# Beyond 'the good Earth'

by Brad Thomas

Holiday observances from space have varied in scope, but the first caused people around the world to turn their attention to the heavens when the Apollo 8 crew delivered its famous Christmas Eve broadcast from lunar orbit.

Commander Frank Borman, Command Module Pilot Jim Lovell and Lunar Module Pilot William Anders became the first humans to orbit the moon on Christmas Eve 1968. They were also the first astronauts to spend Christmas in space.

During the live broadcast, they sent Christmas greetings and images back to their home planet. The mission provided stunning images of the moon and of the Earth, including the famous image of the Earth rising above the lunar surface. Lovell said, "The vast loneliness is awe-inspiring, and it makes you realize just what you have back there on Earth."

Near the end of the broadcast, the Apollo 8 crew read from the Bible in the Book of Genesis. Before the Scripture reading, Borman closed the message with the words "good night, good luck, a Merry Christmas, and God bless all of you – all of you on the good Earth."

It is estimated that as many as 1 billion people watched the historic broadcast or listened to it on the radio.

Apollo 8 launched from Earth on Dec. 21, 1968 and entered lunar orbit on Christmas Eve. The Apollo 8 crewmembers ended their history-making journey when they splashed down in the Pacific Ocean on Dec. 27. Eight more Apollo missions would visit the moon, with six of them landing on its surface.

The Skylab 4 crew was the next set of astronauts to spend Christmas in space, in 1973. To give Skylab a touch of the holiday season, Commander Gerald Carr, Pilot William Pogue and Scientist Edward Gibson made a Christmas tree with food cans.

It would be 22 years before another American would spend Christmas outside Earth's atmosphere. Astronaut John Blaha celebrated the holiday in orbit aboard the Russian Mir space station in 1996.

NASA ISS01E11145

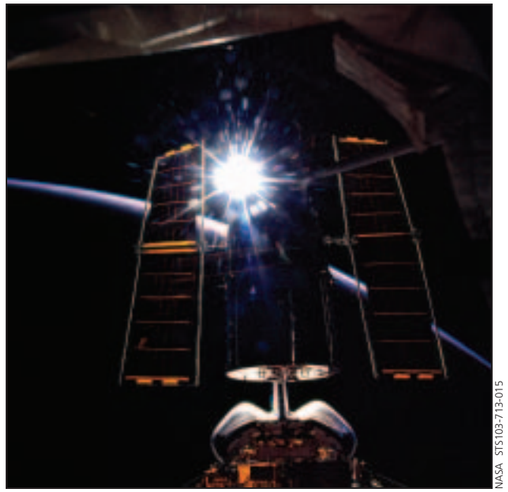
*Astronaut Leroy Chiao, Expedition 10 commander and ISS science officer, poses with holiday decorations in the Destiny laboratory of the International Space Station.*

In 1999, the STS-103 crew gave NASA and the world a present that is still giving to the scientific community. After three consecutive days of spacewalks to make repairs and upgrades, they returned the Hubble Space Telescope to service on Christmas Day. Hubble had been in hibernation since the loss of its fourth gyroscope, which was designed to enable the telescope to point precisely at distant astronomical targets for scientific observations.

After waking to Bing Crosby's "I'll be Home for Christmas," STS-103 Commander Curt Brown began the busy Christmas Day in orbit with a special holiday greeting. "Merry Christmas to all of you down there," Brown said. "And Hubble will be home for Christmas 'cause today we're going to set her free."

Later, each of the seven STS-103 crewmembers, including astronauts from the United States, France and Switzerland, called down holiday wishes from space in several languages after Space Shuttle *Discovery* departed Hubble.

The first Christmas aboard the space station occurred in 2000 with the Expedition 1 crew. Astronaut Bill Shepherd and cosmonauts Yuri Gidzenko and Sergei Krikalev spent a quiet Christmas Day opening gifts and talking to their families.



NASA STS103-713-015

*The sun reflects off the Hubble Space Telescope above the space shuttle Discovery's cargo bay in Earth orbit. It was returned to service by the STS-103 crew on Christmas Day, 1999.*

Even though Santa and his reindeer are unable to reach the orbital outpost, the station crews still receive gifts. The holiday treats are sent to the station on space shuttle, Soyuz and Progress spacecraft.

Four more crews have spent Christmas on the space station. Expedition 4 celebrated with turkey and other traditional holiday foods. The Expedition 6 crew assembled and frosted a cake shaped like a candy cane.

The Expedition 8 crewmembers – Commander Mike Foale and Flight Engineer Alexander Kaleri – celebrated their second Christmas in space with a relaxing day off. Foale served as an STS-103 crewmember and Kaleri served aboard Mir with Blaha. But before winding down for their time off, the duo provided a video of holiday preparations.

In 2004, Christmas Day was unique for Mission Control and for the crew aboard the station. As parts of Houston experienced their first-ever white Christmas, flight controllers tracked the progress of a special delivery to the station. Late in the day, the Expedition 10 crew welcomed the arrival of a Progress cargo ship carrying supplies.

The station's current crewmembers, Expedition 12 Commander Bill McArthur and Flight Engineer Valery Tokarev, expect to receive holiday goodies aboard a Progress cargo ship scheduled to arrive at the station Dec. 23.

## When the clock strikes midnight...


on Jan. 1, it signifies the end of one year and the beginning of another. Officially, the same is true on the International Space Station. However, a station crew could make the case for celebrating New Year's more than once in a 24-hour period.

The station crew's official time-keeping system is Coordinated Universal Time (UTC), which is often referred to as Greenwich Mean Time. Central Standard Time, which is the time used by Houstonians, is six hours behind UTC. For example, when the new year arrives on the station at 0000 UTC (12 a.m.) Jan. 1, it will be 6 p.m. CST Dec. 31 in Houston.

Due to the station's orbit, the crew will unofficially see the arrival of the new year multiple times. The space station orbits the Earth 16 times per day; therefore, it crosses the International Date Line 16 times.

Station crews usually enjoy well-deserved off-duty time and talking with their families on New Year's Day.

The Expedition 1 crew, the first to live aboard the station, marked the beginning of 2001 with a special log entry. Commander Bill Shepherd followed a U.S. Navy tradition in which the person in charge on a ship provides an entry at the start of a new year. He entered a poem that he penned.

NASA ISS008E10768

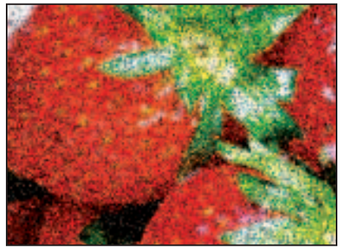
*Astronaut C. Michael Foale (left), Expedition 8 mission commander and ISS science officer, and cosmonaut Alexander Y. Kaleri, flight engineer, pose with holiday decorations in the Zvezda Service Module on the space station.*

# Cosmic cuisine of the future

THE ADVANCED FOOD SYSTEM

by Tiffany Travis





*How do you feed a crew of six astronauts on an 80-million-mile, three-year mission to Mars, where there are no grocery stores, gardens, farms, fertile soil or a resupply vehicle?*

Dr. Michele Perchonok, advanced food systems lead at Johnson Space Center, is one of the many space food scientists working harder than ever to find the answer to this question. Perchonok is developing an Advanced Food System (AFS) that will provide crews traveling to the moon and Mars with safe, nutritious and appetizing food while minimizing volume, mass and waste.

Perchonok said one of the most exciting outcomes of the research and development of an AFS is the potential advancement in food technology.

"There are so many emerging technologies that will be available for use by the time we go on extended missions to the moon or Mars," Perchonok said. "These technologies, whether new preservation technologies or improved methods to process the crops, will allow us to have an even more acceptable and nutritious food system."

## Shelf life and packaging

One of the biggest challenges facing Perchonok and her team of space food scientists is the development of the packaging materials needed for the AFS.

"Our biggest challenge in the near future is to develop a packaging material that provides us with high oxygen and moisture barrier properties without the foil layer (now being used in food packaging). In addition, this packaging material must be compatible with our current preservation technologies," Perchonok said.

"If we are successful, the result will be less packaging waste and easier waste disposal through biodegradation or by incineration," she said.

The AFS approach includes extending the shelf life of a stored food system from 18 months (currently the typical shelf life of space station stored foods) to up to five years, while maintaining a variety of great-tasting foods. With the need for longer shelf life, the menu will move more towards thermostabilized foods, which maintain their quality longer than current freeze-dried foods.

The food will be contained in airtight, lightweight packaging toensure freshness. It will then be stored in the crew vehicle to maximize its shelf life while remaining accessible to the crew.

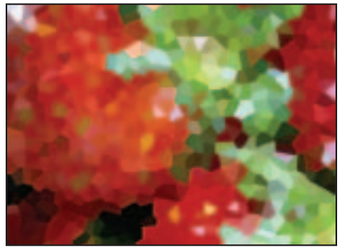
## Space gardening

In addition to stored foods, the AFS includes a menu of fresh vegetables. Ten pick-and-eat vegetable crops have been identified for possible growth in transit on long-duration missions: lettuce, spinach, carrots, tomatoes, green onions, radishes, bell peppers, strawberries, fresh herbs and cabbages.

These crops will provide the crew with added nutrition and variety. Veggies, unlike prepackaged foods, will add bright colors, crisp textures and fresh aromas to the crew's menu.



*A typical martian dinner might include dishes such as spinach and tomato crouton salad, wheat pasta...*



When the crewmembers arrive at their destination, the lack of fertile soil on the lunar and martian surfaces will make stepping into the backyard to grow a garden impossible. Instead, astronauts will build hydroponic growth labs, where pick-and-eat vegetables – as well as white and sweet potatoes, soybeans, wheat, rice, peanuts and dried beans – can be grown. The latter crops would require processing to convert raw goods, such as wheat, into foods such as bread and pasta.

To make food processing a reality, specialized equipment will likely be needed for each crop grown. The martian food processing equipment will be much smaller than standardized equipment and will use minimal water, power and crew time.

If harvested crops cannot be grown, bulk ingredients such as packaged soybeans or wheat berries can be sent with the crew on the mission to be used later.

## What's cooking in the kitchen?

Once on the moon or martian surface, each of the crew's meals will be prepared in the habitat galley using fresh vegetables, ingredients processed from the crops and other stored items. The galley equipment will likely be similar to commercially available gourmet kitchen appliances, modified for use in partial gravity.

A typical martian dinner might include dishes such as spinach and tomato crouton salad, wheat pasta with tomato sauce and a chocolate peanut butter soymilk shake.

## Martian dining for the body and mind

The crew's health and well-being will be a high priority throughout the mission. The longer the mission, the more important it is to have a quality food system that is nutritious, safe and tasty.

In addition to the crew's physical health, psychosocial health has been identified as an important factor during space missions. There is a concern that if crewmembers are under stress, their health and performance will suffer.

Anecdotal reports state that healthier and tastier foods will decrease the stress often experienced by the crew. This suggests that taste, menu variety and an array of textures, colors and flavors can contribute to the psychosocial well-being of the crew.

## Next steps

In the near term, researchers of the AFS must determine the galley requirements for the Crew Exploration Vehicle and develop the new and improved packaging material that will integrate with current preservation technologies.

In the long term, scientists will determine which preservation methods and packaging materials will provide a five-year shelf life for the stored food system. Then experts will need to develop enough products to provide the crew with enough variety and nutrition for the three-year mission to Mars.

Perchonok and her team at JSC are also keeping several extreme long-term goals in mind.

"We will also be developing food preparation and food processing equipment for the Mars missions that is really long term since the Mars missions – where crops are grown and food is processed – are over 30 years away!" Perchonok said.