

Discovery Dispatch

A Quarterly Newsletter of the NASA Discovery Program

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A Note From the Program Manager

Congratulations to CONTOUR Principal Investigator Joe Veverka, Project Manager Mary Chiu, and everyone on the CONTOUR team for a successful launch on July 3rd. I know how much hard work and dedication each and every one of you put into the project to make it a happy Fourth of July for the entire team. Now it's up to the new Project Manager, Ed Reynolds, and the ops and science teams to make the science of CONTOUR a reality. I'd like to thank Mary Chiu for an excellent job in getting CONTOUR that special "1 foot" off of the launch pad! I know that it's been both a privilege and a pleasure working with Mary over the past three and a half years and I wish her well in her "retirement" from APL.

On a different note, I'd like to welcome JPL to the management team for the Kepler project. After careful consideration, Ames Research Center management selected JPL to provide mission management support for Kepler. ARC, JPL, and Ball Aerospace have been doing an outstanding job of integrating JPL's expertise in project management, systems engineering, and mission assurance into the existing Kepler management structure to further strengthen the project's prospects for mission success. Chet Sasaki (of Genesis fame) has been named Kepler Project Manager at JPL.

I'd also like to congratulate Bob Farquhar of APL and Bobby Williams of JPL, who received NASA outstanding achievement medals for their roles in the spectacular landing of the NEAR Shoemaker spacecraft on the surface of asteroid Eros. The NEAR Shoemaker Mission Operations Team also received a NASA Group Achievement Award for the success of the mission. Congratulations, once again!

Dave Jarrett

Discovery Home Page

<http://discovery.nasa.gov>

CONTOUR SPACECRAFT LAUNCHES FROM CAPE CANAVERAL

The [Comet Nucleus Tour](#) (CONTOUR) spacecraft successfully launched July 3rd at 2:47 a.m. EDT aboard a Boeing Delta II rocket from Cape Canaveral Air Force Station, FL. The spectacular nighttime launch signaled the beginning of a very important mission that will provide the closest look yet at comets and add to the body of knowledge about the birth and evolution of the Solar System.

Ground controllers at APL's Mission Operations Center will spend six weeks checking the spacecraft and preparing final targeting for a planned Aug. 15 ignition of the vehicle's 6,070-lb.-thrust solid propellant Earth escape motor. That firing will propel CONTOUR out of its initial Earth orbit and into a solar orbit trajectory that will reintercept the Earth in August 2003.



Shortly after tower rollback CONTOUR is lit up against a colorful Florida sunset.

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Discovery E/PO lead Shari Asplund, left, and CONTOUR E/PO lead Laura Lutz in front of the launch pad under very cloudy skies two hours before tower rollback.



The excitement of launch—CONTOUR challenge winners Katy Kauffman, Meghan Cammilleri, and Katy's mom Cindy Kauffman minutes before lift-off.



CONTOUR successfully launches at 2:47 am EDT on July 3, 2002 from Cape Canaveral Air Force Station.



CONTOUR on the launch pad 17-A, ready for lift off.



The Delta II rocket streaks across the night sky.

The first Earth flyby will provide a gravity assist that will accelerate CONTOUR toward an intercept of comet Encke in November 2003. The Encke flyby will be followed by three more Earth flybys to fling the spacecraft toward an intercept of comet Schwassmann-Wachmann 3 in June 2006.

The mission's flexible four-year plan could add an encounter with a "new" and scientifically valuable comet from the outer solar system, should one be discovered in time for CONTOUR to fly past it. CONTOUR's four scientific instruments will take detailed pictures and measure the chemical makeup of each comet's nucleus while analyzing the surrounding gas and dust.

The 8-sided solar-powered craft will fly as close as 62 miles from each nucleus, protected by a 10-inch-thick, layered dust shield of heavy Nextel and Kevlar fabric. Scientists expect the data to reveal the differences between comet nuclei and answer questions about the role comets had in shaping the Earth and other planets.

What's Next for CONTOUR?

Here are some of the key spacecraft operations planned as CONTOUR orbits Earth, leaves Earth's orbit and enters its first hibernation period.

Launch to Aug. 15, 2002

CONTOUR is in an elliptical orbit around Earth. During each 42-hour phasing orbit CONTOUR ranges from 124 miles to 71,300 miles from Earth. The spacecraft performs several maneuvers that adjust its attitude as well as the timing and height of the phasing orbits. Over several weeks CONTOUR gradually moves into position to fire its solid rocket motor and leave Earth's orbit on Aug. 15.

Aug. 17 – Oct. 31, 2002

With CONTOUR in a stable spin mode, mission operators will activate and check out the spacecraft's guidance and control system before turning on the science instruments. Mission operators will switch CONTOUR to 3-axis mode, checking operations in the mode designed for Earth swingbys and comet encounters. Instrument covers will be deployed and the instruments checked out and calibrated. On Sept. 17, the spacecraft will be 1.07 astronomical units (more than 99 million miles) from the Sun. Around that date the mission team will run a simulated Encke encounter to check power levels and instrument performance. CONTOUR returns to spin mode on Sept. 22.

After a maneuver Oct. 9 to correct the spacecraft's orbit and another to adjust its attitude and spin rate, CONTOUR is powered down and enters hibernation by Oct. 31. During hibernation all the spacecraft's instruments and subsystems are turned off; only the command receivers, thermostatically controlled heaters and critical core components stay on. The mission operations team stands down until preparations begin to "awaken" CONTOUR in July 2003.

Visit the CONTOUR website's [News and Media](#) section to view a replay of the launch, interviews with key personnel, an image

gallery and "downloadables" including a build-your-own-model of the spacecraft.

Listen to the sounds of launch at [Cornell University's CONTOUR page](#).

CONTOUR Education & Public Outreach (E/PO) Highlights

Eight enthusiastic CONTOUR Comet Challenge winners traveled to Florida for an exciting educational experience. The winners had the opportunity to attend CONTOUR science team meetings, interview CONTOUR team members, participate in pre-launch events, including dinners and presentations, visit Kennedy Space Center, and view the successful launch of the CONTOUR spacecraft on July 3rd, 2002. The winners documented their experience with photographs and video footage that they will use during their upcoming outreach events. Click [here](#) for more information on the winners and the programs that they are putting together.



Challenge winners at the Astronaut Memorial Planetarium at Brevard Community College for dinner and talks before the launch. From left: Matthew Smith, Chris Peterson, Meghan Cammilleri, Michael Stapleton, Katy Kauffman, Pamela Vaughan, Marilou Bebak, and Andrea Sease.



Andrea Sease, right, interviews Peter Thomas as Ann Harch observes.

The CONTOUR mission paired up with the New York Space Grant and the Cornell University Laboratory for Elementary and Particle Physics to host a workshop at Cornell for Central New York physical science teachers entitled, "Enhancing Physical Science Curricula: Bringing Particle Physics and Planetary Science into the 21st Century." The three organizations brought high school teachers and Cornell scientists together for a six-day workshop to evaluate and enhance core physical science curricular activities focused on particle physics and planetary science.

The workshop included twelve teachers, three graduate students, two facilitators and eight invited guest lecturers from Cornell. Teachers and scientists teamed up to critically evaluate existing curricula and modify selected activities to reflect their vision of effective science education. Using existing materials assured that the topics are relevant to what is being taught in local high school classrooms. Presentations from Cornell scientists on relevant topics were offered throughout the workshop to familiarize teachers with current scientific research. This workshop was an opportunity for teachers to update core curricula to be consistent with modern research through the assistance of Cornell scientists. Workshop products will include an annotated bibliography of core particle physics and planetary science curricula that contains updated and scientifically accurate versions of essential activities and laboratory materials.



Teachers at the "Enhancing Physical Science Curricula" workshop.

Mars Pathfinder Legacy Lives On

Five years ago, on July 4, 1997, as our nation celebrated its 221st birthday, thousands of eyes were glued to their television sets. They weren't captivated by baseball games or parades here on Earth, but rather by a microrover on Mars as Sojourner emerged from her spacecraft and began an unprecedented exploration of the Red Planet.

Mars Pathfinder, the first Discovery mission, completed its seven-month journey from Earth to Mars by bouncing on inflated airbags to a landing in an ancient Martian flood plain known as Ares Vallis, beginning a new era of Mars exploration. The landing was a

tremendous event at JPL, where mission controllers cheered, clapped and even shed tears over the safe arrival.

Now known as the Sagan Memorial Station, the Mars Pathfinder lander, along with Sojourner, brought Americans together to share new and exciting information about our mysterious neighboring planet. Initially sent to demonstrate new and inexpensive technologies and concepts for use in future lander missions to Mars, the spacecraft ended up literally "finding a path" for a parade of Mars missions that will follow in the next decade.

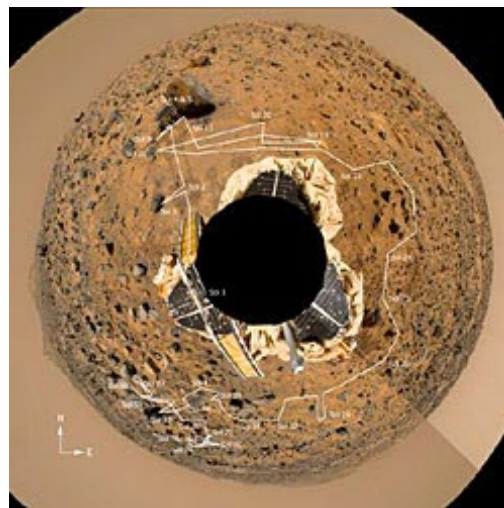
Pathfinder's robust, inexpensive airbag system used a ballistic approach to land on Mars. Without orbiting first, the probe directly entered Mars' atmosphere, using aerobraking and a parachute to slow it down before the airbags inflated to cushion the landing. In 2003, when the first Mars Exploration Rover makes the same journey, it will be equipped with an updated version of this revolutionary landing mechanism. Instead of deflating upon initial impact like a car's airbag system would, the spacecraft's sealed airbags stay inflated, bouncing across Mars' rocky surface like a superball in slow motion, eventually losing energy through friction.

Engineers have changed a lot about the landing system for the Mars Exploration Rover, but the overall architecture is basically the same. The new lander is about 150 kilograms (402 pounds) heavier than Pathfinder's, and its slightly larger structure allows for a bigger rover. The airbags now have more abrasion resistance and additional layers. Still, even though the landing system was successful on Pathfinder, it isn't guaranteed a repeat performance.

"The more we learn about Mars, the harder it seems to get there because Mars is not as safe as we once thought," said Rob Manning, spacecraft chief engineer for Mars Pathfinder and spacecraft systems engineering manager for the Mars Exploration Rover. "We can, however, stack the odds very much in our favor."

Accommodating the Chicken and the Egg

Imagine designing a vehicle that could land anywhere in the United States, from beaches and prairies to hills and mountains. Those



Sojourner's path around the lander.

extremes of terrain and conditions are also present on Mars. Without orbiters like *Odyssey* and the Mars Global Surveyor to take pictures of Mars' terrain, engineers and scientists would have little to go on.

"Pathfinder was the first mission to accurately predict what the landing site was going to be like before getting down to the surface of the planet," said Mars Pathfinder Project Scientist Matt Golombek. However, engineers did not know what conditions the Pathfinder rover would encounter on Mars before they designed the vehicle to survive at least a week of safe roving. "It's kind of like the chicken-and-the-egg problem," Manning said. "We are trying to learn about what Mars is like by sending missions there, but the missions need to know what Mars is like to go there."

Manning likened the evolution of design for Mars spacecraft to that of bicycles in the late 1800s. "Bicycles today look very different than they did back then because we continued to develop them. Vehicles of the future are going to look very different than they do today because we often have to discover what to build as we build it. It's a race between what we learn about the technologies we develop and what we learn about Mars."

Since Pathfinder, engineers have added more intelligence to the spacecraft and more control as the vehicle approaches landing. They have also obtained a better simulation of how winds develop and flow on Mars, as well as a better understanding for how those winds affect a safe landing. This benefits them when picking a landing site, but it limits where and how high they can go.

Sharing the Information

Since no orbiters operated around Mars during the Pathfinder mission, Pathfinder was unable to transmit information via orbiter back to Earth. Instead, the *Sojourner* rover used the Pathfinder lander as a middleman to communicate with Earth. This meant that the rover had to stay close to the lander at all times. This presented limitations not only in the amount of ground that could be explored, but also in the amount of information scientists could receive in one day. Sending and receiving information through the lander's direct-to-Earth link (an antenna pointed toward Earth) used up a lot of energy, and the rover's battery had to be saved to keep warm in Mars temperatures, which varied daily by 38 degrees Celsius (100 degrees Fahrenheit).

Scientists and engineers have learned from this, and as a result, have given the Mars Exploration Rover the ability to communicate directly with Earth. The disadvantage is that images of the rover from the

lander will be unavailable; however, the Mars Exploration Rover will have more ways to send information back to Earth. Critical data like spacecraft health and basic information on findings can travel through a direct-to-Earth link like the one used on Pathfinder. Extraneous images and other non-critical data can travel through the close-by *Odyssey* orbiter, which transmits information to Earth in a matter of minutes.

Serving up the Science

"Pathfinder started the thread of continuity between science, water, climate and life, and the Mars Exploration Rover will continue it," said Golombek, who is also a science team member on Mars Exploration Rover.

Pathfinder's discoveries, combined with images from orbiters and the raging debate among scientists about life on Mars, has in some sense sparked a renaissance in Mars exploration. "It has changed the way scientists work with Mars and the way scientists work together," Manning said. "Scientists of different disciplines now collaborate to solve complicated problems and to understand how life and natural history complement each other."

Mars has been opening secrets very slowly with tantalizing excitement, such as the most recent *Odyssey* discovery of evidence of water. In 1996, before Pathfinder launched, scientists had enough evidence to predict water just below the surface of Mars, but the discovery was still surprising.

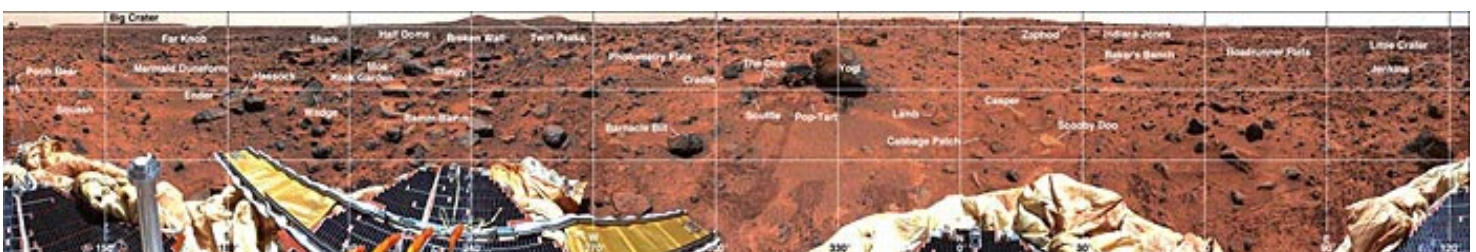
The big question, Manning believes, is where did the water go? "It couldn't have all evaporated," he said, "We know there is a big correlation between water and the evolution of life on this planet, so we have lots of hope that there may be signs of early life on Mars."

Future missions will discover a lot about Mars' very complicated history and how it came to be the way it is now. "You must crawl first, then walk," Golombek said. "Pathfinder was the first baby step, Mars Exploration Rover is going to take the next big step, and we're hoping for more steps beyond that."

Discovery's two missions of opportunity, [ASPERA-3](#) and [NetLander](#), will further Discovery's contribution to Mars exploration.

This article is adapted from a Spotlight featured on the JPL web site on 7/1/02.

Thanks to author Charli Schuler, JPL Media Relations.



Mars panorama with rock names labeled.

Genesis Science Collection Continues

Solar particle collection continues as [Genesis](#) approaches one year of flight. The spacecraft has most recently been in low-speed solar wind. In early July, during some high-speed wind, the concentrator rejection grid's voltage autonomously went to its maximum value of 2060 V without incident. The team estimates that approximately 1350 commands have been radiated to the spacecraft since launch.

Genesis has been collecting solar wind particles for nearly eight months. In mid-May, Genesis successfully completed the first of its five planned loops around L1. Coronal mass ejections, fast solar wind/coronal holes, and slow solar wind regimes have all been observed and the appropriate arrays were deployed to collect samples from each type of solar wind. In late May the solar wind exhibited some unique behavior, including a "day when the solar wind disappeared."

The spacecraft detected extremely low densities (one particle in ten cubic centimeters or less than one particle in a cubic inch), extremely high wind speeds (approaching 1,000 kilometers per second or 2,000,000 miles per hour), and multiple coronal mass ejections. The onboard WIND algorithm was stumped by this rare behavior, so it positioned the collector arrays to a conservative configuration and set the concentrator high voltages to zero until conditions became more normal. WIND has since detected a more normal coronal mass ejection regime and the arrays and concentrator have responded as intended.

Education and Public Outreach Highlights

A new video, "Testing to Assure Mission Success: A Look Inside Los Alamos National Laboratory," documents work done for the mission at Los Alamos National Laboratory, New Mexico. Click [here](#) to view the video, access the teacher guide and student activity that accompany it, and request materials online.



Los Alamos National Laboratory

The latest "Genesis in Education" module is "[Destination L1: A Thematic Travel Unit](#)." This interdisciplinary module about the spacecraft's journey to L1 takes a thematic approach to the concept of traveling and destinations. All of the major disciplines are included in a unit that can be taught in one week. This module focuses on the million-mile journey that Genesis took to LaGrange point 1, or L1,

and also contains information on L1 from a mathematical and historical perspective.

The [Internet Scout Project](#) selected the "Genesis Press Room: Video Releases" for inclusion in the National Science Digital Library Report for Math, Engineering, and Technology (June 21, 2002). The report is a biweekly current awareness publication that highlights new and newly discovered Internet resources.

The Genesis mission sponsored May 2, 2002 Space Day online activities for kids across the country. In a single day, over 150 children had fun with the Genesis [scavenger hunt](#). They completed a quiz to win their choice of prizes, which are being distributed by mail at this time. By visiting the Genesis mission web site, children and parents had the opportunity to learn about space science and its history, a goal of the national Space Day event.

Genesis has produced a mission trajectory [screensaver](#) which you can download to your computer.

Stardust Moving Toward 2004 Comet Encounter

Weekly Deep Space Network passes of the Stardust spacecraft continue and all subsystems are normal. New configuration files have been successfully sent to the spacecraft, updating the knowledge of the Earth and Sun positions. These files are periodically updated with the latest trajectory data to provide better pointing knowledge. The team completed a detailed review of the Comet Wild 2 encounter fault tree, an analysis of all the possible complications that could arise during the Comet Wild 2 encounter. This is an exercise to identify and fix any potential problems in advance. The review identified and analyzed over 230 potential events and showed areas where additional analysis will be required but no showstoppers were identified. Work on the analysis continues.

In June, the European Space Agency's new 35-meter antenna at their deep space tracking station in Perth, Australia, called New Norcia, performed its first tracking test using Stardust's spacecraft signal. During a normal communications session between the Stardust and the DSN station in Canberra, Australia, the New Norcia station was also successful in detecting and tracking Stardust's signal for 2 hours.

A recent study to determine if Stardust flies closely by any of about 50,000 asteroids during the remainder of its mission found that 1,334 asteroids passed within 0.1 astronomical units (just over 9 million miles, or 15 million kilometers). Of the closest of these encounters, only the Asteroid 5535 Annefrank flyby occurs before Stardust plans to encounter Comet Wild 2.

Stardust is currently 298 million kilometers (182 million miles) from Earth and has traveled over 2.2 billion kilometers (1.4 billion miles) around the Sun since its launch in February 1999.

Education and Public Outreach Highlights

In May, aerogel, the particle-collecting substance on Stardust, was recognized by Guinness World Records as the solid with the lowest density. The Discovery Channel Canada and the BBC Discovery Channel, London, aired the Guinness aerogel story. The Pasadena Star News, Los Angeles Times, Space.Com, CNN Science and NY Times Science News also ran articles highlighting JPL's aerogel achievement. On July 11, NASA TV hosted live satellite interviews with project manager Tom Duxbury and aerogel scientist Peter Tsou — who spoke in the first Chinese-language live shot in JPL history.



Scientist Peter Tsou with a sample of aerogel.

In June, the STARDUST E/PO team participated in the Teacher Enhancement Program, sponsored by the National Science Foundation and hosted by the Institute of Astronomy at the University of Hawaii. The focus of the program was Toward Other Planetary Systems 2002, involving educators and the general public. STARDUST personnel discussed comets and NASA missions to comets.

The Stardust Education and Public Outreach (E/PO) team, as part of its passing on lessons learned to other Discovery small body missions, participated in a CONTOUR mission educator training workshop at the Kennedy Space Center as part of CONTOUR launch support activities.

MESSENGER Development in Progress

[MESSENGER](#) science team activities in June continued to center on the planning of data management from the instruments to data recovery on the ground and eventual dissemination to the science community, public, and appropriate archives. The focus is shifting to include dealing with more issues related to instrument calibration requirements and schedule.

Education and Public Outreach Highlights

Many team members are involved in the development of the new MESSENGER web site. It will include educational modules based upon the mission's three science themes; a section on "Mercury – the Planet" with animations and illustrations to illustrate basic characteristics (size, mass, orbit, nearness to Sun, etc.) of the planet; and a "Frequently Asked Questions" area which is currently being designed.

The 9th Annual CASE Summer Science Institute was convened on June 24th with a thematic focus on the Sun and the planet Mercury. Forty elementary teachers and 12 DCPS mentors will meet for five weeks to explore concepts and experiences related to Earth and Space, Life and the Physical Sciences. Sensing Energy, an activity about solar radiation was used the first day in order to develop thinking about the Sun's energy. Such experiences will later be expanded to consider remote sensing, the challenges of planetary exploration and other mission related topics.

Work continues on "MESSENGER – The Movie." The documentary team did one shoot at Goddard, checking in with the MLA team as they began building the engineering model of the instrument, and two shoots at APL, one covering part of the early stage of building the harness onto the spacecraft mock-up and one on the quarterly meeting of the Mission Integration Working Group. The team also spent several days shooting at vendor facilities in California, filming the cutting and assembly of laminate panels for the spacecraft structure, and the testing, welding and re-testing of the propulsion qualification tank.

Deep Impact On Track

Development of the [Deep Impact](#) two-part spacecraft and its science instruments continues on schedule toward a January 2004 launch.

Education and Public Outreach Highlights

The Deep Impact Education and Public Outreach team began new partnerships with the Girl Scouts of the USA and 4H Club through training workshops for their leaders and counselors. The Girl Scout leaders were competitively chosen on a national basis to attend a four-day workshop during which they learned activities based on NASA missions. Deep Impact represented the three NASA Discovery missions to comets with activities in comet science and mission technology.

Deep Impact also headed into new territory for NASA missions by attending and evaluating a pilot program incorporating storytelling into education at the International Storytelling Center in Jonesborough, Tennessee. This program will be offered nationally beginning this year. The Deep Impact mission will have a comet story with connected activities available for educators who would like to teach science through storytelling.

Deep Impact also opened doors to a new audience by training 52 educators of special or at-risk students in comet science and activities. The "ice cream comet" recipe combines candy as comet debris and then asks the students pretend to be spectrometers to figure out what the ingredients are using their senses as filters. It's a real hit!

The University of Maryland portion of the E/PO team continues to develop relationships and programs for amateur astronomers to make them an active part of the launch and encounter with Tempel 1. Many science and engineering team members have been visiting classrooms with slides, comet models and fact sheets to talk about comets and the Deep Impact mission. Others have hosted groups of children at JPL to learn about comets.

The E/PO team partnered with the Europa Orbiter team to bring a cultural experience in comet study to the TOPS workshop for Pacific Island and minority educators in Hawaii. Special guest Joseph Chasinghorse from the Lakota nation brought star stories to combine with movement and storytelling activities from the missions. This encouraged educators to use non-traditional activities in their cultures to reach those students less interested in math and science. Science team member Karen Meech has run the workshop for several years.

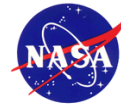
In July the E/PO team trained the educators for the NEW workshop and are now preparing for the Solar System Educators who will come to JPL for their third training in early August.

Discovery Dispatch

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