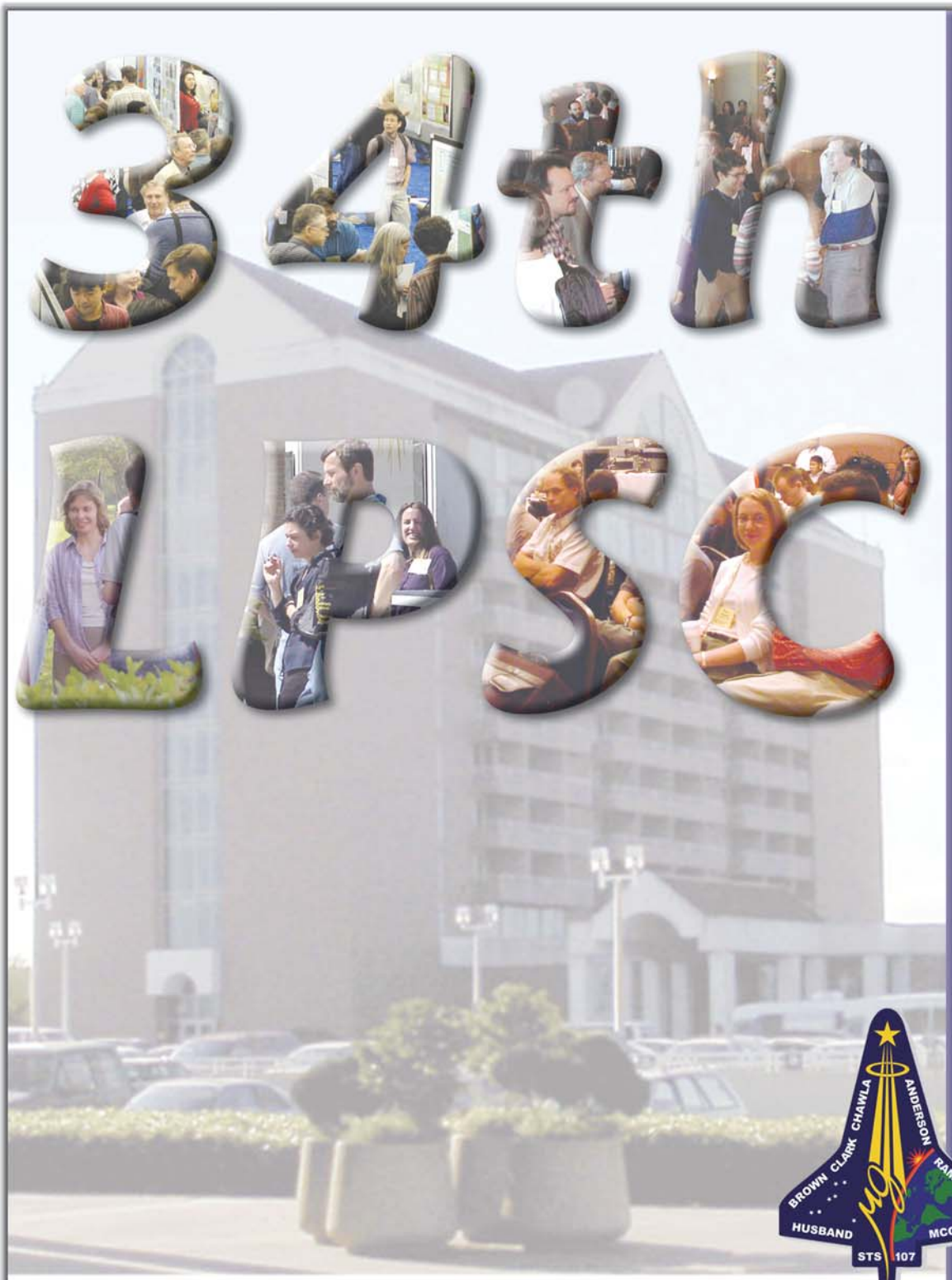

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We will always remember.

Lunar and Planetary Information
BULLETIN
Lunar and Planetary Institute — Universities Space Research Association

Summer 2003
Issue 94

34th LPSC in Review

Setting New Attendance Records in 2003

The 34th Lunar and Planetary Science Conference (LPSC) marked yet another record-breaking year, with 1179 participants from 25 countries attending the conference held at the South Shore Harbour Resort and Conference Center in League City, Texas, on March 17–21, 2003. This year's attendance statistics (see inset) reflect NASA's commitment to education, as well as a positive outlook for the future health of planetary science, as more than 25% of participants were graduate or undergraduate students.

34th LPSC at a Glance

Total number of attendees: 1179

Graduate student attendees: 241
Undergraduate student attendees: 70

Abstracts received: 1132
Abstracts accepted: 1105

Oral presentations: 448
Poster presentations: 516

LPSC has long been recognized among the international science community as the most important planetary conference in the world, and this year's meeting was no exception. Hundreds of planetary scientists attended both oral and poster sessions focusing on such diverse topics as meteorites; the Moon, Mars, Mercury, and Venus; impacts; outer planets and satellites; comets, asteroids, and other small bodies; interplanetary dust particles; origins of planetary systems; planetary formation and early evolution; astrobiology; and education and public outreach. Sunday night's registration and reception were held at the Center for Advanced Space Studies, which houses the Lunar and Planetary Institute. Sunday night's events also featured an open house for the display of education and public outreach activities and programs.

Attendance from Non-U.S. Countries:

Australia: 5	Japan: 62
Austria: 3	Kuwait: 1
Canada: 13	Mexico: 1
Croatia: 1	Netherlands: 6
Czech Republic: 1	Norway: 1
Denmark: 1	Russia: 13
Finland: 1	South Africa: 3
France: 28	Spain: 5
Germany: 39	Switzerland: 6
Hong Kong: 1	Taiwan: 1
Hungary: 3	United Kingdom: 32
Italy: 11	Vatican City State: 1

Total non-U.S. attendees: 239

Highlights of the conference program, established by the program committee under the guidance of co-chairs Dr. Stephen Mackwell (Lunar and Planetary Institute) and Dr. Eileen Stansbery (NASA Johnson Space Center), included special sessions on the first year of science results from the Mars Odyssey mission and analyses of core samples taken from the Chicxulub Scientific Drilling Project. During the Monday afternoon plenary session, the Masursky Lecture was presented by Dr. Peter Goldreich, Lee A. DuBridge Professor Emeritus of Astrophysics and Planetary Physics at the California Institute of Technology. In his talk, entitled "Kuiper Belt Binaries: A New Window on Runaway Accretion," Goldreich argued that the recently discovered binary Kuiper Belt Objects (KBOs) were formed quite early in solar system history when the Kuiper Belt was much more populous. According to Goldreich's model, a weakly bound KBO binary is first formed collisionlessly, with its orbit subsequently stabilized via gravitational interactions with other nearby KBOs.

Other conference highlights included the continuing debate about the source of layered deposits on the martian surface; discussions focusing on the mystery of the scarcity of lunar meteorites; controversy surrounding the composition of the Moon's core; results from the recent flyby of Comet 19P/Borrelly by Deep Space 1; and the ongoing arguments about the presence of fossilized microbial life in martian meteorite ALHA 84001.

Plans are already underway for the 35th LPSC, which will again be held at South Shore Harbour Resort and Conference Center. The dates for next year's conference will be **March 15–19, 2004**, with the first announcement scheduled for release later this summer. *Mark your calendars!*

Special thanks to Dr. Don Burt (Arizona State University) for providing some of the photos of the conference.

The *Lunar and Planetary Information Bulletin* is published by the Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058.

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Production Editor: Renée Dotson
Graphic Design: Leanne Woolley

The *Bulletin* welcomes articles dealing with issues related to planetary science and exploration. The copy deadline for the next issue is **July 1, 2003**. Articles or announcements should be submitted via e-mail to lpibed@lpi.usra.edu.

To be added to the mailing list to receive the Bulletin, please send your mailing address (along with phone, fax, and e-mail if available), to LPIB Editor, 3600 Bay Area Boulevard, Houston TX 77058-1113, USA, or send an e-mail message to *lpibed@lpi.usra.edu*.

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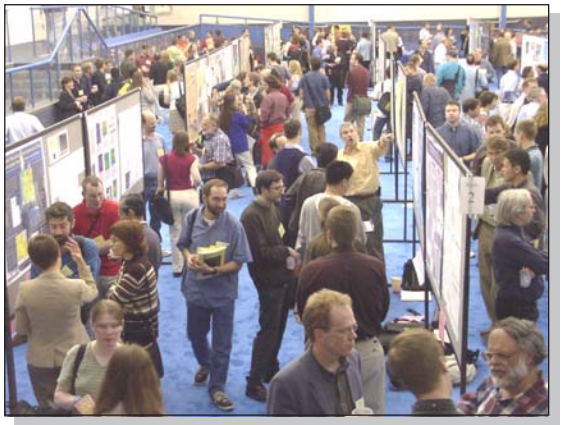
LPSC begins!! Participants arrive for the Sunday night open house and registration at the LPI.

Participants frequent the computer and e-mail workstations in the Amphitheater.

The Publisher's Exhibit displays many new fun and educational books, videos, posters, models, and other interesting items.



Participants peruse the science at this year's much-improved poster sessions.

CHILI, ANYONE???

Best Overall Chili Winners—LPI's Computer Center, AGAIN!

Chili teams prepare for the rush. Organize your team and join next year's competition!!

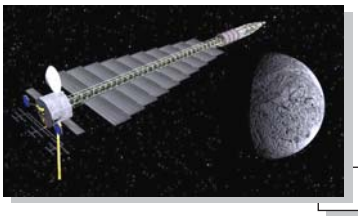
Participants enjoy a Texas tradition, a barbecue dinner.

News from Space

Mission Updates

Listed here is the current status of many current and upcoming space science missions. For more information about any of the missions listed, visit the mission Web sites at the addresses below. For links to other ongoing planetary missions, go to *http://www.lpi.usra.edu/library/website.html*.

Pioneer 10 — Almost 31 years after launch and 29 years after its last pit stop (the first encounter with Jupiter ever made by a spacecraft), Pioneer 10 has fallen silent. Now more than 7.6 billion miles from the Earth, its final radio message was received on January 23. The first spacecraft to leave the solar system, Pioneer has since been passed by Voyager 1 as the most distant man-made object. Au revoir, Pioneer! *http://spaceprojects.arc.nasa.gov/Space_Projects/pioneer/PNhome.html*



Jupiter Icy Moons Orbiter (JIMO) — Galileo's discoveries have led to a new NASA initiative to explore Jupiter's miniature solar system. A nuclear-powered spacecraft called the Jupiter Icy Moons Orbiter is currently under development for possible flight later this decade. Scientists will meet in June at the Lunar and Planetary Institute to discuss science objectives for such a mission. *http://www.jpl.nasa.gov/jimo/*

Artist rendition of the JIMO spacecraft approaching one of Jupiter's moons.

Cassini — Meanwhile, another sophisticated orbiter and probe are on approach to the next giant planet, Saturn. Due to arrive in July 2004, Cassini should start transmitting images exceeding the quality of those from Hubble Space Telescope in April 2004. We should begin seeing details of the icy surface of Titan (see related story on next page) for the first time in May or June 2004. *http://saturn.jpl.nasa.gov/index.cfm*

Artist rendition of the Cassini spacecraft approaching its target, Saturn.

New Horizons — NASA and the U.S. Congress have officially approved the first dedicated mission to Pluto and the Kuiper Belt. This belt (of which Pluto might be considered its largest member) is similar to the asteroid belt except it is comprised of large icy bodies and it orbits the Sun beyond Neptune. Carrying an array of advanced remote sensing instruments, this spacecraft should arrive at Pluto in 2015. *http://pluto.jhuapl.edu/*

Mars Odyssey — The newest Mars orbiter continues to return gamma-ray maps of the elemental composition and thermal and infrared images of Mars on a daily basis. Some of these can be seen on the Image Gallery on the Odyssey Web site. *http://mars.jpl.nasa.gov/odyssey/*

Mars Express — The first European mission to Mars, including the lander Beagle 2, is slated for launch in early June from Baikonur, Kazakhstan. It should enter Mars orbit around the end of December. *http://www.sci.esa.int/marsexpress/*

Mars Exploration Rovers — Two rovers will be launched to Mars this summer. The two landing sites include Gusev Crater, a possible ancient lake bed, and Meridiani Planum, an area partly composed of hematite. Both sites may have once been water-logged. Landings are expected in January 2004. *http://mars.jpl.nasa.gov/mer/*

Artist rendition of the Mars Exploration Rover collecting samples.

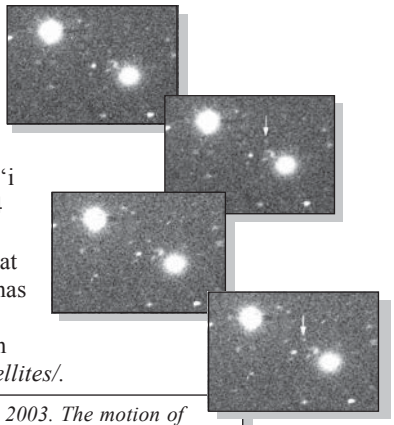
Smart-1 — The first European mission to the Moon will also launch this summer in early August. After a year or so of cruise, it will enter lunar orbit to begin making measurements of the mineralogical and elemental composition of the Moon. *http://www.sci.esa.int/home/smart-1/index.cfm*

Rosetta — Originally planned for launch in February, this revolutionary comet explorer has been rescheduled for launch next year due to concerns over the Ariane V launch vehicle. With a miniature lander onboard, this mission may now go Comet Churyumov-Gerasimenko. The additional costs incurred because of the delay have put the mission at risk, however. *http://www.sci.esa.int/home/rosetta/index.cfm*

Deep Impact — The launch of the first attempt to artificially impact a comet and examine its interior has been delayed due to technical and management issues. Although planned for launch in December 2004, the new trajectory would put the spacecraft at Comet Tempel 1 as originally scheduled in July 2005. *http://deepimpact.jpl.nasa.gov/*

Muses-C — The Muses-C spacecraft, renamed "Hayabusa" (falcon), was successfully launched May 9 from Kogashima, Japan, on a mission to bring back samples from the near-Earth asteroid 1998SF36. Using a relatively new ion-engine propulsion system, the spacecraft will arrive in 2005 and is expected to return its samples to Earth in 2007. *http://www.isas.ac.jp*

NEW SATELLITES OF JUPITER DISCOVERED IN 2003



In April, University of Hawai'i astronomers announced the discovery of 20 new satellites of Jupiter, bringing the current total of known Jupiter satellites to 60. The majority of the new satellites were first seen in early February 2003 by Scott S. Sheppard and David C. Jewitt from the Institute for Astronomy, University of Hawai'i, along with Jan Kleyna of Cambridge University. The satellites were detected using the world's two largest digital cameras at the Subaru (8.3-meter-diameter) and Canada-France-Hawai'i (3.6-meter-diameter) telescopes atop Mauna Kea in Hawai'i. The new moons are small, ranging from 1 to 4 kilometers in size, and orbit Jupiter at great distances from the planet. While the exact origins of these satellites have yet to be determined, many are thought to be captured asteroids or pieces of larger objects that broke apart. Most of them have an orbit opposite the planet's rotation. No other planet in our solar system has more known natural satellites (the next closest, Saturn, has only 30 known satellites). Jupiter also has four large satellites, referred to as the Galilean satellites after the astronomer who first discovered them. To learn more about the jovian satellites, visit the Jupiter Satellite Page at *http://www.ifa.hawaii.edu/~sheppard/satellites/*.

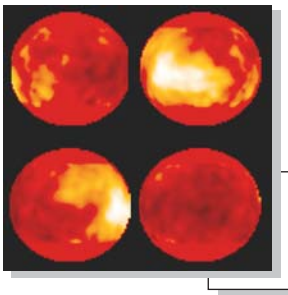
These figures show images of the new Jupiter satellite S/2003 J1 taken about 8 minutes apart on March 4, 2003. The motion of the satellite clearly stands out compared to the steady state background of stars and galaxies. The stars and galaxies appear slightly elongated because the telescope's motion was tracked near the rate of the satellite's motion. Jupiter is not in the field, but is a few degrees to the west of these images. Images courtesy of Scott Sheppard/University of Hawai'i.

TITAN REVEALS A SURFACE DOMINATED BY ICY BEDROCK

Scientists who have peered through the smoggy orange haze of Saturn's largest moon, Titan, have discovered that the surface is not entirely covered by liquid and solid organic materials that rain out of the atmosphere. Extensive areas of icy bedrock lie exposed on Titan's surface. "Titan's surface reflectivity looks a lot like that of Jupiter's moon, Ganymede. This is somewhat surprising because Titan is believed to have a lot of organic gook on its surface," said Caitlin Griffith of the Lunar and Planetary Laboratory in Tucson.

Titan's atmosphere, ten times as dense as Earth's, is primarily nitrogen laced with such poisonous substances as methane and ethane. Titan is thickly veiled by a dense hydrocarbon haze that forms in the high stratosphere as atmospheric methane is destroyed by sunlight. The haze is much thicker than Earth's worst city smog. It was impenetrable to cameras onboard the Pioneer and Voyager spacecraft that flew by the Saturn system in the late 1970s and early 1980s. The Sun's ultraviolet light destroys Titan's methane, forming organic molecules that may be raining down onto the frozen icy surface, forming lakes or oceans. "Assuming that Titan's atmosphere has existed over the moon's 4.6 billion year lifetime, 800 meters of sediments would lie on the surface," Griffith said. "So one might ask whether the surface is covered with the liquid and the solid sediments, such that we can't see the ice and rock that exist beneath."

By looking in narrow infrared windows through the atmosphere, Griffith and her colleagues (Tobias Owen of Hawai'i's Institute for Astronomy, Thomas R. Geballe of the Gemini Observatory, John Rayner of Hawai'i's Institute for Astronomy, and Pascal Rannou of the Pierre and Marie Curie University in Paris) have identified exposed water ice on the surface. Large dark and bright patches were first observed on Titan by Peter Smith (University of Arizona) and colleagues using the Hubble Space Telescope in 1994. "It's not clear what the darker material is, but one possibility is that it is these organic liquids and sediments. The images, taken together with our results, suggest that organic stuff is moved around on the surface in such a way as to expose bedrock ice." We should start getting a clearer picture of these terrains as Cassini approaches Saturn in the spring of 2004.

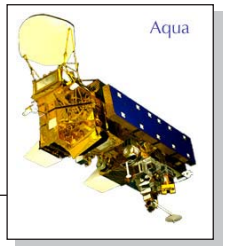


These images, taken in 1994 by the Hubble Space Telescope, show the surface of Saturn's giant, haze-shrouded moon, Titan. Light and dark features over the surface of the satellite were mapped during nearly a complete 16-day rotation. The prominent bright area shown is a surface feature 2500 miles across, about the size of the continent of Australia. Photo courtesy of Space Telescope Science Institute.

NEW NASA DATA HELP TAKE "WHETHER" OUT OF WEATHER PREDICTION

Your weatherperson's job just got a little easier, thanks to new data available from advanced weather instruments onboard NASA's Aqua satellite. The new data are the most accurate, highest-resolution measurements ever taken from space of the infrared brightness (radiance) of Earth's atmosphere. This information can be used to make more accurate predictions of weather and climate. The data come from two microwave sounding instruments that are part of the Atmospheric Infrared Sounder (AIRS) experiment: the Atmospheric Infrared Sounder and the Advanced Microwave Sounding Unit. With its visible, infrared, and microwave detectors, the AIRS experiment provides a three-dimensional look at Earth's weather. Working in tandem, its instruments can make simultaneous observations from space all the way to Earth's surface, even in the presence of heavy clouds. With more than 2400 channels sensing different regions of the atmosphere, the system creates a global, three-dimensional map of atmospheric temperature and humidity. AIRS provides information about clouds, greenhouse gases, and many other atmospheric phenomena.

Using six onboard instruments, Aqua's planned six-year mission will collect data on global temperature variations, cycling of water, global precipitation, and evaporation, changes in ocean circulation, and ways in which clouds and surface-water processes affect climate. The information will help scientists better understand how global ecosystems change, and how they respond to and affect global environmental change. Visit the Aqua Web site at *http://www.aqua.nasa.gov.*



The Aqua satellite carries six state-of-the-art instruments in a near-polar low-Earth orbit. Each of the instruments has unique characteristics and capabilities, and all six serve together to form a powerful package for Earth observations.

Spotlight on Education

Recognizing the importance of heightening public interest in space science, the Education and Public Outreach (E/PO) department of the Lunar and Planetary Institute (LPI) supports NASA's Office of Space Science (OSS) in its central mission to inspire the next generation of space scientists. The OSS "support network" is a nationwide infrastructure composed of Broker/Facilitators and Educational Forums. As a Broker/Facilitator and a part of this support network, LPI's purpose is to aid space science investigators in identifying and developing high-quality E/PO opportunities. We aim to help create a better scientific and technical workforce through strong partnerships between science and educational communities, as well as arrange appropriate alliances between those communities.

The OSS E/PO Program

The NASA OSS E/PO program is now one of the largest programs in astronomy and space science education ever undertaken. E/PO activities focus on K–14 education and the public understanding of science, and are embedded in every OSS flight mission and research program. The OSS E/PO Support Network coordinates and integrates these efforts, and provides a point of entry for individuals and organizations wishing to participate in the OSS E/PO program.

The OSS E/PO Support Network

Education Forums:

- Focus on a specific OSS science theme
- Coordinate the E/PO efforts of individual OSS space science missions within their theme area
- Help make mission discoveries, results, and associated E/PO efforts accessible and readily available to the education community

Brokers/Facilitators:

- Focus on a specific geographical region
- Create and nurture partnerships between space scientists and educators to carry out high-leverage E/PO activities
- Facilitate the development and dissemination of space science E/PO products and materials

Areas covered by the brokers and a more detailed description of the support network may be found at *http://spacescience.nasa.gov/education/resources/ecosystem*.

Forums

Astronomical Search for Origins and Planetary Systems (ASO)
Space Telescope Science Institute
Phone: 410-338-4733
http://origins.stsci.edu/

Structure and Evolution of the Universe (SEU)
Smithsonian Astrophysical Observatory
Phone: 617-496-7689
http://cfa-www.harvard.edu/seuforum/

Solar System Exploration (SSE)
Jet Propulsion Laboratory
Phone: 818-354-4450/818-393-7734
Leslie.L.Lowes@jpl.nasa.gov
http://sseforum.jpl.nasa.gov/

Sun-Earth Connection (SEC) (East Coast)
NASA Goddard Space Flight Center
Phone: 301-286-8112
http://sunearth.gsfc.nasa.gov/

Sun-Earth Connection (SEC) (West Coast)
University of California, Berkeley
Phone: 510-643-5662
http://sunearth.gsfc.nasa.gov/

Broker/Facilitators

New England Space Science Initiative in Education (NESSIE)
Point of Contact: Cary Sneider
Phone: 617-589-0227
E-mail: nessie@mos.org

Center for Educational Technologies (CET)
Point of Contact: Nitin Naik
Phone: 304-243-2388
E-mail: nitin@cet.edu
http://www.cet.edu/ossbroker

SouthEast Regional ClearingHouse (SERCH)
Point of Contact: Cassandra Runyon
Phone: 843-953-8279
E-mail: cass@cofc.edu
http://serch.cofc.edu/serch/

DePaul University (DU)
Point of Contact: Lynn Narasimhan
Phone: 773-325-1854
E-mail: cnarasim@condor.depaul.edu
http://analyzer.depaul.edu/NASABroker/

Lunar and Planetary Institute (LPI)
Point of Contact: Robert Herrick
Phone: 281-486-2116
E-mail: herrick@lpi.usra.edu
http://www.lpi.usra.edu/education/broker.shtml

Space Science Network Northwest (S2N2)
Point of Contact: Julie Lutz
Phone: 206-543-0214
E-mail: nasaerc@u.washington.edu
http://www.waspacegrant.org/s2n2/html/main.html

Space Science Institute (SSI)
Point of Contact: Cheri Morrow
Phone: 303-492-7321
E-mail: camorrow@colorado.edu
http://www.spacescience.org/Products/Brokering/

Spotlight on Education (continued)

Tips for Scientists

ROSS NRA Outreach Proposals (Research Opportunities in Space Science)

Within 60 days of an award being issued in response to the ROSS NRA or within 75 days of subsequent anniversary dates, space scientists are allowed to submit a supplemental proposal for up to $15K to conduct E/PO activities related to the grant. Multiple PIs may collaborate to submit an institutional proposal for up to $50K. Details for submission and an in-depth description of evaluation criteria can be found at *http://spacescience.nasa.gov/education/scientists/guidelines/index.html*. All proposers are encouraged to contact their regional Broker/Facilitator for assistance in proposal preparation.

Here we summarize some common traits of successful proposals as presented by NASA HQ personnel in various venues. Successful proposals inevitably have a strong partner within the education community, and that partner has a meaningful, well-defined role. The PI also must have a meaningful, well-defined role (i.e., all the work cannot be sloughed off on graduate students). Although the size of these awards typically makes it unfeasible to hire a professional evaluator, significant thought must be given to how it will be determined if the proposed activities have been successful in meaningfully reaching and affecting the target audience. Proposal guidelines call for meeting one of three specific criteria: aligning with educational standards, reaching underserved communities, or potential for high leveraging. It is necessary to address only one of these criteria, and proposals that address all three in a mediocre fashion fare more poorly in the evaluation process than those that address one criterion well. As a hopefully useful counterexample, a proposal most likely to fare poorly would be one that revolves around creating a Web site with no plans to publicize the site, no coordination with other space science Web entities, no education partner assisting in creation, and no means for determining who uses the site or how they use it.

NASA Outreach

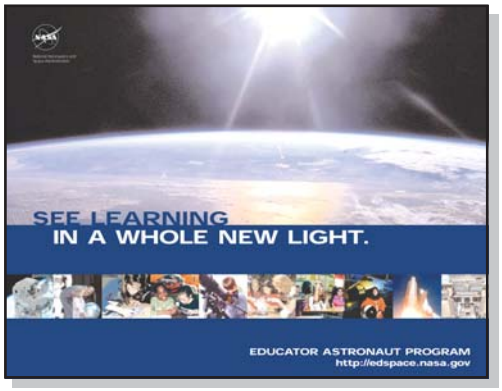
SERCH Grant Program — Good Money for Great Outreach

South Carolina-based Broker/Facilitator SERCH (Southeast Regional Clearinghouse) is part of NASA's Office of Space Science (OSS) education and public outreach (E/PO). Every year SERCH dedicates money from its budget to support worthwhile E/PO initiatives. They are particularly interested in proposals for E/PO efforts that establish lasting partnerships between space science and education communities that support the education mission of OSS. As we speak, SERCH is accepting funding opportunities for its 2003 mini-grants. The mini-grants are awarded for a period of one year in amounts ranging from $5,000 to $10,000. SERCH encourages those interested to submit a proposal for funding by completing the online letter of intent found at *http://serch.cofc.edu/serch/funding/2003opportunity.htm*. Award notifications are sent out in July and the anticipated start date for a funded project is August 1. The OSS-funded SERCH program not only promotes space science awareness, but also aims to enhance interest in math and technology through the use of NASA's OSS mission data and educational products.

Educator Astronaut Program and Earth Crew — Dreams Can Come True

Some teachers dream of being a part of space exploration, but few ever get the chance to fulfill those dreams. NASA's Office of Education is in the process of turning those dreams into reality for a select few. The Educator Astronaut Program aims to take fully qualified members of NASA's Astronaut Corp who have expertise in K–12 education and connect their knowledge of space exploration with the classroom. Along with performing their everyday shuttle and ISS operations, these unique individuals have developed the skills necessary to communicate concepts associated with science, technology, engineering, and math in an educational setting. In other words, they have truly learned how to teach.

When not in Astronaut Candidate or mission training, Educator Astronauts will be on technical assignment within the Astronaut Office and working with NASA's education programs to convey their experiences to educators and students across the country. To help translate these experiences to educators and students, NASA will employ technologies and media such as telepresence, the Internet, online postings (Webcasts and chatrooms), video, and in-person engagements. NASA's Office of Education will be the focal point for the organization and distribution of these "connections." The Educator Astronaut will be a U.S. citizen; certified to teach students in grades K–12; have had three years of classroom teaching experience within the past four years; and have a bachelor's degree in math, science, or education (with a concentration in a related field). They must also be able to pass a NASA Class II Space Flight physical. A total of three to six lucky and talented candidates will be selected later this year to enter the Astronaut Candidate Program. Just think . . . *Dreams really can come true!*



For those of us not lucky enough to become an Educator Astronaut, the **"Earth Crew"** program is still a great way to get involved in the space program. It takes a NASA team of dedicated people to safely send an astronaut to space and back again. If you do not work for NASA, yet desire to play a role in the exploration of space, then the Earth Crew might be just right for you. An Earth Crew is made up of students, teachers, and other adults dedicated to supporting the Educator Astronauts as they prepare for and explore space. In addition, Earth Crew members will participate in groundbased projects and missions. NASA is currently recruiting students, educators, and families to join the Earth Crew team. An Earth Crew must have at least one sponsor (teacher, parent, or club leader who is at least 13 years old). The sponsor must be able to send and receive e-mail (students will receive e-mail updates about new projects and activities and will have the opportunity to provide suggestions to NASA about the planning of upcoming missions). Those interested can fill out the Earth Crew survey found at *http://edspace.nasa.gov*. Earth Crew is another way that NASA aims to make dreams come true.

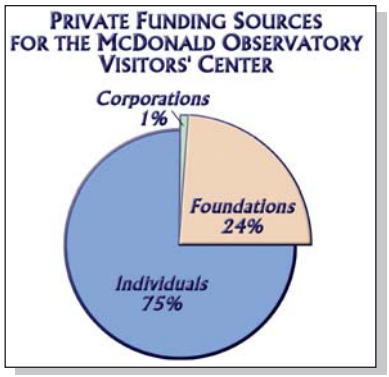
SCIENTIST-TEACHER COOPERATION AWARDS — A LITTLE MONEY GOES A LONG WAY

Last year a handful of awards were granted to teachers and scientists across the country. These awards were used for necessary supplies and materials for small educational projects that involve scientist-teacher cooperation. One example of this cooperation is a proposal submitted last August for Dr. Mary Urquhart to team up with Ames Childcare Center Director Camala O'Reilly. Their objective was to utilize award monies for materials ranging from foam runways and marbles (a gravity and motion activity) to supplies for creating a model volcano in Ames' own preschool playground. Another example of money well spent is a proposal submitted last April for the purchase of a Dobsonian telescope and spectrometers. Dr. Allan Treiman of the LPI volunteered his time to team up with astronomy teacher Karen Stocco of the Pasadena Independent School District to help students learn how to use both devices in her high school astronomy classroom.

The LPI Broker/Facilitator team is pleased to announce the continuation of the availability of these gifts for scientist-teacher cooperation. In an effort to increase scientist participation in educational outreach, we are offering up to $300 for materials and supplies for projects involving scientist-teacher partnerships. Proposals will consist of a one- to two-page letter signed by both scientist and teacher. The awards are intended to be available to all scientists performing research supported by NASA's Office of Space Science (OSS), including OSS-funded Principal Investigators and their Co-Investigators, technical support staff, and graduate students. Proposals will be considered year-round, but monies will be awarded on a first-come, first-served basis until available monies are exhausted. Within a few weeks of submission, a Co-Investigator of the Broker/Facilitator team will review each of the proposals. Only one award is allowable each fiscal year to each scientist and teacher. In the event that available monies run out before the end of the fiscal year, all subsequent submissions will be given the option of being considered for an award for the next fiscal year without resubmission. Upon completion of the project, the scientist-teacher team will be required to write a short summary that includes an evaluation of the project's impact and its potential for use by others. For questions or other information about the program, please e-mail an inquiry to outreach@lpi.usra.edu.

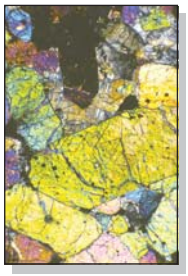
KEYS TO THE KINGDOM: UNLOCKING THE DOORS TO CORPORATE AND PRIVATE OUTREACH PROGRAMS AND FUNDING SOURCES

As part of its Broker/Facilitator effort, on March 16, 2003, the LPI hosted a one-day workshop immediately preceding the 34th Lunar and Planetary Science Conference for scientists interested in education and public outreach. The program explored corporate and private entities as potential funding sources for space science outreach programs. Speakers included scientists and organizations that have successfully obtained significant private funding for outreach, and representatives from corporate and private foundations. An important point that multiple speakers emphasized was that the vast majority of private funding (~80%) to outreach organizations comes from individuals and not foundations. Of those individual donors, ~95% of gift dollars come from ~5% of the donors, so targeting "big fish" is important. Unlike the government grant process, developing and nurturing personal relationships with potential donors is absolutely critical. Donor contributions should be well acknowledged, and contributors should, as much as possible, be made to feel they are involved in the activities they are funding. Corporate and private foundations often have very specific missions, and it is important to ensure that requests for money match their mission. Foundations often have specific guidelines for submitting proposals, and, like the government grant process, it is critical that those guidelines be carefully followed. National and regional councils of foundations are a good place to begin the networking process that is critical to achieving success in obtaining private sector funding.



Meeting Highlights

Workshop on Unmixing the SNCs: Chemical, Isotopic, and Petrologic Components of Martian Meteorites, October 11–12, 2002, Houston, Texas



As the number of known martian meteorites (the "SNCs") has grown in the last few years, so have chemical and petrologic studies of their origins. An intriguing result from these studies is that the chemical and isotopic compositions of the martian meteorites can be modeled as mixtures of only a few components. It remains unclear just how many components are involved, and whether a component defined in one area (e.g., Xe isotopes) can be correlated with those in other areas (e.g., rare earth elements). The workshop served as a forum for active researchers in the field to present and compare results, and perhaps be inspired to interdisciplinary investigations. A critical part of the workshop was the comparison of martian results with terrestrial processes (e.g., assimilation and mantle metasomatism), as presented by invited experts.

The long-term value of a workshop like this is difficult to gauge. In the short term, however, the workshop has served as a focus for papers on chemistry and physics of differentiation and mixing inside Mars. Later this year the journal *Meteoritics & Planetary Science* will publish a special issue devoted to the workshop results. Links to the workshop program and abstracts, as well as a summary of the workshop, can be found at the workshop Web site at *http://www.lpi.usra.edu/meetings/sncs2002/*.

2002 RASC–AL Forum, November 5–8, 2002, Cocoa Beach, Florida

Revolutionary Aerospace Systems Concepts–Academic Linkage (RASC–AL) is a program of the Lunar and Planetary Institute (LPI) in conjunction with the Universities Space Research Association. The RASC–AL Forums are organized by the LPI's Education and Public Outreach Department. The key objectives of the RASC–AL program are to develop relationships between universities and NASA that lead to opportunities for future NASA research and programs, and to develop revolutionary aerospace systems concepts and technology requirements to enable future NASA missions.

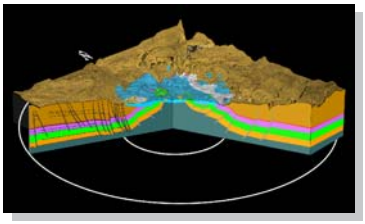
The first RASC–AL Forum was held November 5–8, 2002, at the Hilton Cocoa Beach Oceanfront Hotel in Cocoa Beach, Florida. University teams were invited to submit research designs that reflected one of the following themes: Human and Robotic Space Exploration, Orbital Aggregation & Space Infrastructure Systems (OASIS), Zero-Emissions Aircraft, and Remote Sensing. At the Forum, representatives from 10 university teams presented their student research design projects. The Forum also included oral presentations by NASA and industry representatives, a poster session, and a field trip to the Kennedy Space Center.

The second RASC–AL Forum was held May 18–21, 2003, at the same location. For more information about the 2003 RASC–AL Forum, and general program information, visit the RASC–AL Web site at *http://www.lpi.usra.edu/rasc-al/rascal2003/*.

Impact Cratering: Bridging the Gap Between Modeling and Observations, February 7–9, 2003, Houston, Texas

Earlier this year, approximately 60 scientists gathered at LPI for a workshop devoted to improving knowledge of the impact process. Significant recent work has been done in key areas of impact studies, but there is a disconnect between groups employing different approaches, in particular modeling versus observations. The workshop brought together these disparate groups to have an open dialogue to answer outstanding questions about the impact process and to set future research directions. Participants had research specialties that included numerical modeling, field geology, small-scale experimentation, geochemical sample analysis, seismology, and planetary remote sensing. Workshop co-conveners were Robert Herrick of LPI and Betty Pierazzo of the Planetary Science Institute.

The workshop was divided into sessions devoted to different aspects of the cratering process. Each session was opened by two invited talks, one given by a specialist in numerical or experimental modeling, and the other by a specialist in geological, geophysical, or geochemical observations. Shorter talks and open discussions filled out the sessions. "Modelers" were requested to address the question of what observations would better constrain their models, while "observationalists" were requested to discuss how their observations can constrain modeling efforts.



A proceedings volume is planned as a special issue of *Meteoritics & Planetary Science*, to be published in early 2004. Links to the program and abstracts, summaries of the sessions, other workshop information, and an open forum devoted to the impact cratering process can be found at the workshop Web site at *http://www.lpi.usra.edu/meetings/impact2003/*.

Milestones

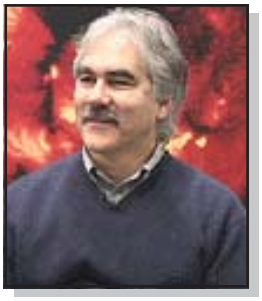
USRA Names New Director for the Lunar and Planetary Institute

The Universities Space Research Association (USRA) has selected Dr. Stephen Mackwell as the Director of the USRA-managed Lunar and Planetary Institute in Houston, Texas. Mackwell, formerly Director of Bayerisches Geoinstitut, Universität Bayreuth, Germany, assumed leadership of the LPI concurrent with the start of its new, five-year Cooperative Agreement between USRA and NASA for the continued operation of the Institute. A world-recognized expert in experimental geophysics, Mackwell is enthusiastic about taking over the reins of the LPI. "It is an honor to be selected in the tradition of great leadership of the LPI," Mackwell said. "I look forward to working closely with the university community that USRA represents in building a bright future for the Institute." Dr. David C. Black, who became LPI Director in 1988 and who is now President of USRA, describes Mackwell as "an ideal leader for the Institute as the nation reinvigorates its efforts to collect and study samples of extraterrestrial material." Future LPI research will have an emphasis on astromaterials, anticipating NASA sample return missions to come. Through the new cooperative agreement, USRA looks forward to even closer collaboration between the LPI and NASA, particularly the nearby Johnson Space Center.

Mars Odyssey Has New Project Scientist

Dr. Jeffrey Plaut has been named project scientist for NASA's 2001 Mars Odyssey mission, succeeding Dr. R. Stephen Saunders who retired. Plaut had been the deputy project scientist for Odyssey. Plaut came to JPL in 1991 and has served on the Magellan mission to Venus and three space shuttle radar missions. He is currently the co-principal investigator on the 2003 Mars Express radar sounder and a team member on the 2005 Mars Reconnaissance Orbiter radar team. Plaut has a bachelor's degree from Brown University and a doctorate in Earth and Planetary Sciences from Washington University at St. Louis.

New Manager Named to Genesis Mission



A NASA mission to gather particles shed by the Sun is now operating under the management of Donald Sweetnam of NASA's Jet Propulsion Laboratory, Pasadena, California. Sweetnam has worked on the project since its proposal stage in 1997, most recently as manager of mission operations. The Genesis spacecraft, launched in 2001, will return its collected sample of the solar wind to Earth in September 2004 with a dramatic mid-air catch by helicopter over the Utah Test and Training Range. "Genesis is an exciting scientific mission that will give us a fundamentally new understanding of the composition of the Sun and could rewrite the early history of the solar system," Sweetnam said. "The Earth return is going to be exciting. It will be the first sample return to Earth from beyond lunar orbit." Genesis is sponsored by NASA's Discovery Program, which competitively selects low-cost missions for solar system exploration. Sweetnam succeeds Chester Sasaki, who is now project manager for Kepler, a Discovery mission slated for launch in 2007.

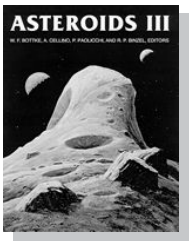
Space Shuttle Program Manager Decides To Leave Post

Ronald D. Dittemore, a 26-year NASA veteran, announced his intention to step aside as the Space Shuttle Program Manager at the Johnson Space Center in Houston to pursue other opportunities. Dittemore, who has served as the Shuttle Program Manager for more than four years, will remain in his current position until the Columbia Accident Investigation Board finishes its investigation and a complete "Return to Flight" path has been established. "My decision to leave the Space Shuttle Program has been a very difficult one, but it is a decision that I began struggling with long before the tragedy of the Columbia accident," Dittemore said. "The timing of my departure is based on what I believe will allow for the smoothest management transition possible, as the pace of work to return the Shuttle to flight begins to ramp up." Dittemore first joined NASA in 1977 as a propulsion systems engineer. His awards include two Senior Executive Presidential Rank Awards for Distinguished Executive and Meritorious Executive; the NASA Outstanding Leadership Medal; the NASA Exceptional Service Medal; and Johnson Space Center's highest award, the Certificate of Commendation.

NEW AND NOTEWORTHY

These products are available from booksellers or the publisher listed.
Please note that the LPI does not offer these products through its order department.

BOOKS



Asteroids III. Edited by William F. Bottke, Jr., Alberto Cellino, Paolo Paolicchi, and Richard P. Binzel. University of Arizona Press, 2002. 785 pp., Hardcover, $95.00. *www.uapress.arizona.edu*

This volume brings together the latest information obtained by spacecraft, combined with astronomical observations and theoretical modeling, to present our best current understanding of asteroids and the clues they reveal for the origin and evolution of the solar system. This collective knowledge, prepared by a team of more than 100 international authorities on asteroids, includes new insights into asteroid-meteorite connections, possible relationships with comets, and the hazards posed by asteroids colliding with Earth. The book includes reports on surveys based on remote observation and summaries of physical properties; results of *in situ* exploration; studies of dynamical, collisional, cosmochemical, and weathering evolutionary processes; and discussions of asteroid families and the relationships between asteroids and other solar system bodies.

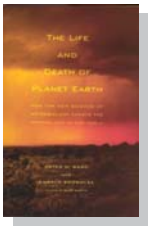
The Big Splat, Or How Our Moon Came to Be. By Dana Mackenzie. John Wiley & Sons, Inc., 2003. 240 pp. Hardcover, $24.95. *www.wiley.com*

This work relates one of the great recent breakthroughs in planetary astronomy — a successful theory of the birth of the Moon. Science journalist Dana Mackenzie traces the evolution of this theory, one little known outside the scientific community: A Mars-sized object collided with Earth some 4.5 billion years ago, and the remains of the colossal explosion — the Big Splat — came together to form the Moon. Beginning with notions of the Moon in ancient cosmologies, Mackenzie relates the fascinating history of lunar speculation, from Galileo and Kepler to George Darwin (son of Charles) and the Apollo astronauts, whose trips to the lunar surface helped solve one of the most enigmatic mysteries of the night sky: Who hung the Moon?

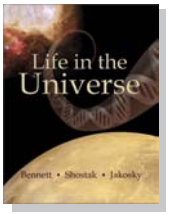
Dust in the Galactic Environment, Second Edition. By D. C. B. Whittet. Institute of Physics Publishing, 2003. 408 pp. Paperback, $49.99. *www.bookmarkphysics.iop.org*

This new edition of a best-selling graduate textbook aims to provide an overview, covering general concepts, methods of investigation, important results and their significance, relevant literature, and some suggestions for promising avenues of future research. The text also encompasses the many important new discoveries that have been made in the field of cosmic dust since the first edition of this book was published in 1991.

The Life and Death of Planet Earth: How the New Science of Astrobiology Charts the Ultimate Fate of Our World. By Peter Ward and Don Brownlee. Henry Holt and Company, 2003. 256 pp. Hardcover, $25.00. *www.henryholt.com*



In their new book, Peter Ward and Don Brownlee provide a comprehensive portrait of Earth's life cycle that allows the reader to understand and appreciate how the planet sustains itself today, and offers a glimpse of our place in the cosmic order.



Life in the Universe. By Jeffrey Bennett, Seth Shostak, and Bruce Jakosky. Addison-Wesley, 2003. 346 pp., Paperback, $80.00. *www.aw.com*

This textbook offers an introduction to a wide range of sciences, including astronomy, biology, chemistry, geology, and cosmology. *Life in the Universe* explores fundamental questions: How did life begin on Earth? What are the most extreme forms of life currently known? How likely is life in our solar system and beyond? What are the challenges of trying to colonize another planet?

The Moon Landings: An Eyewitness Account. By Reginald Turnill. Cambridge University Press, 2003. 476 pp., Hardcover, $27.00. *us.cambridge.org*

The Soviet-American race to land the first man on the Moon was a technical challenge unlike any other in recent human history. Reginald Turnill, the BBC's Aerospace Correspondent, covered the entire story firsthand, and his reports were heard and seen by millions around the world. With unparalleled access to the politicians, scientists, and technicians involved in the race to the Moon, Turnill got to know all the early astronauts — Alan Shepard, John Glenn, Neil Armstrong, and Buzz Aldrin — as they pioneered the techniques that made the Moon landings possible. This is a unique eyewitness account of one of the most thrilling adventures of the twentieth century, the story of the race to the Moon.

Video

Apollo 11: Men on the Moon DVD. Produced by Mark Gray. Spacecraft Films, 2002. Three-disc set, total running time over 10 hours, $54.99. *www.spacecraftfilms.com*

From the moment man set foot on a body other than Earth, the world has been a different place. This chronicle of Apollo 11 features new digital transfers of film and television coverage, including several of the unscheduled transmissions that were never broadcast. This three-disc set features the unbelievable experience of man's first voyage to another world and presents over 10 hours of spectacular material.

Models

Asteroid Models. Design Cast Studios, 2000. Deluxe model with base, $25.00 each. *www.dcstudios.com*

These museum-quality scale models of asteroids 1998 KY26, Bacchus, Castalia, Eros, Geographos, Golevka, Kleopatra, and Toutatis are licensed under authority of NASA and the Jet Propulsion Laboratory. These reproductions were made using radar images taken by astronomers, then formed in a 3-D layering, or stereolithography, machine. The deluxe model includes a base for display, an illustrated educational booklet, and Certificate of Authenticity.

Journals

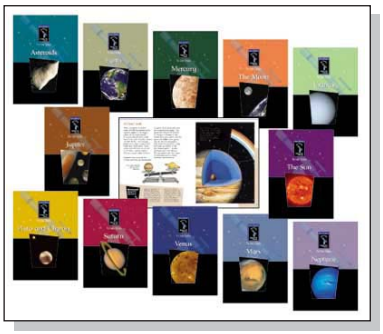
A Lively Electronic Compendium of Research, News, Resources, and Opinion
Astronomy Education Review

Astronomy Education Review. Online journal. *aer.noao.edu*

This new online journal for astronomy and space-science education aims to serve a broad audience of those involved in education. The journal, published with the support of the National Optical Astronomy Observatories and the NASA Office of Space Science, includes sections of research and applications, short reports on innovations, annotated lists of educational resources, announcements of opportunities, news, reviews, and opinion pieces.

New for Kids

Books



Isaac Asimov's 21st Century Library of the Universe: The Solar System. Isaac Asimov and Richard Hantula. Gareth Stevens Publishing, 2002. 12-volume set, 32 pp. each volume, $203.40. *www.garethstevens.com*

This 12-volume set is an updated and revised edition of the highly acclaimed Isaac Asimov's New Library of the Universe. Noted science author Richard Hantula has reworked the text throughout to reflect the latest discoveries and theories, and has selected the most up-to-the-minute new photographs to bring these volumes into the twenty-first century while maintaining the authority and accessibility of the original. Asimov's original work forms the basis for a mixture of science fact and theory combined with simple prose style. The result is a series capable of answering, in an understandable and informative way, the questions children ask when they gaze skyward. (Suitable for grades 3 and up.)

Home on the Moon: Living on a Space Frontier. By Marianne Dyson. National Geographic, 2003. 64 pp., Hardcover, $18.95. *www.MarianneDyson.com*

Written by a former NASA mission controller with firsthand knowledge of the space program, this book combines a description of humankind's race to the Moon with a detailed vision of the Moon as our next frontier. Dyson packs lots of Moon science into this futuristic vision, presenting kids with key facts in many fields — from geology to engineering to astronautics. Actual images of the Moon from NASA's extensive files are paired throughout with artistic renditions of how a Moon colony might look. Four hands-on activities are included.

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EDUCATIONAL PRODUCTS

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	S-SOLAR	THE SOLAR SYSTEM IN 3-D **(40 slides)**	$25.00	
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	C-RSPECTG	ALTA REFLECTANCE SPECTROMETER CLASSROOM LESSONS **(CD-ROM)**	$5.00	

OTHER PUBLICATIONS

AVAILABLE FOR THE COST OF SHIPPING AND HANDLING

	CB-954	TRACES OF CATASTROPHE: HANDBOOK OF SHOCK-METAMORPHIC EFFECTS IN TERRESTRIAL METEORITE IMPACT STRUCTURES **(book)**	$0.00	
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Calendar 2003

Information was valid as of this issue's publication and is subject to change without notice. For more information see the Web sites listed.

June

12–14 **Forum on Concepts and Approaches for Jupiter Icy Moon Orbiter,** Houston, Texas. *http://www.lpi.usra.edu/meetings/jimo2003*

15–17 **Milky Way Surveys: The Structure and Evolution of our Galaxy,** Boston, Massachusetts. *http://www.bu.edu/iar/galactic_meeting/index.html*

16–20 **9th International Symposium on Materials in a Space Environment,** Noordwijk, The Netherlands. *http://www.estec.esa.nl/conferences/03A02/index.html*

18–20 **Which Model(s) for the Early Universe? (8th Claude Itzykson Meeting),** CEA-Saclay, France. *http://www-spht.cea.fr/Itz8.html*

24–26 **Earth Science Technology Conference (NASA),** University of Maryland, Adelphi, Maryland. *http://esto.nasa.gov/conferences/esto2003/*

25–Jul 2 **95th Anniversary of the Tunguska Event,** Moscow, Russia. *http://olkhov.narod.ru/conf03.htm#7b*

30–Jul 11 **IUGG General Assembly,** Sapporo, Japan. *http://www.IUGG.org*

July

4–8 **NASA's 15th Annual Planetary Science Summer School,** Pasadena, California. *http://www.jpl.nasa.gov/pscischool/*

6–11 **Gordon Research Conference on the Origins of Solar Systems,** Bristol, Rhode Island. *http://www.grc.uri.edu/programs/2003/origins.htm*

13–19 **The Great Desert: Geology and Life on Mars and in the Southwest,** Albuquerque, New Mexico. *http://www.lpi.usra.edu/education/EPO/desert2003/*

13–26 **International Astronomical Union XXVth General Assembly,** Sydney, Australia. *http://www.astronomy2003.com*

20–25 **Sixth International Conference on Mars,** Pasadena, California. *http://www.lpi.usra.edu/meetings/sixthmars2003*

21–25 **8th International Conference on Permafrost,** Zürich, Switzerland. *http://www.geo.unizh.ch/ICOP2003*

28–Aug 1 **66th Annual Meteoritical Society Meeting,** Münster, Germany. *http://www.lpi.usra.edu/meetings/metsoc2003*

August

3–8 **Instruments, Methods, and Missions for Astrobiology VI (AM115),** San Diego, California. *http://www.spie.org/conferences/Programs/01/am/confs/4495.html*

5–7 **Third International Conference on Large Meteorite Impacts,** Nördlingen, Germany. *http://www.lpi.usra.edu/meetings/largeimpacts2003*

10–15 **Workshop on Cometary Dust in Astrophysics,** Crystal Mountain, Washington. *http://www.lpi.usra.edu/meetings/stardust2003*

11–16 **The Fourth G. Gamow's Odessa Astronomical Summer School,** Odessa, Ukraine. *http://www.odessa2000.cjb.net*

14–17 **International Mars Society Conference 2003,** Eugene, Oregon. *http://www.marssociety.org/*

14–17 **International Air & Space Symposium and Exposition,** Dayton, Ohio. *http://www.aiaa.org*

17–24 **Order and Chaos in Stellar Planetary Systems,** St. Petersburg, Russia. *http://www.astro.spbu.ru/AGAVA/*

September

2–6 **35th Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society,** Monterey, California. *http://dps03.arc.nasa.gov*

7–12 **Thirteenth Annual V. M. Goldschmidt Conference,** Kurashiki, Japan. *http://www.ics-inc.co.jp/gold2003*

8–12 **12th UN/ESA Workshop on Basic Space Science,** Beijing, China. *http://www.seas.columbia.edu/~ah297/un-esa/*

8–20 **NATO Advanced Study Institute Program Chaotic Worlds: From Order to Disorder in N-Body Gravitational Dynamic Systems,** Cortina D'Ampezzo, Italy. *http://www.astro.gla.ac.uk/users/martin/nato/cortina03.html*

15–20 **The Sun and Planetary Systems — Paradigms for the Universe,** Freiburg, Germany. *http://www.kis.uni-freiburg.de/AG03/*

18–21 **International Meteor Conference,** Bollmannsruh, Germany. *http://aipsoe.aip.de/~rend/2003imc.html*

23–25 **AIAA SPACE 2003 Conference,** Long Beach, California. *http://www.aiaa.org/space2003/*

24–26 **Fifth IAA International Conference on Low-Cost Planetary Missions,** Noordwijk, The Netherlands. *http://www.estec.esa.nl/conferences/03A04/index.html*

October

4–9 **American Institute of Professional Geologists 40th Annual Meeting,** Glenwood Springs, Colorado. *http://www.aipg.org*

11–12 **The Astronomical Society of the Pacific 115th Annual Meeting,** Berkeley, California. *http://www.astrosociety.org/events/meeting.html*

13–16 **Multiwavelength Mapping of Galaxy Evolution,** Venezia, Italy. *http://www.eso.org/venice03*

13–17 **Third International Conference on Mars Polar Science and Exploration,** Alberta, Canada. *http://www.lpi.usra.edu/meetings/polar2003*

November

2–5 **Geological Society of America Fall Meeting,** Seattle, Washington. *http://www.geosociety.org/meetings/2003*

10–14 **30th International Symposium on Remote Sensing of Environment,** Honolulu, Hawaii. *http://isrse.pdc.org/*

17–23 **IAU Colloquium 194 "Compact Binaries in the Galaxy and Beyond,"** La Paz, Mexico. *http://www.astrosen.unam.mx/~iau194/casatest.html*

December

8–12 **American Geophysical Union Fall Meeting,** San Francisco, California. *http://www.agu.org/meetings/fm03/*