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### The Mission



**Orbiter:** Discovery  
**Mission:** STS-128  
**Payload:** Leonardo  
**Launch:** Aug. 28, 2009  
**Time:** 11:59 p.m. EDT  
**Site:** Pad 39A, Kennedy Space Center  
**Landing:** Sept. 10 @ approx. 7:06 p.m.  
**Site:** KSC's Shuttle Landing Facility

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### The Crew



Meet the astronauts flying aboard Discovery's STS-128 mission.

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- PLT: [Kevin Ford](#)
- MS 1: [Pat Forrester](#)
- MS 2: [Jose Hernandez](#)
- MS 3: [Danny Olivas](#)
- MS 4: [Christer Fuglesang](#)
- Up: [Nicole Stott](#)
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## Can vaccine breakthrough help cure NASA's ills?

BY CRAIG COVAULT  
SPACEFLIGHT NOW

Posted: September 7, 2009



A vaccine to protect people against Salmonella, a deadly bacteria that often contaminates food processing operations, is headed for human testing following commercial development in zero gravity on the space shuttle and International Space Station.

Astrogenetix, the Austin, Texas based research company which funded the work, is in the process of applying to the Food and Drug Administration for human trials then, marketing of the space developed Salmonella drug.

The U.S. Center for Disease Control (CDC) says that Salmonella annually sickens about 7 million people alone in the U.S., hospitalizing 20,000 and killing about 500-700 of its victims. The disease costs the food processing industry billions of dollars annually in protective measures. And every month the CDC is forced to temporarily close plants and compel the recall of food products that may be contaminated by Salmonella.



Color-enhanced scanning electron micrograph image shows live Salmonella bacteria (red) invading cultured human cells. Astrogenetix is developing a vaccine for Salmonella using gene removal pioneered on space shuttle missions

### Current Shuttle Mission Patch

The official embroidered patch for shuttle Discovery's flight to deliver equipment and research gear to the space station.



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### Ares 1-X Patch

The official embroidered patch for the Ares 1-X rocket test flight, is available for purchase.



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### Apollo Collage

This beautiful one piece set features the Apollo program emblem surrounded by the individual mission logos.



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### Project Orion

The Orion crew exploration vehicle is NASA's first new human spacecraft developed since the space shuttle a quarter-century earlier. The capsule is one of the key elements of returning astronauts to the Moon.



- [U.S. STORE](#)

to ISS. Credit: Rocky Mountain Laboratories

With the Salmonella results in hand, Astrogenetix is funding research specifically on STS-128 and future station missions to develop a vaccine for Mersa, a serious skin disease. The initial Mersa results are to be returned to Earth this week on board Discovery.

In addition to a possible major advance in public health, the vaccine work could mark an historic and elusive milestone in space pharmaceutical research and materials processing.

NASA has been trying for 35 years to make commercial pharmaceutical research one justification for its space station expenditures across the Skylab, Spacelab and International Space Station programs.

With the station nearing completion and designated as a National Laboratory, the agency may have finally mastered a winning strategy. That plan now includes multiple companies lining up to fly drug and other materials research efforts on the major new research hardware just carried to the ISS by Discovery.



STS-128 commander Rick Sturckow was imaged in cockpit of Discovery during one of three EVAs performed on the mission. Discovery will be undocked from the ISS tomorrow in preparation for its scheduled landing at Kennedy Thursday evening. Credit: NASA


But can major advancements, like the space developed salmonella vaccine, also help cure what ailes NASA?

Ironically this and other major new commercial interest in using the ISS is developing just as top managers and politicians increasingly cite the ISS as an albatross around NASA's neck.

Some good news could not have come at a better time as most NASA officials fight to maintain funding just to keep the facility aloft beyond 2016 to at least 2020.

"We are very excited about theses Salmonella results that would not have been possible had we not had continuous access to space to the iterative studies necessary," says Jeanne

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Becker chief scientist at Astrogenetix.

Discovery, which today is still docked to the ISS, carried several thousand pounds in new research hardware to the station to substantially increase its materials furnace and fluid laboratory capabilities.

The strong U.S. and European commercial interest in the new facilities will also help generate a stronger user market for commercial unmanned launch and reentry and recovery services for the ISS after the shuttle retires, officials believe.

The orbiter is to undock Tuesday at about 3:30 p.m. EDT. After a final survey for micrometeorite damage and a day of reentry thruster and flight control system checks, the crew will (weather permitting) prepare for a Kennedy Space Center landing Thursday at about 7:05 p.m. EDT.

The new hardware includes a large Materials Science Research Rack (MSSR) furnace and Fluids Integrated Rack (FIR). It is coupled with a highly automated Light Microscopy Module (LMM) capable of examining the zero-g character of diverse fluids and materials. Advanced freezers important to preserving life sciences specimens for return to Earth were also launched to the ISS.

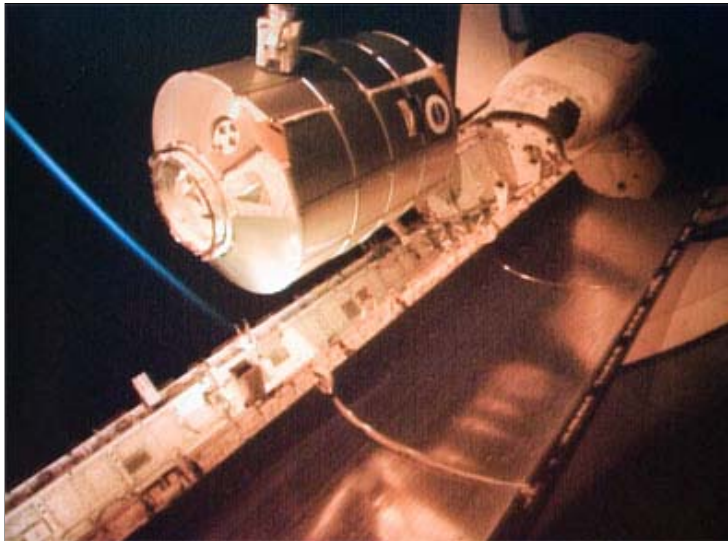
Discovery also carried six U.S. materials samples to melt in the new furnace while European Space Agency provided 11. Many of the ESA samples involve titanium, says Martin Zell, head of ISS Utilization for ESA.

Also paired with the Microscopy Module are two of an eventual six modules for the Glenn Research Center Constrained Vapor Bubble Experiment developed to study advanced heat pipe thermal conductivity systems.

All of the hardware was carried in the Leonardo logistics laboratory to be removed from the ISS later today.



ESA astronaut Christer Fuglesang (top foreground) and NASA STS-128 astronaut Tim Kopra, install the new Minus Eighty Degree Laboratory (MELFI) Freezer on board the ISS Destiny laboratory. Credit: NASA



What goes up must come down. Italian built Leonardo multipurpose logistics module that delivered major new materials and fluid processing facilities to station hangs on ISS manipulator arm above Discovery's payload bay with Earth's limb at sunset in background. Credit: NASA

The Salmonella breakthrough occurred when AstroGenetix, established by Astrotech, discovered that zero gravity increases the potency of the Salmonella bacteria. AstroGenetix then did space tests to determine which genes in Salmonella were responsible for this.

The space testing narrowed the increased virulence to two genes in the bacteria. Those genes were then removed individually for space testing. The bacteria was fed to tiny research worms, which would die if they consumed bacteria with a specific gene. That testing resulted in discovery of the specific gene that causes Salmonella to cause disease.

The company believes that by identifying that specific gene, its scientists can remove that specific gene from Salmonella bacteria reproducing in a ground laboratory. This would create harmless salmonella bacteria that can be used to create a vaccine.

The same gene removal research can be used to disable other disease-causing bacteria for other vaccine production.

"We're really on the forefront of something big here," said Thomas B. Pickens, Astrotech chief executive officer and chairman of the board for the AstroGenetix parent company.

AstroGenetix will follow its Salmonella and Mersa research on Streptococcus pneumonia bacteria. They shuttle will also launch Enterococcus faecalis bacteria that can cause life threatening digestive ailments and the Listeria monocytogenes bacteria that can cause the digestive tract disease Listeriosis. The CDC says that the disease sickens thousands of people per year in the U.S. killing about 30 annually.

AstroGenetix shuttle/station gene research will also be conducted on the bacteria Pseudomonas aeruginosa, which

the CDC says causes troublesome skin diseases. Astrogenetix will target genes and proteins that can be used for therapeutic development. This will include work develop vaccines and antimicrobial and antibiotic drugs, the company says.

Other major developments in connection with STS-128 and the station's transition from assembly to laboratory operations include:

**-- U.S./European cooperation:** The new Marshall Space Flight Center MSRR furnace will be a major new focal point of cooperative U.S./European research, says Julie Robinson ISS program scientist at the Johnson Space Center. That will involve at least for two years of joint work.

But, eventually it will also involve extensive research proprietary to users from each side of the Atlantic and Japan, researchers agreed.

"This is a really exciting facility because there are a number of ways that metal alloys perform in microgravity that are completely different from the way that they form on Earth," she said.

"These are things important to industry like metals, alloys and polymers. So this MSRR furnace will be the first major facility that supports large scale materials science investigations by scientists around the world," says Robinson.

**-- Fluid physics objectives:** The new Glenn Fluids Integrated Rack will allow major new research in areas like colloids, jells, capillary action, bubblers and phase changes, says Robinson. "These are all of the things that matter when you transfer fluids in a microgravity environment."

"Fluid behaviors in zero-g 'matter' from a basic fundamental physics research standpoint and also from a from fluid system operations standpoint," Robinson says. This a fundamental area for the advancement of engineering in new space systems and breakthroughs in the science of fluid physics involved in all manner of ground based research.

**-- U.S. cell growth:** Cell growth for medical and other life



Fluid Integrated Rack/Microscopy Module is pictured during prelaunch testing in Glenn Research Center Acoustic Testing Laboratory. The system will allow the zero-g processing of fluids and examination of diverse materials in highly automated microscopy system. A Vapor Bubble heat pipe experiment was also launched with the system on Discovery. Credit: NASA

sciences research is an especially major new area of commercial fluid research soon getting underway much more extensively on the ISS, says Mark Uhran, NASA assistant administrator for the ISS. "Earlier we flew bioreactors to keep cells alive and propagating," he said. "We now, however, are at the edge of a new frontier" for experimentation that earlier researchers did not have enough time in orbit to fully exploit. The ISS with its new fluid and freezer facilities will allow much more such research, he said.

-- **NASA Announcement of Opportunities:** A major AO has just been issued by the space agency seeking commercial, and other research projects for the new furnace and fluid racks, says Uhran. He expects more than 100 responses soon because industry now know the risk of flying space based research is far more manageable than it is was years ago. "We are very excited about the station's transition from the assembly phase to the science phase" Uhran says. He believes that enthusiasm is mirrored in the research communities outside of NASA, including commercial industry.

-- **European research:** ESA also issued an AO for the new station research hardware somewhat earlier and "the response to it has been enormous," says Zell. " This means the user community is now convinced 'the ISS is really here' as a major laboratory." He said ESA has received about 300 letters of intent from industry and other users, a remarkably strong response.

-- **European technologies:** Zell said many small companies are especially showing interest in developing efficient high performance electrical systems. These are aimed at development in zero-g of new materials that would help spur more efficient electrical power systems for use in new "green economies" he says.

Traditional large aerospace companies like Rolls Royce have also submitted proposals for jet engine related materials improvements such as for titanium used in turbine blades. The European Dusen materials company has also submitted proposals, he says.

-- **U.S. medical heat pipes:** A vapor bubble heat pipe experiment carried aloft by Discovery in connection with the Glenn fluids rack could result in development of brain implants for epilepsy patients, says Joe Plawsky, Rensselaer Polytechnic Institute co investigator for the Glenn Vapor Bubble heat experiment.

He said the ISS research would help engineers model how the design of heat pipe walls and other factors affect how heat pipe bubbles move, shifting warm or cool temperatures from one place to another.

He and other researches are looking how such tiny heat pipe implants could slightly change the temperature of specific

locations in the human brain to counter brain activity that causes epileptic symptoms.

Becker of Astrogenetix and Uhran and Robinson of NASA along with Zell from ESA provided a detailed briefing on all the new developments at the Kennedy Space Center just prior to the launch of the STS-128. It was attended in person by only two journalists.

One problem is that early in the shuttle program 25 years ago, companies like 3M Corp. and Battelle regularly briefed to standing room only news conferences. But none of the advancements they expected ever paid off and the media largely abandoned coverage of the space processing.

Among the more "enthusiastic" forecasters that contributed to this was the Cambridge, Mass. Center for Space Policy where analyst Jeff Mamber predicted that by the year 2000, space pharmaceutical production would hit \$27 billion in annual revenues, generating \$5.4 billion in annual tax dollars.

The center also predicted that by 2000, space processed glasses and semiconductor processing would reap \$14 billion in annual revenues generating \$600 million in tax dollars.

Hindsight shows such predictions were ridiculous.

A quarter of a century later, the completion of the ISS and its designation as a National Laboratory has increased the reliability of NASA commercial projections and partnerships, says Uhran.

"We did have a great partnership with 3M Corp.," he says. But now we have far broader collaboration and access to the National Laboratory structure.

He says new agreements and collaboration with the National Institutes of Health, the U.S. Dept. of Agriculture, the Food and Drug Administration and Veterans Administration provide a far stronger foundation for analysis of potential commercial collaboration than did the think tanks of old.



Marshall Space Flight Center Materials Science Research Rack was cooperatively developed by NASA and ESA to provide the most advanced space processing facility ever developed. Hundreds of U.S./European researchers are in line to use the new facility that couple pioneer a whole new class of metals, glasses and semiconductor materials. Credit: NASA

"We are really now finally on the home stretch" for major advancements in new materials and fluid processing in space, says Robinson.

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