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The Conference in Review

Contents

Lunar and Planetary Information

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The Conference in Review

Attendance at the 37th Lunar and Planetary Science Conference (LPSC) set yet another record for this conference, with 1546 participants from 24 countries attending the meeting held at the South Shore Harbour Resort and Conference Center in League City, Texas, on March 13–17, 2006 (see inset for attendance statistics). Rearrangement of the configuration of the meeting rooms, along with additional overflow seating, allowed conference organizers and staff to accommodate the marked increase in attendance, thereby being able to maintain the current meeting venue and hence the low registration fee, which enables the high number of student attendees.

LPSC continues to be recognized among the international science community as the most important planetary conference in the world, and this year's meeting substantiated the merit of that reputation. More than 1400 abstracts were submitted in consideration for presentation at the conference, and hundreds of planetary scientists and students attended both oral and poster sessions focusing on such diverse topics as the Moon, Mars, Mercury, and Venus; outer planets and satellites; meteorites; comets, asteroids, and other small bodies; impacts; interplanetary dust particles and presolar grains; origins of planetary systems; planetary formation and early evolution; and astrobiology. Sunday night's registration and reception were again held at the Center for Advanced Space Studies, which houses the Lunar and Planetary Institute. Featured on Sunday night was an open house for the display of education and public outreach activities and programs.

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 focusing on the Phoenix mission landing site; the Bosumtwi meteorite impact crater drilling project; results from the Deep Impact mission; the importance of planetary cartography; and results from the Hayabusa mission.

During the Monday afternoon plenary session, the Masursky Lecture, presented by planetary scientist Jonathan I. Lunine, was entitled "Beyond the Asteroid Belt: What to Do Next in the Outer Solar System, and Why" (see related article on p. 4). Later that evening, a student/scientist reception provided students with an opportunity to meet and interact with established professionals in the field of planetary science.

Attendance from Non-U.S. Countries

Australia:	**8**	**Ireland:**	**1**
Austria :	**4**	**Italy:**	**16**
Belgium:	**2**	**Japan:**	**81**
Canada:	**32**	**Netherlands:**	**8**
China:	**1**	**Norway:**	**1**
Croatia:	**1**	**Portugal:**	**1**
Czech Republic:	**1**	**Russia:**	**10**
Denmark:	**6**	**South Africa:**	**1**
Finland:	**5**	**Spain:**	**6**
France:	**55**	**Switzerland:**	**10**
Germany:	**49**	**Taiwan:**	**2**
Hungary:	**7**	**United Kingdom:**	**51**

Total non-U.S. attendees: 359

Dr. Mary Cleave, Associate Administrator for the Science Mission Directorate, and Dr. Andrew Dantzler, Director of NASA's Planetary Division, address a packed crowd during the NASA HQ Briefing on Monday afternoon.

Dr. Eileen Stansbery chats with a few LPSC participants during the student/scientist reception held on Monday evening.

Another highly successful year of posters at the South Shore Harbour Fitness Center.

Masursky Lecture Presented at the 37th Lunar and Planetary Science Conference

Beyond the Asteroid Belt: Where to Go Next in the Outer Solar System, and Why

— Jonathan I. Lunine, INAF-IFSI, Rome, Italy
(currently on leave from the University of Arizona)

Planetary scientist Jonathon Lunine poses with a model of the Cassini/Huygens spacecraft. Image courtesy of University of Arizona.

The outer solar system is the vast region extending roughly from where the ice stability line during planet formation ended (3 or 4 AU) out to — let's say — 100 AU, which is just beyond the semimajor axis of the super-Pluto 2003 UB 313. Most of the planetary mass and angular momentum of our solar system resides there, and most of the variety. The distance between places to explore is daunting when moving from one giant planet to another, yet trivial within each of the giant planet moon/ring/magnetospheric systems. Indeed, one might say that the outer solar system is less a place than a "state of mind": a different kind of exploration experience from the more focused targets within the rocky and dusty terrestrial planet zone close to the Sun.

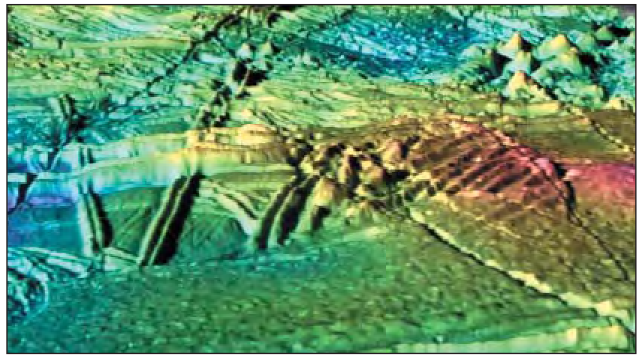
Half a dozen spacecraft and their probes have operated, or are operating, in the outer solar system since 1973, and all four of the giant planet systems have been at least visited with flybys. The Pioneer and Voyager missions were largely justified on the basis of simply discovering "what is out there," while Galileo and Cassini had, and have, more focused goals. Other than the New Frontiers mission to Jupiter (Juno), no missions beyond the asteroid belt are under development; efforts to get a mission to Europa to follow up on the discoveries of Galileo remain stymied. It is a good time to take stock of where we are in exploring this realm.

One good way to organize an assessment is by expressing the scientific goals of solar system exploration as three questions. First, how did our solar system arrive at the architecture it now possesses? Second, how did the giant planets and their moons form? Third, how do environments become habitable for life, and are there potentially habitable environments in the solar system?

The outer solar system has much to tell us with respect to the first question. The giant planets, in particular Jupiter, played key roles in determining the timing of terrestrial planet formation, the mechanisms of growth and radial redistribution of material, and finally the availability of life-sustaining organics and water. Sampling of small bodies that represent a variety of primordial reservoirs of planet-building material — the asteroid belt (where some or most of Earth's water may have been derived) and the Kuiper belt — directly address this issue. Cassini has already provided spectra and bulk physical properties for Phoebe, a Saturn-captured body that is a remnant of primitive material that once was in abundance in the outer solar system. The Discovery mission Dawn will examine close up two large asteroids, Ceres and Vesta, while New Horizons will fly by Pluto, Charon, and possibly other Kuiper belt objects. Finally, following on the heels of over a half-dozen cometary probes since 1986, the European Space Agency's (ESA) Rosetta mission will rendezvous with and study in detail the nucleus of a short-period comet.

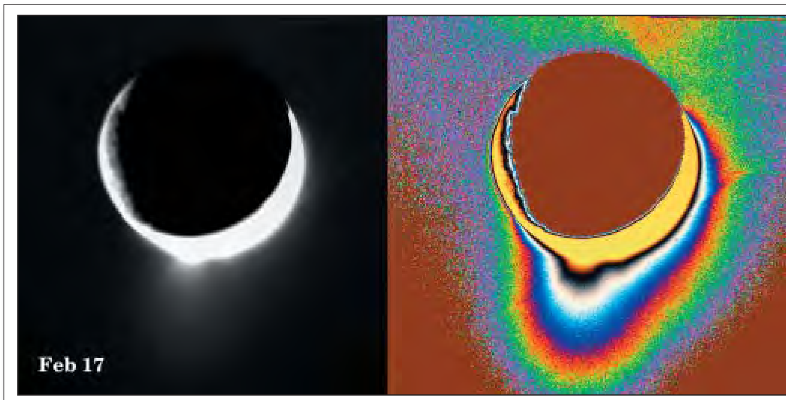
The processes by which giant planets and their moons formed, the second fundamental question, is important not only for understanding the properties of objects in our own solar system, but also for developing insights into how extrasolar giant planets form, and the likelihood that those in particularly salubrious orbits might harbor habitable moons. Here again, ongoing and future missions seem to well serve this goal. Cassini, in its current prime, and planned extended, mission phase, will continue to provide physical and chemical data on Saturn, its rings, and moons that constrain the formation and history of this intricate system. Juno will orbit Jupiter and provide an extremely detailed look at the planet's major-element composition, physical structure, magnetic field generation, and processes of internal energy transport. Finally, New Horizons and Rosetta will examine less-evolved bodies whose chemical compositions provide constraints on models of giant planet formation and subsequent (or contemporaneous) contamination with heavy-element material.

It is only in the third, and perhaps to the public most compelling, scientific question that the prospects for progress seem limited. Potentially accessible environments in the outer solar system that could be habitable or have much to teach us about habitability are the subcrustal ocean on Europa, the plume(s) of Enceladus, and the surface of Titan. The Cassini prime mission and proposed extended mission will extend the physical and compositional mapping of Titan's surface, look for changes, and provide opportunities for even closer examination of the Enceladus plumes. Yet beyond this, nothing is planned.



Europa, as it might be seen from a low-flying spacecraft over the surface. This Galileo image mosaic was reprocessed using high-resolution topographic data, and has been color-coded to help show topography (red is high, blue is low). Image courtesy of P. Schenk.

The Galileo orbiter's extraordinary images of a youthful and in places thin crust, and magnetic field measurements strongly suggesting the presence of subsurface liquid water, led the 2003 National Academy decadal survey to place Europa at the top of its list of targets for major missions. Yet attempts to get a mission into orbit around Europa continue to be stymied after seven years of effort. Discoveries by the Galileo orbiter represent extremely strong evidence for a subsurface liquid ocean, but left to be determined are the thickness of the crust, the possible existence of oceanic material on the surface or close to it (delivered by convective upwellings from the ocean), and detailed information on surface features and topography essential to planning a landing. Although frustrating, the seven years of delays from 1999 have brought with them technologically new solutions to the problem of ambient jovian radiation, and ESA as a potential new partner with NASA that is keenly interested in the exploration of Europe's homonymous world.

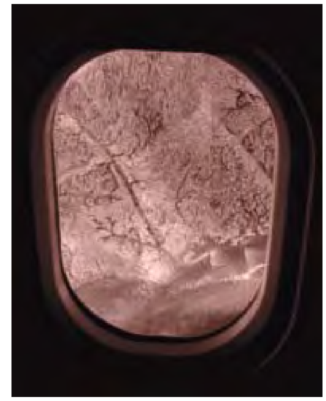


Plumes of icy material extend above the southern polar region of Saturn's moon Enceladus as imaged by the Cassini spacecraft in February 2005. Image courtesy of NASA/JPL/Space Science Institute.

The plumes of Enceladus revealed by the powerful complement of instruments onboard the Cassini orbiter raise the possibility that liquid water exists — indeed, persists — not too far below the surface of this small but unusually rocky saturnian moon. It is possible, but unlikely, that the plumes may have at their source warm water ice, rather than liquid water, or that the plumes are sufficiently rare that a putative liquid water source is frozen the majority of the time. It is thus difficult at the moment to evaluate the level to which Enceladus should rise in the limited pantheon of targets for dedicated future exploration. The E61 and potential extended mission flybys of Enceladus by Cassini are therefore extremely important, insofar as they can provide more detailed information on plume output, energetics, and variability.

Titan as a target for post-Cassini exploration addresses the theme of habitability in several ways, from the rather Earth-like complexity of a world shaped by atmospheric, fluvial, and tectonic or possibly volcanic processes, to the question of the extent of prebiotic evolution of the widespread surface organics and the intriguing issue of whether a form of life might be sustained in liquid hydrocarbons.

The alien landscape of a few tens of square kilometers viewed by Huygens during its parachute descent whetted the human appetite for other views, and the seepage of hydrocarbon vapors into the landed Huygens probe held hope for the possibility of detecting interesting organic chemistry on the surface with more advanced instruments. Titan can be explored in a variety of ways, but most exciting would be a mission that uses the dense atmosphere to make feasible the dream of flight in an alien atmosphere, with the freedom to land in a number of intriguing places and then depart again for undiscovered country.



The Huygens Titan lander acquired images during its January 2005 descent to the surface, shown here as if viewed from an airplane window. Such a view is possible in the future. Modern-day aircraft would have little trouble navigating Titan's hazy atmosphere, although the hydrocarbon smog could be corrosive!

The extended nature of the atmosphere allows spacecraft to aerobrake into desired orbits, and provides relatively benign entry conditions compared to the giant planets, and even Earth. Radiation is low around Titan and absent in the environment near the surface. The air density at lower altitudes is high, the air is cold and mostly stable nitrogen, and the winds relatively light and predictable below 10–20 kilometers. The most economical, elegant, and reliable way to navigate this environment is with a hot air balloon that uses the varying winds at different altitudes to cruise across the landscape and sample interesting regions. Diurnal and seasonal wind shifts are predictable, and simple adaptation schemes to unexpected wind shifts are readily implemented. An alternative, powered, approach would rely on a small blimp that could move against the ambient, gentle winds at low altitude. Vistas that a Titan balloon mission would relay to Earth could well prove to be among the most hauntingly familiar yet exotically different landscapes viewed by humankind in the solar system.

All three of these moons — Europa, Enceladus, and Titan — are important and intriguing targets in the future exploration of the outer solar system. The challenges of selecting and reaching places to land on all three would have been of profound interest to Harold Masursky, and his skills and insights in site selection and geologic interpretation will be sorely missed when missions are finally underway. Despite the vast distances that must be crossed, all three are well within our reach . . . it is only the taxingly familiar problem of NASA politics and funding that keeps them from being within our grasp.

NASA's New Mars Orbiter Returns Test Images

The first test images of Mars from NASA's newest spacecraft provide a tantalizing preview of what the orbiter will reveal when its main science mission begins next fall. Three cameras on NASA's Mars Reconnaissance Orbiter were pointed at Mars at 8:36 p.m. PST on March 23, while the spacecraft collected 40 minutes of engineering test data. The cameras are the High Resolution Imaging Science Experiment (HiRISE), the Context Camera, and the Mars Color Imager.

"These high-resolution images of Mars are thrilling, and unique given the early morning time-of-day. The final orbit of Mars Reconnaissance Orbiter will be over Mars in the mid-afternoon, like Mars Global Surveyor and Mars Odyssey," said Alfred McEwen of the University of Arizona, principal investigator for the orbiter's HiRISE camera. "These images provide the first opportunity to test camera settings and the spacecraft's ability to point the camera with Mars filling the instruments' field of view," said Steve Saunders, the mission's program scientist at NASA Headquarters. "The information learned will be used to prepare for the primary mission next fall." The main purpose of these images is to enable the camera team to develop calibration and image-processing procedures such as the precise corrections needed for color imaging and for high-resolution surface measurements from stereo pairs of images.

To get desired groundspeeds and lighting conditions for the test images, researchers programmed the cameras to shoot while the spacecraft was flying about 1547 miles or more above Mars' surface, about nine times the range planned for the orbiter's primary science mission. Even so, the highest resolution of about 8 feet per pixel — an object 8 feet in diameter would appear as a dot — is comparable to some of the best resolution previously achieved from Mars orbit.

The Mars Reconnaissance Orbiter has been flying in elongated orbits around Mars since it entered orbit on March 10. Mission operations teams at the Jet Propulsion Laboratory (JPL) in Pasadena, California, and at Lockheed Martin Space Systems in Denver continue preparing for aerobraking. That process will use about 550 careful dips into the atmosphere during the next seven months to shrink the orbit to a near-circular shape less than 200 miles above the ground.

The first color image of Mars from the HiRISE camera onboard the Mars Reconnaissance Orbiter. This is not natural color as seen by human eyes, but infrared color, shifted to longer wavelengths. Image courstesy of University of Arizona/HiRISE-LPL.

More than 25 gigabits of imaging data, enough to nearly fill five CD-ROMs, were received through NASA's Deep Space Network station at Canberra, Australia, and sent to JPL. They were made available to the camera teams at the University of Arizona's Lunar and Planetary Laboratory and Malin Space Science Systems in San Diego, California. Preliminary images from HiRISE and additional information about the Mars Reconnaissance Orbiter are available on line at ***www.nasa.gov/mro*** or ***HiRISE.lpl.arizona.edu***.

Cassini finds "Missing Link" Moonlet Evidence in Saturn's Rings

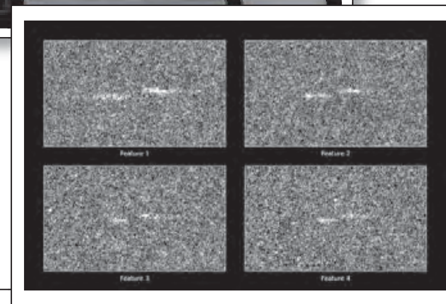
Scientists with the Cassini mission have found evidence that a new class of small moonlets resides within Saturn's rings. There may be as many as 10 million of these objects within one of Saturn's rings alone. Careful analysis of high-resolution images taken by Cassini's cameras revealed four faint, propeller-shaped double-streaks. These features were found in an otherwise bland part of the mid-A ring, a bright section in Saturn's main rings. Cassini imaging scientists believe the "propellers" provide the first direct observation of how moonlets of this size affect nearby particles. Cassini took the images as it slipped into Saturn's orbit on July 1, 2004.

"These moonlets are likely to be chunks of the ancient body whose break-up produced Saturn's glorious rings," said Joseph Burns of Cornell University, Ithaca, New York. Burns is a co-author of a recent report on these findings that was published in *Nature*.

Previous measurements, including those made by the Voyager spacecraft in the early 1980s, have shown that Saturn's rings contain mostly small water-ice particles ranging from less than one-half inch across to the size of a small house. Scientists knew about two larger embedded ring moons, the 19-mile-wide Pan and the 4-mile-wide Daphnis.

The latest findings mark the first evidence of objects of approximately 300 feet in diameter. From the number of moonlets spotted in the very small fraction of the A ring seen in the images, scientists estimated the total number of moonlets to be about 10 million.

The propeller moonlets represent a hitherto unseen size-class of particles orbiting within the rings. Image courtesy of NASA/JPL/ Space Science Institute.



The four propeller-shaped structures discovered by the Cassini spacecraft in close-up images of Saturn's A ring. Image courtesy of NASA/JPL/Space Science Institute.

Moons as large as Pan and Daphnis clear large gaps in the ring particles as they orbit Saturn. In contrast, smaller moonlets are not strong enough to clear out the ring, resulting in a partial gap centered on the moonlet and shaped like an airplane propeller. Such features created by moonlets were predicted by computer models, which give scientists confidence in their latest findings. The detection of moonlets embedded in a ring of smaller particles may provide an opportunity to observe the processes by which planets form in disks of material around young stars, including our own early solar system.

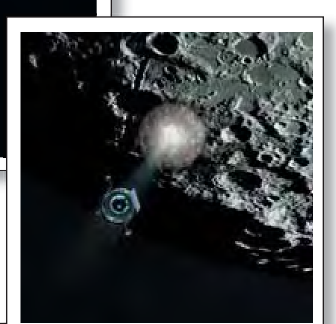
"The structures we observe with Cassini are strikingly similar to those seen in many numerical models of the early stages of planetary formation, even though the scales are dramatically different," said co-author Carl Murray, an imaging team member at Queen Mary, University of London. "Cassini is giving us a unique insight into the origin of planets."

For more information about the Cassini mission, visit ***www.nasa.gov/cassini*** or ***saturn.jpl.nasa.gov***, or visit the Cassini imaging team home page at ***ciclops.org***.

New NASA Ames Spacecraft to Look for Ice at Lunar South Pole

On April 10, NASA announced that a small, "secondary payload" spacecraft, to be developed by a team at NASA Ames Research Center, has been selected to travel to the Moon to look for precious water ice at the lunar south pole in October 2008.

Artist rendition of LCROSS enroute to the Moon. Image courtesy of NASA.



Artist rendition of LCROSS plume developing with Shepherding Spacecraft (S-SC) looking down. Image courtesy of NASA.

The smaller secondary payload spacecraft will travel with the Lunar Reconnaissance Orbiter (LRO) satellite to the Moon on the same rocket, the Evolved Expendable Launch Vehicle (EELV), to be launched from Kennedy Space Center in Florida. The Ames team proposed the secondary payload mission, which will be carried out by the Lunar CRater Observation and Sensing Satellite (LCROSS).

"The LCROSS mission gives the agency an excellent opportunity to answer the question about water ice on the Moon," said Daniel Andrews of NASA Ames, whose team proposed the LCROSS mission. "We think we have assembled a very creative, highly innovative mission, turning the upper stage of the rocket that will bring us to the Moon into a substantial impactor on the Moon."

After launch, the secondary payload LCROSS spacecraft will arrive in the lunar vicinity independent of the LRO satellite. On the way to the Moon, the LCROSS spacecraft's two main parts, the Shepherding Spacecraft (S-S/C) and the Earth Departure Upper Stage (EDUS), will remain coupled. As the spacecraft approaches the Moon's south pole, the upper stage will separate, and then will impact a crater in the south pole area. A plume from the upper stage crash will develop as the S-S/C heads in toward the Moon. The

S-S/C will fly through the plume, and instruments on the spacecraft will analyze the cloud to look for signs of water and other compounds. Additional space and Earth-based instruments also will study the 2.2-million-pound (1000-metric-ton) plume.

"The LCROSS mission will help us determine if there is water hidden in the permanently dark craters of the Moon's south pole," said Marvin (Chris) Christensen, Robotic Lunar Exploration Program (RLEP) manager, and acting director of NASA Ames. "If we find substantial amounts of water ice there, it could be used by astronauts who later visit the Moon to make rocket fuel," Christensen added.

To prepare for the return of astronauts to the Moon, NASA will conduct various RLEP robotic missions from 2008 to potentially 2016 to study, map, and learn about the lunar surface. These early missions will help determine lunar landing sites and whether resources, such as oxygen, hydrogen, and metals, are available for use in NASA's long-term lunar exploration objectives. "Establishing research stations on the Moon will give us the experience and capabilities to extend to Mars and beyond," noted robotics deputy program manager Butler Hine of Ames.

Hubble finds "Tenth Planet" is Slightly Larger than Pluto

For the first time, the Hubble Space Telescope has seen distinctly the "tenth planet," currently nicknamed "Xena," and has found that it is only slightly larger than Pluto. Although previous groundbased observations suggested that Xena's diameter was about 30% greater than Pluto, Hubble observations taken December 9 and 10, 2005, showed Xena's diameter as 1490 miles (with an uncertainty of 60 miles). Pluto's diameter, as measured by Hubble, is 1422 miles.

Artist's concept of the Kuiper belt object nicknamed "Xena," with its moon dubbed "Gabrielle" just above. The Sun can be seen in the upper left corner. Image courtesy of NASA, ESA, and A. Schaller (for STScI).

"Hubble is the only telescope capable of getting a clean visible-light measurement of the actual diameter of Xena," said Mike Brown, planetary scientist at the California Institute of Technology in Pasadena. Brown's research team discovered Xena, officially cataloged as 2003 UB313, and its results have been accepted for publication in the *Astrophysical Journal*.

Located 10 billion miles from Earth with a diameter a little more than half the width of the United States, the object is 1.5 pixels across in Hubble's view. That's enough to make a precise size measurement.

Because Xena is smaller than previously thought, but comparatively bright, it must be one of the most reflective objects in the solar system. The only object more reflective is Enceladus, a geologically active moon of Saturn whose surface is continuously recoated with highly reflective ice by active geysers. Xena's bright reflectivity is possibly due to fresh methane frost on its surface.

Xena takes about 560 years to orbit the Sun, and it is now very close to aphelion (the point on its orbit that is farthest from the Sun). Brown next plans to use Hubble and other telescopes to study other recently discovered Kuiper belt objects that are almost as large as Pluto and Xena. The Kuiper belt is a vast ring of primordial icy comets and larger bodies encircling Neptune's orbit.

Finding that the largest known Kuiper belt object is a virtual twin to Pluto may only further complicate the debate about whether to categorize the large icy worlds that populate the belt as planets. If Pluto were considered to be the minimum size for a planet, then Xena would fulfill this criterion as well.

Mars Rovers Head for New Sites After Studying Layers

The Mars rover Spirit has reached a safe site for the martian winter, while its twin, Opportunity, is making fast progress toward a destination of its own. The two rovers recently set out on important — but very different — drives after earlier weeks inspecting sites with layers of Mars history. Opportunity finished examining sedimentary evidence of ancient water at a crater called "Erebus," and is now rapidly crossing flat ground toward the scientific lure of a much larger crater, "Victoria."

Spirit studied signs of a long-ago explosion at a bright, low plateau called "Home Plate" during February and March. Then one of its six wheels quit working, and Spirit struggled to complete a short advance to a north-facing slope for the winter. "For Spirit, the priority has been to reach a safe winter haven," said Steve Squyres of Cornell University in Ithaca, New York, principal investigator for the Mars Exploration Rover project.

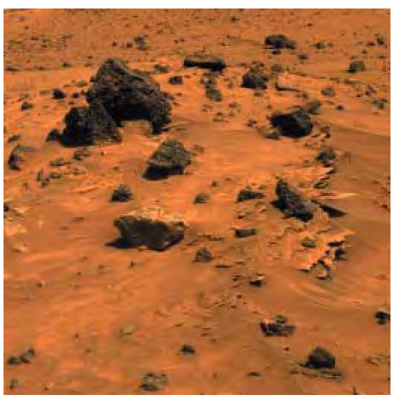
The rovers have operated more than eight times as long as their originally planned three-month explorations on Mars. Each has driven more than 6.8 kilometers (4.2 miles), about 11 times as far as planned. Combined, they have returned more than 150,000 images. Two years ago, the project had already confirmed that at least one place on Mars had a wet and possibly habitable environment long ago. The scientific findings continue.

Opportunity spent most of the past four months at Erebus, a highly eroded impact crater about 300 meters (1000 feet) in diameter, where the rover found extensive exposures of thin, rippled layering interpreted as a fingerprint of flowing water. "What we see at Erebus is a thicker interval of wetted sediment than we've seen anywhere else," said John Grotzinger of the California Institute of Technology. "The same outcrops also have cracks that may have formed from wetting and drying."

In mid-March, Opportunity began a 2-kilometer (1.6-mile) trek from Erebus to Victoria, a crater about 800 meters (half a mile) across, where a thick sequence of sedimentary rocks is exposed. In the past three weeks, Opportunity has already driven more than a fourth of that distance.

At Home Plate, Spirit found coarse layering overlain by finer layering in a pattern that fits accumulation of material falling to the ground after a volcanic or impact explosion. In one place, the layers are deformed where a golfball-sized rock appears to have fallen on them while they were soft. "Geologists call that a 'bomb sag,' and it is strong evidence for some kind of explosive origin," Squyres said. "We would like to have had time to study Home Plate longer, but we needed to head for a north-facing slope before winter got too bad."

Spirit is currently in Mars' southern hemisphere, where the Sun is crossing lower in the northern sky each day. The rovers rely on solar power. The amount available will keep dropping until the shortest days of the Mars winter, four months from now. To keep producing enough electricity to run overnight heaters that protect vital electronics, Spirit's solar panels must be tilted toward the winter Sun by driving the rover onto north-facing slopes. However, on March 13, the right-front wheel's drive motor gave out. Spirit has subsequently driven about 80 meters (262 feet) using five wheels and dragging the sixth, but an initial route toward a large hill proved impassable due to soft ground. Last week, the team chose a smaller nearby ridge, dubbed "Low Ridge Haven," as the winter destination. Spirit reached the ridge on April 9 and has a favorable 11° tilt toward the north.



At least three different kinds of rocks await scientific analysis at the place where Spirit will likely spend several months of martian winter. They are visible in this picture, which the panoramic camera on Spirit acquired on April 12. Paper-thin layers of light-toned, jagged-edged rocks protrude horizontally from beneath small sand drifts; a light gray rock with smooth, rounded edges sits atop the sand drifts; and several dark gray to black, angular rocks with vesicles (small holes) typical of hardened lava lie scattered across the sand. Image courtesy of NASA/JPL-Caltech/Cornell.

Stardust Findings May Alter View of Comet Formation

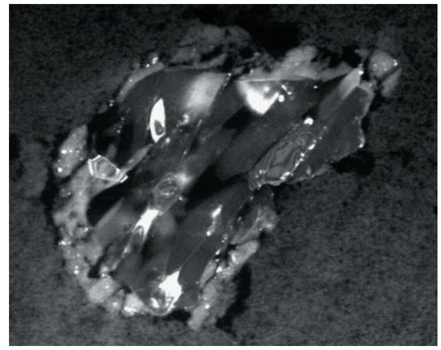
Samples from Comet Wild 2 have surprised scientists, indicating the formation of at least some comets may have included materials ejected by the early Sun to the far reaches of the solar system.

Scientists have found minerals formed near the Sun or other stars in the samples returned to Earth by the Stardust spacecraft in January. The findings suggest materials from the center of the solar system could have traveled to the outer reaches where comets formed. This may alter the way scientists view the formation and composition of comets.

"The interesting thing is we are finding these high-temperature minerals in materials from the coldest place in the solar system," said Donald Brownlee, Stardust principal investigator from the University of Washington, Seattle. Scientists have long thought of comets as cold, billowing clouds of ice, dust, and gases formed on the edges of the solar system.

But comets may not be so simple or similar. They may prove to be diverse bodies with complex histories. Comet Wild 2 seems to have had a more complex history than thought.

"We have found very high-temperature minerals, which supports a particular model where strong bipolar jets coming out of the early Sun propelled material formed near to the Sun outward to the outer reaches of the solar system," said Michael Zolensky, Stardust curator and co-investigator at NASA's Johnson Space Center (JSC) in Houston. "It seems that comets are not composed entirely of volatile-rich materials but rather are a mixture of materials formed at all temperature ranges, at places very near the early Sun and at places very remote from it." One mineral found in the material brought back by Stardust is olivine, a primary component of the green sand found on some Hawaiian beaches. It is among the most common minerals in the universe, but scientists were surprised to find it in cometary dust.



This particle, a type of olivine called forsterite, was brought to Earth in the Stardust sample-return capsule. The grain, encased in melted aerogel, is about 2-millionths of a meter across. Image courtesy of University of Washington/NASA.

Stardust passed within 149 miles of Comet Wild 2 in January 2004, trapping particles from the comet in an exposed gel. Its return capsule parachuted to the Utah desert on January 15, 2006. The science canister with the Wild 2 sample arrived at JSC on January 17. Samples have been distributed to approximately 150 scientists for study.

"The collection of cometary particles is greater than we ever expected," said Stardust Deputy Principal Investigator Peter Tsou of the Jet Propulsion Laboratory in Pasadena, California. The grains are tiny, most smaller than a hair's width. Thousands of them appear to be embedded in the glass-like aerogel. A single grain of 10 micrometers, only one-hundredth of a millimeter (0.0004 inches), can be sliced into hundreds of samples for scientists.

In addition to cometary particles, Stardust gathered interstellar dust samples during its seven-year journey. The team at JSC's curatorial facility hopes to begin detailed scanning of the interstellar tray within a month. They will initiate the Stardust at Home project, which will enable volunteers from the public to help scientists locate particles.

After registering, Stardust at Home participants may download a virtual microscope. The microscope will connect to a server and download "focus movies." The movies are images of the Stardust Interstellar Dust Collector from an automated microscope at the Cosmic Dust Lab at JSC. Participants will search each field for interstellar dust impacts.

Stardust science team members presented their first findings in March at the 37th Lunar and Planetary Science Conference (see related article on page 2). For more information about Stardust, visit ***www.nasa.gov/stardust***.

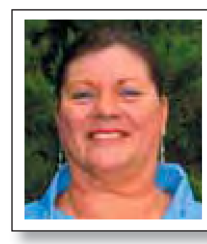
Milestones

NASA Announces Solar System Ambassadors Class of 2006

What do a teacher, surfer, firefighter, award-winning book author, and neurosurgeon have in common? A love of space and a desire to share that passion. They've joined a growing number of private citizens in NASA's Solar System Ambassador program, which brings space information to the public through planetarium talks, telescope-viewing parties, mall displays, and other events. Twenty-nine new ambassadors joined the program this year, bringing the total to 450 ambassadors from all 50 states and Puerto Rico.

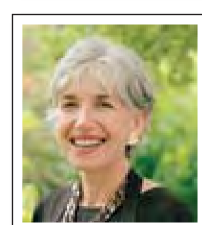
For swim coach and surfer Mike Olsberg of Newport Beach, California, looking up at the stars overhead always captured his imagination, so becoming a NASA ambassador was a no-brainer. "When Neil Armstrong and Buzz Aldrin walked on the Moon, it represented the culmination of all of man's technological achievements up to that moment. Since that day, space exploration has always has been a personal interest for me," Olsberg said. He began his career as a swim coach, which led to a teaching position at Fountain Valley High School in Orange County, California.

For Kevin Kilkenny, a 15-year veteran of the New York City Fire Department stationed in Brooklyn, New York, looking to the sky has been a favorite activity since he was eight years old. "I like watching the faces of the youngsters as they learn about faraway planets and then go outside and see them through a telescope. Watching them make their own discovery is priceless," he said. Kevin was glued to the TV that summer day in 1969 when Apollo 11 made its historic landing on the Moon. He is currently building scale models of the Cassini and Deep Impact spacecraft.



"I have known since my early childhood that I was born to teach," said Judy M. Dominguez, a retired teacher of math and science, who lives in Downey, California. "I realized that I had the gift of being able to explain complex ideas in such a way that people could understand them, and by doing so, I experienced great joy."

For Dr. Ronald Ignelzi, becoming an ambassador was a chance to speak about how space technology can help improve everyday lives. Ignelzi recently retired as a neurosurgeon and lives in La Jolla, California. "I believe space exploration and NASA are a great part of our planet's future and that already some of the technology developed for spacecraft has applications in medicine. These spin-offs have propelled medical technology and will continue to do so in the future."



"As a long-time space cadet, I loved the idea of becoming an ambassador for the solar system," said Dava Sobel of East Hampton, New York, an award-winning author of popular science books. "I'm often invited to speak at local schools and libraries about my work. Invariably my talks turn to space exploration and mention of at least one NASA mission, but now I'll be able to do this in a semi-official capacity."

Each ambassador agrees to hold at least four public events during the year. In 2005, ambassadors participated in 2071 events that reached more than one million people. Now in its ninth year, the JPL-managed program prepares these volunteers through a series of Internet training courses and teleconferences. Ambassadors speak directly with scientists and engineers on missions like Cassini to Saturn, the Mars Exploration Rovers, and the Stardust mission that brought home comet samples. They also receive materials to help them in their presentations.

For more information about the program, visit the Web site at ***www.jpl.nasa.gov/ambassador/front.html***. To contact a local ambassador in your area or find out about an event near you, check the calendar of events at ***www2.jpl.nasa.gov/ambassador/events.html***.

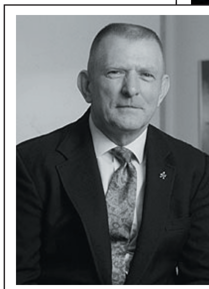
Dwornik Award Winners Honored

During the Monday afternoon plenary session at this year's 37th Lunar and Planetary Science Conference (see related story on page 2), the winners of the 2005 GSA Stephen E. Dwornik Student Awards were honored. The Dwornik awards are given to a U. S. citizen for the best student research presentations at the Lunar and Planetary Science Conference. The purpose of these awards is to provide encouragement, motivation, and recognition to our most oustanding future planetary scientists. The awards are administered through the Planetary Geology Division of the Geological Society of America.

The winner for best oral presentation was Jeff C. Hanna of Washington University ("Tectonic pressurization of aquifers in the formation of Mangala and Athabasca Valles on Mars"); the winner for best poster presentation was Sarah M. Miklovich of Brown University ("Stratigraphic analysis of the north polar cap of Mars"). Honorable mention (oral) was given to Oleg Abramov of the University of Arizona ("Impact-induced hydrothermal activity on early Mars"); honorable mention (poster) was awarded to Noah E. Petro of Brown University ("The lunar-wide effects of the formation of basins on the megaregolith"). Congratulations to these students!

NASA Names Additional Ambassadors of Exploration

Two distinguished names have been added to the list of NASA's first generation of explorers honored as Ambassadors of Exploration. They include a man considered the architect of Mission Control, designing systems from the ground up and known to many in the early days of space exploration simply as "Flight." The other will be forever linked to the phrase "Failure is not an option," and is remembered for his flat-top hairstyle and relentless dedication to mission success. Christopher C. Kraft and Eugene F. Kranz join an eminent list of honorees that include astronauts Alan Shepard, U.S. Senator John Glenn, and Neil Armstrong.



Christopher C. Kraft at top right and Eugene F. Kranz at bottom left. Images courtesy of NASA.

NASA's Ambassadors of Exploration are presented a unique award that includes a Moon rock to recognize the sacrifices and dedication of the astronauts and others who were part of the Mercury, Gemini, and Apollo programs. The award celebrates the realization of a vision for exploration first articulated 45 years ago by President John F. Kennedy, who was looking to bolster a nation and a fledgling space program. It was a mandate to extend humanity's reach further into the cosmos.

Kraft began his career as an aeronautical engineer with the National Advisory Committee for Aeronautics, predecessor of NASA, and later became an original member of the Space Task Group for NASA in 1958. He was the agency's first flight director, responsible for developing the technologies and procedures for ground operations for Project Mercury. Kraft served as flight director throughout Mercury, including Shepard's historic first spaceflight and Glenn's orbital mission. He later moved up to director of flight operations throughout the entire Apollo program. He is considered the father of Mission Control and later became the director of NASA's Johnson Space Center in Houston from 1972 to 1982.

Kranz joined the Air Force in 1954 and flew jet fighter aircraft. He was selected to join the Space Task Group in 1960 and was assigned as assistant flight director. His first duty as flight director came in 1965 for Gemini 4, which featured the first spacewalk by an American astronaut. Kranz was flight director for Apollo 11 and led the team that helped to return the crew of Apollo 13 safely back to Earth. He later became director of

NASA mission operations and retired in 1994 shortly after the space shuttle flight that repaired the ailing Hubble Space Telescope.

For information about the Ambassadors of Exploration award, the exploration of the Moon, and the Vision for Space Exploration, visit ***www.nasa.gov/exploration*** or ***www.nasa.gov/apollo***.

Bethe Prize Awarded Posthumously

The late Alastair G. W. Cameron, professor emeritus at Harvard University, the Donald H. Menzel Research Professor of Astrophysics at Harvard, and a research scientist in the Lunar and Planetary Laboratory at the University of Arizona, was posthumously awarded the Hans A. Bethe Prize at the April meeting of the American Physical Society. The purpose of the Bethe Prize is to recognize outstanding work in theory, experiment, or observation in the areas of astrophysics, nuclear physics, nuclear astrophysics, or closely related fields. Cameron was cited "for his pioneering work in developing the fundamental concepts of nuclear astrophysics. These basic ideas, laid out almost 50 years ago, are still the basis of current research in this field." Cameron, one of the great astrophysicists of the twentieth century, died of heart failure in October 2005 at the age of 80 (see tribute on page 8 of ***Issue #104***).

DPS Announces 2005 Award Recipients

The Division for Planetary Science (DPS) of the American Astronomical Society (AAS) is the largest organization of professional planetary scientists in the world. More information information on the annual DPS meeting and its prizes can be found on the DPS Web site at ***www.aas.org/~dps/dps.html***. All images are courtesy of DPS.

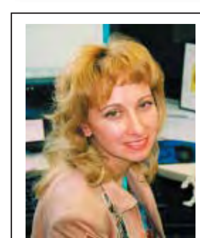
Kuiper Prize Awarded to William Hubbard

The Gerard P. Kuiper Prize for outstanding contributions to the field of planetary science was awarded to William B. Hubbard, Professor of Planetary Science at the University of Arizona. Hubbard's work has centered on the study of the internal structure and evolution of giant planets and brown dwarfs, as well as on the use of stellar occultations to study the atmospheres of the outer planets.

Urey Prize Awarded to David Nesvorny

The Harold C. Urey Prize for outstanding achievement in planetary research by a young scientist was awarded to David Nesvorny of the Southwest Research Institute in Boulder, Colorado. Nesvorny is recognized for his exemplary record of achievement in the study of the dynamical evolution of small bodies in the solar system. His early work introduced the idea of three-body resonances, which are now understood to be a major cause of chaos in the orbits of planets and play a major role in the delivery of asteroids to near-Earth orbits.

Carl Sagan Medal Awarded to Rosaly Lopes



The Carl Sagan Medal for Excellence in Public Communication by a planetary scientist was awarded to Dr. Rosaly Lopes, a Principal Scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, and an Investigation Scientist for the Titan Radar Mapper on the Cassini-Huygens mission to Saturn. Throughout her career studying planetary volcanism, Lopes has been an enthusiastic and untiring communicator of planetary science to the public. Lopes is particularly active with Hispanic groups, and has been an inspiration for many young people in her native Brazil. She has worked tirelessly to bring science to Hispanic communities, and has been very active in the encouragement of women and minorities in science.

Harold Masursky Award Presented to J. Kelly Beatty

The Harold Masursky Award for outstanding service to planetary science and exploration was awarded to J. Kelly Beatty, Executive Editor of *Sky & Telescope* magazine and Editor of *Night Sky* magazine. For more than 30 years, Beatty has been a leading communicator and interpreter of planetary science through his writing, editing, broadcasting, and public speaking. He has been equally adept at explaining the results of professional research and enabling his audience to vicariously experience the excitement of doing that research. *The New Solar System*, a book that Beatty conceived and edited and that has been translated into several languages over the past two decades, is one of the most comprehensive and accessible overviews of planetary science for the public.

Solicitation for Contributions

Contributions to the Lunar and Planetary Information Bulletin (LPIB) are solicited from the planetary community and beyond. Articles exploring issues related to planetary science and exploration are welcome. Of special interest are articles describing Web-based research and educational tools, meeting highlights and summaries, and descriptions of new space missions that may be of interest to our readers. Peer-reviewed research articles, however, are not appropriate for publication in the LPIB. The LPIB is published quarterly and serves the planetary research community, science libraries, educators, students, and lay readers interested in space-science-related research. Suggested topics can be e-mailed to the editors, who will provide guidelines for formatting and content.

Dr. Paul Schenk,
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The Bulletin welcomes articles dealing with issues related to planetary science and exploration. The copy deadline for the next issue is June 9, 2006. Articles or announcements should be submitted via e-mail to ***lpibed@lpi.usra.edu***.

To be added to the list to receive notification by e-mail of future issues, please send your e-mail address to ***lpibed@lpi.usra.edu***.

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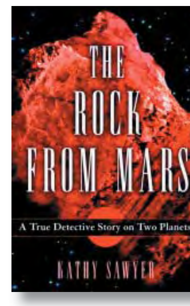
New and Noteworthy

Books —

Testing the Limits: Aviation Medicine and the Origins of Manned Space Flight. Maura Phillips Mackowski. Texas A&M University Press, 2006. 304 pp., Hardcover, $49.95. ***www.tamu.edu/upress***

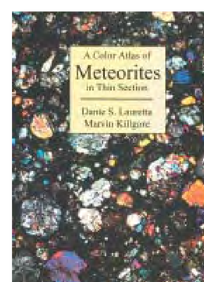
In 1958 the United States launched its first satellite and created the National Aeronautics and Space Administration (NASA). By 1961 NASA was confident enough to put a human being into space thanks to decades of military medical research. Efforts at Wright Field and the U. S. Army's School of Aviation Medicine, a world-class research institution, were the real reason for the successful start to America's manned space program. In *Testing the Limits*, Mackowski describes the crucial foundational contributions of military flight surgeons who routinely risked their lives in test aircraft, research balloons, pressure chambers, rocket-propelled sleds, or parachute harnesses. Drawing on rare primary sources and interviews, Mackowski also reveals the little-known but vital contributions of German emigré scientists whose expertise in areas unknown to Americans created a hybrid specialty: space medicine. Mackowski reveals new details on human aeromedical experimentation at Dachau, Washington's decision to limit astronaut status to males, and the choice to freeze the Air Force out of the research specialty it had created and brought to fruition.

The Rock from Mars: A True Detective Story on Two Planets. Kathy Sawyer. Random House, 2006. 416 pp., Hardcover, $25.95. ***www.randomhouse.com***



Journalist Kathy Sawyer reveals the deepest mysteries of space and some of the most disturbing truths on Earth in *The Rock from Mars*, the story of how two planets and the spheres of politics and science all collided at the end of the twentieth century. It began sixteen million years ago. An asteroid crashing into Mars sent fragments flying into space, and eons later, one was pulled by Earth's gravity onto an icy wilderness near the southern pole. There, in 1984, geologist Roberta Score spotted it, launching it on a roundabout path to fame and controversy. In its new home at NASA's Johnson Space Center in Houston, the rock languished on a shelf for nine years, a victim of mistaken identity. Then, in 1993, geochemist David "Duck" Mittlefehldt unmasked the rock as a martian meteorite. Before long, specialist Chris Romanek detected signs of once-living organisms on the meteorite. But how did nine respected investigators come to make such startling claims about the rock that they triggered one of the most venomous scientific battles in modern memory? The narrative traces the steps that led to this risky move and follows the rippling impact on the scientists' lives, the future of space exploration, the search for life on Mars, and the struggle to understand the origins of life on Earth.

A Color Atlas of Meteorites in Thin Section. Dante S. Lauretta and Marvin Killgore. Southwest Meteorite Press, 2005. 301 pp., Hardcover, $98.00. ***www.meteorite-lab.com***



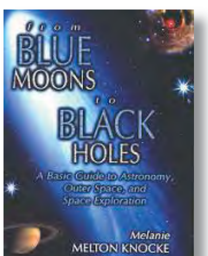
This atlas provides the first photographic survey of meteorites in thin sections. Nearly every known stony meteorite type is included. The book is organized by classification and subtype, from primitive chondrites LL3.0, to planetary achondrites. The first section of the book is dedicated to the ordinary chondrites, followed by the enstatite, carbonaceous, K, and R chondrite classes. The next two sections of the book cover primitive and evolved achondrites. A data block is presented with each meteorite that gives its name, the locality from which it originated, its classification, shock and weathering grades if known, and the source of the thin section photographed. Each classification is presented in six views. The first two are overviews (10 mm–25 mm) in cross-polarized and plane-polarized light, followed by four low-magnification views with plane-polarized, cross-polarized, reflected-light, and BSE (back-scattered electron) images. Readers should have a basic knowledge of thin sections and meteorite science. Although each chapter gives the encapsulation of the grouping of the type, a brief description of each of the meteorites chosen to represent the classification is given with brief notations and comments on the selected photographs. *A Color Atlas of Meteorites in Thin Section* is a comprehensive reference for anyone interested in meteorites, mineralogy, or petrology.

The Volcano Adventure Guide. Rosaly Lopes. Cambridge University Press, 2005. 362 pp., Hardcover, $50.00. ***www.cup.org***

The Volcano Adventure Guide is the first book of its type, containing vital information for anyone wishing to visit, explore, and photograph active volcanos safely and enjoyably. Following an introduction that discusses eruption styles of different types of volcanos, how to prepare for a volcano trip, and how to avoid volcanic dangers, the book presents guides to visiting 42 different volcanos around the world. This section is packed full of practical information including tour itineraries, maps, transportation details, and warnings of possible nonvolcanic dangers. Three appendices at the end of the book direct the reader to a wealth of further volcano resources. Aimed at nonspecialist readers who wish to explore volcanos without being foolhardy, it will fascinate amateur enthusiasts and professional volcanologists alike. The stunning color photographs throughout the book will delight armchair travelers as well as inspire the adventurous to get out and explore volcanos for themselves.

The Real Space Cowboys. Ed Buckbee. Apogee Books, 2005. 200 pp., Paperback, $29.95. ***www.cgpublishing.com***

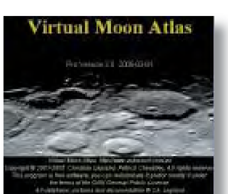
Author Ed Buckbee, who has enjoyed a 40-plus year association with the U.S. manned space flight program, follows the brave men who pioneered the U.S. space program — Alan Shepard, Gordon Cooper, Gus Grissom, John Glenn, Scott Carpenter, Wally Schirra, and Deke Slayton, also known as the Mercury Seven. Through time and personal friendships, he captures dreams of flying higher, faster, and farther than anyone in the known universe. Readers are invited behind the scenes to witness the competition between chimpanzees and astronauts, and the conflict between NASA engineers designing capsules and those who would pilot them. Throughout this book, readers feel the collective will of a nation to defeat the Russians in an all-out space race via an American team of 400,000 engineers, technicians, astronauts, and support personnel who performed as if the country were at war.



From Blue Moons to Black Holes: A Basic Guide to Astronomy, Outer Space, and Space Exploration. Melanie Melton Knocke. Prometheus Books, 2005. 313 pp., Paperback, $19.00. ***www.prometheusbooks.com***

Our universe is a magnificent place, full of exotic entities like black holes and blue moons, white dwarfs and red giants. And it's out there for anyone who takes the time to look up! You don't need a degree in astrophysics to explore the vast reaches of outer space. All you need is curiosity and a little imagination. *From Blue Moons to Black Holes* is written specifically for those who have always been intrigued by or have been developing a growing interest in astronomy and space, but have had little time to explore the amazing world of exploding stars, distant galaxies, rovers on other planets, and more. The book consists of three sections: Questions and Answers, Quick Facts, and A Brief History of Lunar and Planetary Exploration. This illustrated volume also includes a color insert containing, among other pictures, beautiful images of Saturn from the Cassini spacecraft, currently in orbit around the planet. Whether read from cover to cover or used as a reference tool to search for specific answers, *From Blue Moons to Black Holes* will prove to be fun, accessible, and thought-provoking.

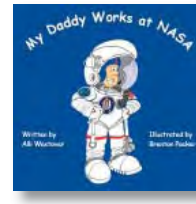
CD-ROM —



Virtual Moon Atlas Pro Version 3.0. Produced by Christian Legrand and Patrick Chevalley. 2005. ***astrosurf.com/avl/UK_index.html***

This lunar atlas software, developed by Christian Legrand and Patrick Chevalley, can visualize the Moon for every date and hour and pilot computerized telescopes on the Moon's surface. It also permits the study of lunar formations with a unique database and pictures library. It is easy to use in the field and for study at home. It also interfaces with Patrick Chavelley's freeware "Sky Charts." The authors upgrade the software, database, and pictures library periodically. English and French versions are available with the basic package.

For Kids!!!



My Daddy Works at NASA. Alli Westover. Little Lunar Books, LLC, 2005. 36 pp., Hardcover, $15.95. ***www.alliwestover.com***

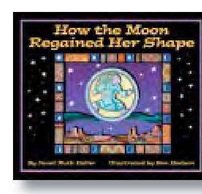
Have you ever wondered what kind of jobs people at NASA have to help get the astronauts ready for a space mission? Well, now your little ones can have an opportunity to see behind the scenes of what goes on at NASA to get our astronauts ready for space. Alli Westover, a former NASA engineer and new children's author, has written this book, which describes what moms and dads do at the space center in preparation for future space missions. This wonderfully illustrated book has 16 fun-loving illustrations that give the smallest explorer an opportunity to dream of working at NASA one day as an engineer, scientist, doctor, technician, or astronaut.

Planet Quest. Learning Resources, 2005. $24.95.
www.learningresources.com

The first animal in space was a dog. True or false? The Sun is a star. True or false? Learning about our solar system is much more than memorizing planets! It's full of fascinating facts. For 2–4 players or teams, this board game includes 132 true/false questions on the nine planets, Earth's moon, supernovas, asteroids, and much more. Earn planet cards for correct answers. Put the planets in the right order, and you win! Measures 48". For ages 7–11.

Giant Solar System Floor Mat. Learning Resources, 2005. $32.95.
www.learningresources.com

Journey from planet to planet on this giant vinyl floor mat that features the Sun and all the planets of our solar system. The mat provides a concrete, kinesthetic way to learn about the planets and how Earth fits into the universe. Also includes 10 large (4.5" × 7"), double-sided cards with facts and true/false questions about each planet and the Sun. Cards can be used for quizzing or for game play. A teaching guide is included. The mat measures 10' × 1'.



How the Moon Regained Her Shape. Janet Ruth Heller. Sylvan Dell Publishing, 2006. 32 pp., Hardcover, $15.95. ***www.sylvandellpublishing.com***

Influenced by Native American folktales, this story deals with overcoming adversity, gaining self-confidence, and understanding the phases of the Moon. After the Sun insults her, the Moon gets very upset and disappears — much to the chagrin of rabbits who miss their moonlight romps. With the help of her friends, the Moon gains more self-confidence each day until she is back to her full size. The "Creative Minds" section explains the phases of the Moon and helps to answer those pesky questions like "Why is the Moon up during the day?," or "Why does the shape of the Moon change?" Moon crafts and games supplement the understanding. For ages 6–10.

May

1–5 **ASPRS 2006 Conference, "Prospecting for Geospatial Information Integration,"** Reno, Nevada. *http://www.asprs.org/reno2006/*

4-7 **The 25th Annual International Space Development Conference,** Los Angeles, California. *http://isdc.nss.org/2006/*

7–15 **Dynamical Processes in Space Plasmas,** Beer-Sheva, Israel. *http://physics.bgu.ac.il/~gedalin/Isradynamics/*

6–11 **North to Alaska: Geoscience, Technology and Natural Resources,** Anchorage, Alaska. *http://anchorage2006.com/*

8–11 **Origin and Distribution of Life in the Universe — A Nordic Perspective,** Stockholm, Svenska. *http://astrobiology.molbio.su.se/conferences/2006/index.html*

8–12 **Atmospheric Science Conference,** Frascati, Italy. *http://earth.esa.int/atmos2006/*

8–12 **First International Conference on Impact Cratering in the Solar System,** Noordwijk, The Netherlands. *http://www.rssd.esa.int/index.php?project=TOP&page=craters*

11–12 **Planetary Robotics: To Mars and Beyond,** Pasadena, California. *http://www.jpl.nasa.gov/events/lectures/may06.cfm*

14–17 **Geological Association of Canada Annual Meeting,** Montreal, Canada. *http://www.gac.ca/ANNMEET/annmeet.html*

14–18 **77th Annual Scientific Meeting of the Aerospace Medical Association,** Orlando, Florida. *http://www.asma.org/meeting/index.php*

18–19 **From Protostellar Disks to Planetary Systems,** Ontario, Canada. *http://www.astro.uwo.ca/~disks/*

21–23 **Workshop on Surface Ages and Histories: Issues in Planetary Chronology,** Houston, Texas. *http://www.lpi.usra.edu/meetings/chron2006/*

23–26 **2006 AGU Joint Assembly,** Baltimore, Maryland. *http://www.agu.org/meetings/ja06/*

28–June 2 **Planetary Science: Challenges and Discoveries,** Blois, France. *http://opserv.obspm.fr/confs/Blois2006/index.htm*

31–June 2 **First Landing Site Workshop for the 2009 Mars Science Laboratory,** Pasadena, California. *http://marsoweb.nas.nasa.gov/landingsites/*

June

2–3 **Bethe Centennial Symposium on Astrophysics,** Ithaca, New York. *http://astro.cornell.edu/~dong/bethe.htm*

4–8 **208th Meeting of the American Astronomical Society and 2006 Meeting of the Canadian Astronomical Society,** Calgary, Alberta, Canada. *http://www.ism.ucalgary.ca/meetings/aas06/*

6–8 **30th Symposium on Antarctic Meteorites,** Tokyo, Japan. *http://yamato.nipr.ac.jp/AMRC/EN/symposium1.html*

8–14 **Impact Craters as Indicators for Planetary Environmental Evolution and Astrobiology,** Ostersund, Sweden. *http://www.geo.su.se/Lockne2006*

12–17 **International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI),** Reykholt, Borgarfjordur, Iceland. *http://www2.norvol.hi.is/page/nordvulk_walker*

19–22 **11th International Conference on Ground Penetrating Radar,** Columbus, Ohio. *http://www.gpr.osu.edu/*

19–23 **SpaceOps 2006 — Earth, Moon, Mars and Beyond,** Rome, Italy. *http://www.spaceops2006.org/*

19–23 **10th International Symposium on "Materials in a Space Environment,"** Collioure, France. *http://www.cert.fr/colloques/ismse2006/aboutSymposium.htm*

22–23 **Moon, Mars and Beyond — Apollo on Steroids,** Pasadena, California. *http://www.jpl.nasa.gov/events/lectures/jun06.cfm*

25–29 **AAS Division on Dynamical Astronomy,** Halifax, Nova Scotia. *http://dda.harvard.edu/meetings/2006/*

27–30 **Fourth Annual International Planetary Probe Workshop,** Pasadena, California. *http://ippw.jpl.nasa.gov/*

27–30 **ICSO 2006 Sixth International Conference on Space Optics,** Noordwijk, The Netherlands. *http://www.congrex.nl/06a05/main.html*

July

2–6 **Australian Earth Sciences Convention 2006,** Melbourne, Australia. *http://www.earth2006.org.au/*

9–15 **18th World Congress of Soil Science,** Philadelphia, Pennsylvania. *http://www.colostate.edu/programs/IUSS/18wcss/index.html*

10–14 **AOGS 2006 3rd Asia Oceanic Geosciences Society Meeting,** Singapore. *http://www.asiaoceania-conference.org/*

16–23 **36th COSPAR Scientific Assembly,** Beijing, China.
http://meetings.copernicus.org/cospar2006/

17–20 **36th International Conference on Environmental Systems,** Norfolk, Virginia.
http://www.sae.org/events/ice/

17–21 **The Planet-Disc Connection,** Cambridge, England.
http://www.ast.cam.ac.uk/meetings/discs06/

23–27 **8th ILEWG International Conference on Exploration and Utilization of the Moon,** Beijing, China.
http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=38863

23–28 **19th General Meeting of the International Mineralogical Association,** Kobe, Japan.
http://www.congre.co.jp/ima2006/index_e.html

24–27 **Western Pacific Geophysics Meeting,** Beijing, China.
http://www.agu.org/meetings/wp06/

24–28 **2006 Michelson Summer Workshop — Frontiers of Interferometry: Stars, Disks and Terrestrial Planets,** Pasadena, California.
http://msc.caltech.edu/workshop/2006/

August

3–4 **Desert Meteorites Workshop,** Casablanca, Morocco.
http://www.fsac.ac.ma/meteorite/index.html

3–6 **9th International Mars Society Conference,** Washington, DC.
http://www.marssociety.org/convention/2006/index.asp

6–11 **69th Annual Meeting of the Meteoritical Society,** Zurich, Switzerland.
http://www.lpi.usra.edu/meetings/metsoc2006/

6–11 **8th International Mercury 2006,** Madison, Wisconsin.
http://www.mercury2006.org/

13–18 **International Heat Transfer Conference,** Sydney, Australia. *http://ihtc-13.mech.unsw.edu.au/*

14–25 **IAU XXVIth General Assembly,** Prague, Czech Republic.
http://www.astronomy2006.com/

21–25 **IAU Symposium 239 Convection in Astrophysics,** Prague, Czech Republic.
http://www.astro.keele.ac.uk/iaus239/

27–Sept 1 **16th Annual V. M. Goldschmidt 2006 Conference,** Melbourne, Australia. *http://www.goldschmidt2006.org/*

September

11–15 **Workshop "From Dust to Planetesimals,"** Ringberg Castle, Germany. *http://www.mpia.de/homes/fdtp/*

13–16 **The Second International Symposium on Space Climate,** Sinaia, Romania. *http://www.issc2.ro/*

14–15 **Beyond Pluto: The Discovery of the "10th Planet",** Pasadena, California.
http://www.jpl.nasa.gov/events/lectures/sep06.cfm

16–18 **118th Annual Meeting of the Astronomical Society of the Pacific, Engaging the Education and Outreach Community: Best Practices, New Approaches,** Baltimore, Maryland.
http://www.astrosociety.org/events/meeting.html

18–22 **Europlanet #1: European Planetary Science Congress,** Berlin, Germany.
http://meetings.copernicus.org/epsc2006/index.html

24–27 **7th International Symposium on Environmental Geochemistry,** Beijing, China.
http://www.iseg2006.com/2001_welcome.htm

25–28 **Transiting Extra-Solar Planets Workshop,** Heidelberg, Germany. *http://www.mpia-hd.mpg.de/transits/wk/*

October

2–6 **4th International Conference on Mars Polar Science and Exploration,** Davos, Switzerland.
http://www.lpi.usra.edu/meetings/polar2006/

2–6 **57th International Astronautical Congress,** Valencia, Spain. *http://www.iac2006.com/principal.asp?sm=0*

4–7 **High Energy Astrophysics Division 2006,** San Francisco, California.
http://www.confcon.com/head2006/head06.php

5–6 **Workshop on Spacecraft Reconnaisance of Asteroid and Comet Interiors**, Santa Cruz, California.
http://www.lpi.usra.edu/meetings/recon2006/

8–13 **38th Annual Meeting of the Division of Planetary Sciences of the American Astronomical Society,** Pasadena, California.
http://www.aas.org/dps/dps.html

10–12 **Strategic Space 2006,** Omaha, Nebraska.
http://www.stratspace.org/

12–13 **Advanced Technology for Life Detection and Biology,** Pasadena, California.
http://www.jpl.nasa.gov/events/lectures/oct06.cfm

22–24 **Workshop on Martian Sulfates as Recorders of Atmospheric-Fluid-Rock Interactions,** Houston, Texas.
http://www.lpi.usra.edu/meetings/sulfates2006/

22–25 **GSA 2006 Annual Meeting and Exposition,** Philadelphia, Pennsylvania.
http://www.geosociety.org/meetings/2006/index.htm

31–Nov 2 **Space Resources Roundtable VIII,** Golden, Colorado.
http://www.lpi.usra.edu/meetings/roundtable2006/