Roundup

SPACE CENTER ROUNDUP • Lyndon B. Johnson Space Center
Volume 44 • Number 4

Explore. Discover. Understand.

Home on the range at JSC

NASA/Markowitz JSC2005E07651

NASA/Markowitz JSC2005E07650

NASA/Blair JSC2005E07372

The Texas Independence Trail Ride arrived at JSC just in time for Rodeo Houston! Astronauts joined the trail riders as they rode through the Center. Children from the JSC Child Care Center participated in the festivities by greeting the trail riders and learning about various livestock. NASA shared its Vision for Space Exploration this year at Rodeo Houston with an interactive exhibit and autograph opportunities from several astronauts.

Clockwise from top left: *Astronaut Ron Garan accompanies the trail riders.*

The trail riders make their way past Rocket Park.

Riley Martin holds a baby chick at the JSC Childcare Center.

Space Center Roundup

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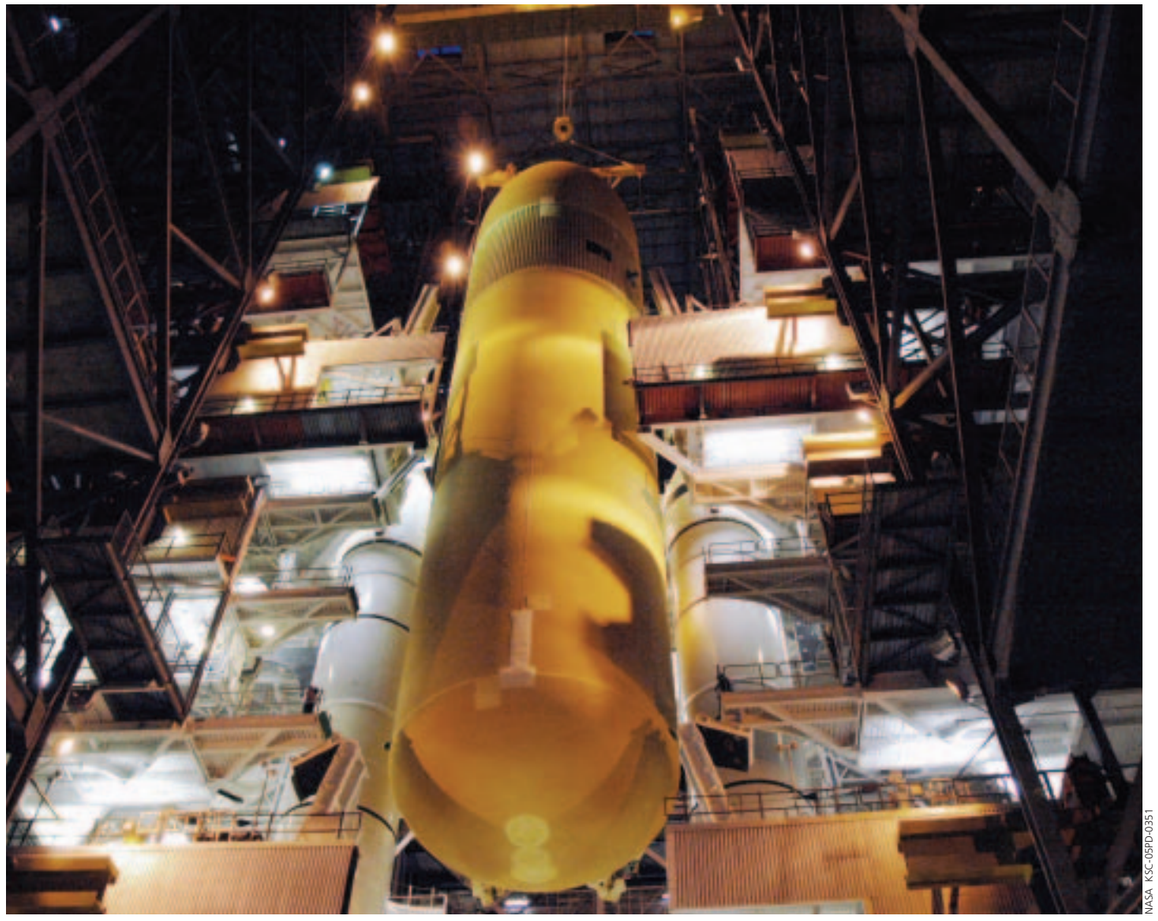


NASA KSC-05PD-0351

Getting ready to rumble

The immense size of the External Tank (ET) is captured here as a crane lowers it between the Solid Rocket Boosters (SRBs) on the Mobile Launcher Platform. The ET, designated for the Return to Flight mission STS-114, will be mated to the SRBs for launch. The 154-foot long ET was recently redesigned to meet recommendations of the *Columbia* Accident Investigation Board before returning to flight. Among dozens of changes is a redesigned forward bipod fitting to reduce the risk to the Space Shuttle from falling debris during ascent. Considered a test flight, STS-114 will carry supplies and equipment to the International Space Station.

April 2005
Houston, Texas

Beak sends...

A MESSAGE FROM CENTER DIRECTOR LT. GEN. JEFFERSON D. HOWELL JR.

April thoughts

A time of renewal. New beginnings. New life. Hot sun. Warm weather. Old muscles feeling better. The birds and the bees, etc.

Spring rain. Green fields. Clear blue skies. Mocking Bird serenades early in the morning. Wild flowers. Millions of Blue Bonnets between Columbus and Bastrop.

Baseball. A new season. Go Astros!

A new Administrator named. Impressive resume. Sound views. New energy. Solid leadership.

Exploration. Much excitement. Much uncertainty. Assurance that we will be in the middle of it.

ISS crew change. Well done to Expedition 10! All the best to Expedition 11. Back to Moscow and Kazakhstan. Outstanding US team in Russia. Our partners come through again.

The final push for Return to Flight. Stress. Continual boards and meetings. Added Stress. Stacks of paper to close. More stress. Important issues yet to resolve. Even more stress. Determination to get it done. Excitement mixed with concern. We're going to fly!

Profound thanks for being a part of this elite team!

IT'S GREAT TO BE ALIVE AND IN HOUSTON!!

"Victory belongs to the most persevering."

Napoleon Bonaparte

Courtesy of the Joint Leadership Team

Closer to launch

NASA KSC-05PD-0489

The orbiter Discovery *slowly rolls out of the Orbiter Processing Facility bay 3 to begin its transfer to the Vehicle Assembly Building (VAB). Inside the VAB,* Discovery *will be mated to the External Tank/Solid Rocket Booster assembly for Return to Flight mission STS-114.* *See the complete story on pages 4 and 5.*

NASA's Space Shuttle *Discovery* is one important step closer to launch. *Discovery* was rolled from its hangar early in the morning of March 29 to the Vehicle Assembly Building (VAB). *Discovery* will be attached to its propulsion elements, a redesigned External Tank (ET) and twin Solid Rocket Boosters (SRBs) at NASA's Kennedy Space Center, Fla.

NASA's *Discovery* rolls to major return to flight milestone

"THIS IS A TREMENDOUS ACCOMPLISHMENT

for the Space Shuttle Program," Bill Parsons, Space Shuttle Program Manager, said. "This effort has taken a talented team dedicated to meticulously preparing the vehicle and implementing all the modifications for a safe Return to Flight."

Discovery's launch window is from May 15 to June 3. Its mission, designated STS-114, will take Commander Eileen Collins and six crewmembers to the International Space Station. The mission is the first of two test flights to check out new inspection and repair techniques, as well as to deliver supplies to the Station. It is the first Shuttle mission since the *Columbia* accident in Feb. 2003.

Discovery's journey began as it was moved from its hangar to the VAB. In the VAB, a lifting sling was attached to the orbiter in preparation for attachment to the ET and twin SRBs. Work on *Discovery* in the VAB includes installation of a new digital camera, testing electrical and mechanical attachments between the orbiter and ET and umbilical checks.

"I could not be more proud of the team that spent the last two years working on *Discovery*. We are extremely excited to reach this point in the processing for flight," Stephanie Stilson, NASA Vehicle Manager for *Discovery,* said. "Seeing the orbiter roll to the VAB is the culmination of all of that hard work. We look forward to a safe Return to Flight."

While in the Orbiter Processing Facility, *Discovery* underwent 41 modifications in response to the *Columbia* accident and the recommendations of the *Columbia* Accident Investigation Board. They included addition of the new Orbiter Boom Sensor System; equipping the orbiter with cameras and laser systems to inspect the Shuttle's Thermal Protection System (heat shield) while in space; sensors in the leading edge of the Shuttle's wings, a new safety measure that monitors the orbiter's wings for debris impacts; and a new digital camera to view the ET during launch.

Discovery also completed its Orbiter Major Modification (OMM) period that began in Sept. 2002. Technicians completed 107 additional modifications to *Discovery*, 17 will be flying for the first time. OMMs are scheduled at regular intervals to enhance safety and performance and to infuse new technology.

The next Return to Flight milestone, currently scheduled for the first week of April, will be when *Discovery* begins its four mile journey to Launch Pad 39-B.

NASA KSC-05PD-0488

NASA KSC-05PD-0490

Above: One of the orbiter Discovery*'s payload bay doors is nearly upright as it closes. Seen in the center and at left are the new Orbiter Boom Sensor System (OBSS) and the Remote Manipulator System. The OBSS is one of the new safety measures for Return to Flight, equipping the orbiter with cameras and laser systems to inspect the Shuttle's Thermal Protection System while in space.*

Left: Workers show their support as the orbiter Discovery *slowly rolls out of the Orbiter Processing Facility bay 3 to begin its transfer to the Vehicle Assembly Building.*

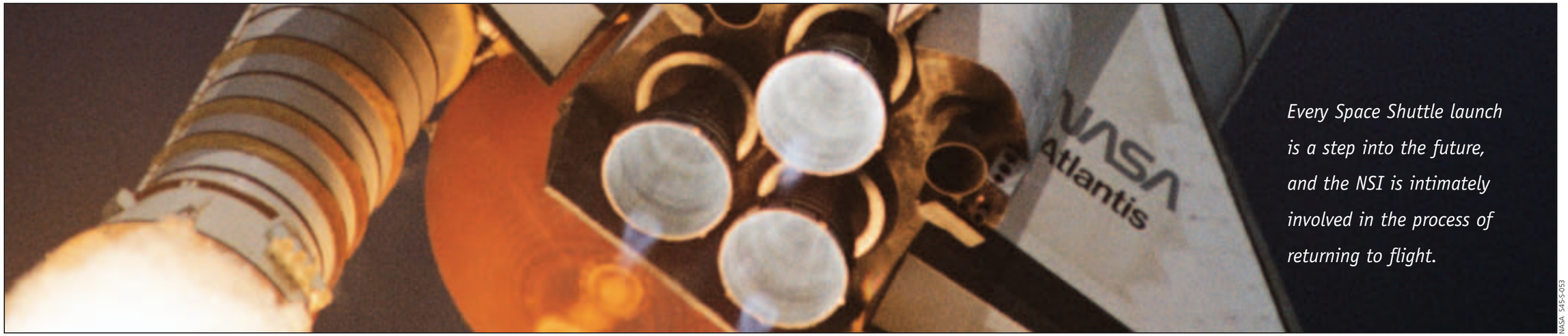
NASA KSC-05PD-0491

The orbiter Discovery *rolls over to the Vehicle Assembly Building, marking a major milestone in the march to Return to Flight.*

All fired up!

JSC pyrotechnics propel space exploration

by Catherine E. Borsché



Every Space Shuttle launch is a step into the future, and the NSI is intimately involved in the process of returning to flight.

NASA S45-S053

What device not only sparks the imagination of engineers but also ignites the pyrotechnic chain of events that powers the Space Shuttle? The NASA Standard Initiator (NSI) does this and much more for the space program. Considered the world standard for electro-initiated explosives, NSIs are small explosive devices used in the Shuttle, Mars Exploration Rovers and many Jet Propulsion Laboratory (JPL) planetary probes.

"The NSI is basically the electric match that starts it all," Todd Hinkel, subsystem manager for Orbiter Pyrotechnics, said.

It's easiest to think of the NSI as a mini explosive. Each NSI contains a bridgewire, which is a tiny piece of metal used to conduct electric current into the device.

"To make the NSI go off, you send current through that bridgewire," Keith Van Tassel, group lead for Johnson Space Center Pyrotechnics, said. "It gets so hot that it melts, and there's enough heat from that melting to ignite the propellant that's around it."

And, in roughly 300 microseconds, the NSI detonates.

"Generally, we use pyrotechnic events for a one-shot function. If you want to push or pull on something just once, then the amount of energy and the amount of volume taken up by a pyrotechnic device is much more efficient than using hydraulics or an electric motor," Van Tassel said.

The efficiency of the NSI, as well as its stellar performance throughout the history of the space program, makes it a popular choice for engineers.

"The NSI is an extremely robust device that has an operational temperature range of +300 degrees to –420 degrees Fahrenheit," Hinkel said. "We've had approximately 10,000 successful firings on the Shuttle. We've even had tens of thousands of successful firings if you take it back to the Apollo era and consider the other vehicles and unmanned craft that have used NSIs."

Currently, the Space Shuttle is NASA's largest NSI customer. A total of 137 units are flown on each mission, with 102 fired during a normal flight. The remaining NSIs are installed for emergency situations where deployment or separation is needed for immediate use.

NSIs are prevalent in JPL's crewless programs as well.

"In the case of the Mars rovers, most of the NSIs were used during the landing phase. Some were used to slow the descent, jettison the heat shield, deploy parachutes and then cut away the parachutes. They were also used to inflate and deflate the balloon air bags," Van Tassel said. "Once the rover was stabilized on the ground, there were some NSIs that fired pyrotechnics to cut wires and release the rover from the pad."

JSC has the distinct responsibility of logistics management, manufacture and certification of NSI for government-wide consumption. JSC is also the only NASA facility capable of performing the –420 degree Fahrenheit functional tests to evaluate the hardware.

"NSIs are deceptively simple, but there's a lot of work and technology that goes into making sure they work right and are so reliable," Van Tassel said.

The rigorous testing done at JSC is just a part of what makes NSIs so safe.

"The testing at –420 (degrees Fahrenheit) weeds out manufacturing defects," Hinkel said. "We are very abusive to our devices before they get put on a NASA flight."

Another important safety feature is that there is always a backup NSI in case one does not fire. The redundancy built into the system is designed to provide a safety net if in fact an NSI does happen to fail.

Every Space Shuttle launch is a step into the future, and the NSI is intimately involved in the process of returning to flight.

"We are there from the start of the mission to the finish, from lighting the Solid Rocket Boosters to finally releasing the drag chute at the end of the mission," Hinkel said.

There is no question why these small wonders are so inherently tied to space exploration.

"Basically, when you want something that you know is going to be reliable, you ask for the NSI," Van Tassel said.

STAR Design 2005

by Brad Thomas

Architecture students often dream about designing grand skyscrapers or palatial homes on Earth. Recently, however, a group of students had the opportunity to use their rulers and compasses to design an out-of-this-world home for astronauts.

Seven architecture majors and a physics major from Sweden's Lund Institute of Technology participated in the NASA educational outreach program called STAR Design 2005. One of the program's objectives for 2005 is the development of innovative crew habitation systems that could help NASA in realizing the Vision for Space Exploration.

The students spent two weeks at Johnson Space Center in Houston working with the Exploration Systems Engineering Office and the Advanced Extravehicular Activity Team. They learned about the human spaceflight program and designed the interior of a cylindrical living module, with an emphasis on human needs like eating, recreation, and rest to name a few.

STAR Design is a cooperative program between NASA and Lund that began in 1998. Each year there has been a different focus for the students.

Larry Toups, an engineer of the Exploration Systems Engineering Office, serves as the director of the program at JSC. Toups said that the students' work could help NASA as it prepares for future missions to the Moon and Mars.

"Yes, any time we use educational outreach as a means for gathering new ideas and concepts for how we might explore is always beneficial," he said. "Students think of new approaches at how we might live and work on the Moon and Mars based on their terrestrial design experiences."

This year's students were tasked to submit designs for the interior of a silo at the JSC Planetary Rockyard. The silo is an existing structure at the center's Planetary Rockyard, which contains simulated lunar and martian terrain. The silo could be converted into a habitation module mock-up for future astronaut training purposes.

Even though this was an architecture project, Toups said that math and science education played a role in the students' efforts. "Architecture curriculum does include the study of math and science as part of a broad base of training," Toups said. "During this project the students were constantly having to convert between our English units of measure and their metric units. Also, in researching about the lunar/Mars environment that the real habitat would function in, they had to readjust their assumptions used in terrestrial design, such as differences in gravity and atmosphere."

Like the International Space Station or the Space Shuttle, the habitable volume of a structure on the Moon or Mars will be limited and much planning must take place in order to use that space as efficiently as possible.

> *"You have to have science to be creative."*

Designing the interior of a human habitat for the Moon or Mars offers a challenge that designing the interior of a space station does not – gravity. Since the Space Station is in a microgravity environment, the restrictions on the use of habitable volume are less than they would be in a structure on the Moon or Mars. On the Moon and Mars, gravity will limit the amount of space that can be used.

NASA/Stafford JSC2005E10553

From left to right: Lund Institute of Technology students Elin Mossberg, Niklas Weser and Emma Rytoft discuss their STAR Design 2005 project with Sue and Connie Lee.

There is another twist. Since the Moon's gravity is about one-sixth of the Earth's gravity and Mars is about one-third, the architecture students could not treat the design as if it were for a structure on Earth. For example, the ceilings would need to be higher since the astronauts would have more "spring" in their step when they walk.

Architecture student Hanna Odestig said that their job was to provide ideas that could be used to prepare for future missions and that science played a part in their efforts. "It has been interesting to look at the flexibility," she said. "You have to have science to be creative."

Their design concepts included movable slabs and expandable walls.

Lund Architecture Lecturer Christian Wilke accompanied the students to JSC. He said that the eight students were selected after an in-depth interview process. Wilke said that this project will help the students in their future endeavors, even if they choose work in fields other than space exploration.

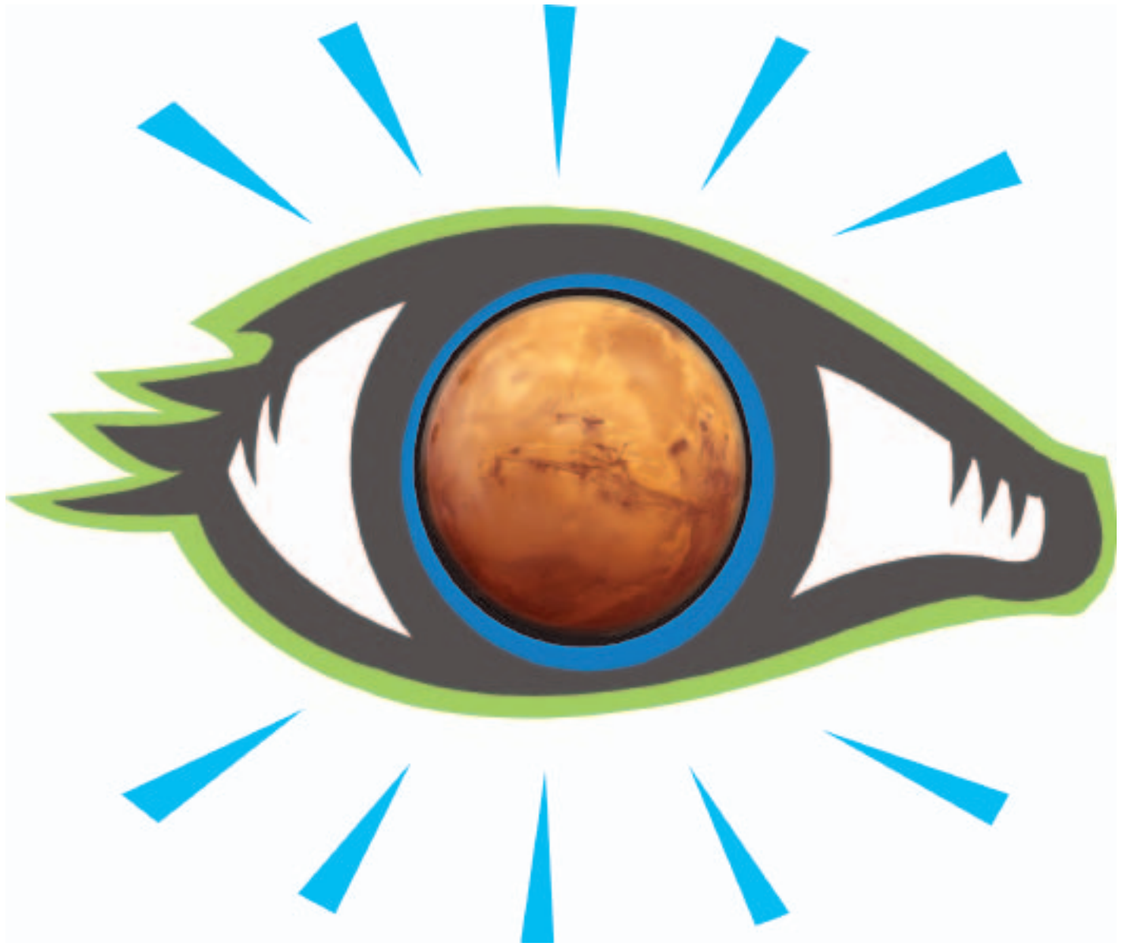
"The main idea is to put them in an unknown context in which they can't relate in the beginning, so they will start asking questions instead of using old solutions," Wilke said. "By doing this, they will get a more research-approach to architecture and science."

During the process, some of the students thought about what would be their greatest human need if they were an astronaut going to live on the lunar or martian surface. Odestig said that privacy would be a need for her. "I would want a good way to find my own private space," she said. "It is not a very large area."

Architecture student Sandra Kopljar said that she enjoyed the experience and stressed the importance of education in getting opportunities like she had with the STAR Program.

"If you really put an effort into your education, you have so much more to choose from," Kopljar said. "That is your reward."

Toups said that the students are not the only ones that learned during the project. "Any time I work with students, I feel as though I am learning from them," he said. "We need to remember that regardless of our focus here at NASA, a fresh set of eyes and imagination are needed to look at the way we envision the future. Don't forget that some of these students may be the ones who will actually be there when we establish permanent human presence outside of Earth orbit."



Eyeing the future

by Catherine E. Borsché

In space travel, one thing is certain: We have only scratched the surface when learning about the effects of microgravity on the human body. One topic of particular interest to the medical community is the effect that spaceflight has on the eye health of astronauts. Due to the lack of information in this field, scientists at Johnson Space Center are working to uncover the answers.

"While we thoroughly examine each astronaut prior to and following a mission, we must always concern ourselves with the harm that is sustained during a mission but may not manifest itself for years," Dr. Keith Manuel, senior vision consultant with JSC Flight Medicine, said.

Investigators in the Space and Life Sciences Directorate at JSC, in association with Brigham and Women's Hospital in Boston, Baylor College of Medicine, Space Center Eye Associates and Wyle Laboratories, have developed a study to evaluate cataract development in space. This study will determine the eye health risks associated with spaceflight and help scientists find ways to countermeasure the harmful effects.

A cataract is a clouding of the normally clear lens of the eye, which can be compared to a window that is frosted or yellowed. Clouding occurs because fiber cells in the lens become abnormal and block light from passing through the lens. Surgery is currently the only option for correcting cataracts.

"Information obtained from the study will provide new insights into the role of various components of space radiation in cataract development, as well as establish new leads for future research," Dr. Francis Cucinotta, chief scientist for the Space Radiation Health Project, said.

To complete the study, investigators will track eye lens changes in various control groups using specialized digital imaging. Three groups are being carefully monitored: astronauts; civilians with a history of military aviation; and civilians with a history of no military, commercial or private aviation.

NASA/Markowitz JSC2005E10557

Dr. Keith Manuel, senior vision consultant for JSC Flight Medicine and optometrist, conducts an eye exam with patient Lisa Marek of Wylie Laboratories. Annual eye exams enable scientists to track the progression of lens abnormalities for the cataract study being done by the JSC Space and Life Sciences Directorate.

Recently, a team of investigators in JSC's Space and Life Sciences Directorate reported that cataract occurrence is greater among astronauts when compared with non-astronauts. Also, preliminary studies done with animals using heavy ion accelerators to simulate radiation suggest that cataracts will grow faster in space. Scientists are concerned that risk factors linked to spaceflight and astronaut training could possibly contribute to cataract formation.

"There are many physiologic threats that astronauts sustain when they 'go to work,' and we in the medical community must keep a constant vigil on their behalf," Manuel said.

In space, astronauts do not have the Earth's natural protection from radiation, noted Cucinotta.

This study will determine the eye health risks associated with spaceflight...

During the first few years of the study, participants will get an annual eye exam and complete a food frequency questionnaire. Using data collected from the participants, researchers will then determine the prevalence and progression of different types of cataracts and probe the potential risks of radiation exposure during spaceflight.

While there have been limited studies on space radiation and cataracts, some basic information has also been acquired from ground-based medical research.

"Patients exposed to increasing doses of radiotherapy for cancer or bone marrow transplantation have been shown to develop cataracts," Cucinotta said. "Another study conducted with commercial pilots showed an association between flight time and cataract prevalence."

"Another goal of the investigation is to develop a means of assessing agents that may slow the incidence or progression of cataracts," Cucinotta said.

Baby Boomers will benefit from these studies as they age and need advanced medical care for ailing eyesight. Future spaceflight will also reap the rewards.

"The knowledge gained from this study will be invaluable for NASA and its population of astronauts by improving radiation shielding in space vehicles and future prevention of cataract development," Cucinotta said. "This investigation will make a significant contribution to spaceflight safety."