



Lockheed Martin Space Day: Other Resources

Cosmic Chats – Interviews with former Astronauts

Lockheed Martin Corporation employs a number of former NASA Astronauts. These astronauts were interviewed and they share some of their fun and interesting experiences from their travels in space. A short biography of each astronaut is included, and complete biographies can be obtained at the NASA website: www.nasa.gov.

The following astronauts are interviewed below:

Daniel C. Brandenstein
Brian Duffy
Sidney M. Gutierrez
Richard J. Hieb
Bruce McCandless II
Kenneth S. Reightler Jr.

Daniel C. Brandenstein

Vice President – Program Management

Lockheed Martin Information Technology & Global Services

Daniel Brandenstein became an astronaut in 1979. He was the ascent spacecraft communicator and a member of the astronaut support crew for the first flight of the Space Shuttle, and he served for five years as chief of the Astronaut Office. He logged more than 789 hours in space on four flights. His space flight experience includes:

Pilot — STS-8 Challenger (1983), which deployed the Indian National Satellite, operated new equipment such as the Remote Manipulator System and conducted numerous medical and space-science experiments.

Commander — STS-51G Discovery (1985), which deployed communications satellites for Mexico, the Arab League and the United States; deployed and retrieved a satellite that conducted experiments in space; and performed medical and scientific experiments.

Commander — STS-32 Columbia (1990), which deployed a satellite, retrieved a satellite, conducted numerous middeck experiments and performed medical tests.

Commander — STS-49 Endeavour (1992), which conducted the initial test flight of the Space Shuttle Endeavour on its maiden flight; retrieved, repaired and deployed the International Telecommunications Satellite; and performed a variety of medical, scientific and operational tests.

Mr. Brandenstein retired from NASA in 1992. Today he is Vice President and Program Manager of the Mission Support Operations Contract at Lockheed Martin Space Operations. He was named a member of the Astronaut Hall of Fame in 2003.

What is it like to eat in space?

It's not like at home where you sit down to a table that's nicely set and everything stays where you put it. All of the food containers have Velcro on them so the containers don't float away.

When you're eating in space, you have to be careful that no one bumps you when you have the food on the fork or spoon. If you have fruit cocktail on your spoon and someone accidentally bumps you, it can be a mess because it floats off in all directions.

You have to drink carefully, too. All liquids come in aluminum envelopes, and the straws have on/off valves. You have to close the valve after you take a sip. If you don't close the valve, the liquid will continue to flow right out through the straw.

One funny thing is that adults play with their food in zero gravity. For example, some astronauts like to let lemonade out of their straw. It forms a big ball, then they poke it with the straw and slurp it down. They also like to let go of things like peanut M&Ms and catch them in their mouths.

Did you have a favorite food in space?

I really liked peanut butter burritos, which our crew invented. You'd spread peanut butter on a tortilla and you didn't have to worry about crumbs, like you would from bread. You could put it in your pocket, it was easy to eat and tasted pretty good.

I also liked the shrimp cocktail and the barbecue beef, and a lot of the casseroles were good. Trail mix, M&Ms and cookies were my favorite snacks.

What does the crew do during the ascent?

The commander and the pilot are making sure everything is working all right. The ascent lasts about eight and a half minutes, and they monitor all of the systems and are prepared to take over and intervene if something goes wrong.

If it's a normal launch, there's not a whole lot they have to do during the ascent, but there is a lot of diligence to make sure all of the systems are working right. You have cue cards with numbers for the various speeds, and you verify that while the vehicle is on autopilot it's flying the trajectory it's supposed to be flying. You might take a quick peak outside, but mostly you're focused on what's happening in the cockpit.

Then, once you're in space, the commander and pilot have to reconfigure the computers and other systems to be on orbit. That takes about an hour.

What was your favorite aspect of zero gravity?

It's all amazing. Floating around is a lot of fun. It takes about three hours to learn how to operate in that environment, and you've got to be patient. If you try and hurry, you're going to be clumsy. You find out what's possible through trial and error, but it's best to start out slowly and in a controlled fashion.

What is it like to sleep in space?

I liked to sleep floating free. Some people like sleeping that way, others like feeling tucked in and strap themselves into a sleeping bag attached to the wall. If you're on a flight where there are mission operations around the clock, there's a berthing area with private sleep stations where you can sleep while the others are working.

You're circling the Earth at 17,500 miles an hour in the orbiter, so you have 45 minutes of light when you're on the side of the Earth closest to the Sun, then 45 minutes of darkness when you're on the other side. They've installed window shades to block the light while people are sleeping, but our crew never used them because the people who were awake enjoyed looking out the window.

What was your favorite mission patch?

Probably the one from my last mission, STS-49. It was the maiden flight of Endeavour, and it has a simple elegance because we used an image of the ship, Endeavour, which was the ship Captain Cook used to sail around the world in the 1700s. The Endeavour

was the replacement vehicle for the Challenger, and the first President Bush sponsored a nationwide school contest to name the vehicle. There was a science contest held in conjunction with that, and we used the school colors of the two winning schools for the mast pennants of the ship on our patch.

What are some of the biggest things you learned in space?

One thing that struck me from space is that this planet is so beautiful, yet there is so much conflict and strife. When you see the Earth's beauty from space, it's hard to understand why some people can't get along here.

Another thing that struck me is the Earth's atmosphere. Everyone on Earth depends on the atmosphere to stay alive. When you look back and realize how thin the atmosphere is, you get a better sense of how important it is to take care of the environment.

What would you like students to know about your experiences in space?

I tell students the same things my parents and teachers told me — set goals and work toward them. I might have rolled my eyes when they said it, but I know now that it's true. It worked for me. Set goals, decide what you want to do and figure out intermediate goals to attain your final goal.

When I was a freshman in college, I decided I wanted to be an astronaut. I was interested in aviation and intrigued by the Mercury program because it looked like the top level of aviation. I looked at the biographies of each of the Mercury astronauts and tried to find things that were common in their backgrounds. What I found was that all of them were college graduates with degrees in science, mathematics or engineering. So I did that, too.

They were military pilots, too. I followed in their footsteps, and I chose the Navy because landing on carriers seemed more challenging than landing on three miles of runway. The Mercury astronauts also were test pilots, so once I was eligible, I did that, too.

Then, in 1977, when NASA put out the call for astronauts for the Shuttle program, I applied and was successful at getting in. I am a firm believer in goal setting and working toward the goals you set.

What have been the highlights of your career?

One of the greatest highlights for me has been to see the full breadth of the space team and to know that it's the whole team that works together to make space flight successful. As an astronaut I got to visit a lot of NASA locations, and I was able to meet a lot of people on the team.

Every individual is important, and they're not all astronauts and rocket scientists. There are secretaries, security guards, contracts people, people working on technical projects, and lots more. It's a diverse team. I got to see how huge the team is and how important every job is to the success of the space program.

It feels really good to be part of a great team like that. Astronauts quite often are the ones who are recognized, but I always felt that it was a real honor to represent such an outstanding team.

Brian Duffy

Vice President - Strategic Planning

Lockheed Martin Information Technology & Global Services

Brian Duffy became an astronaut in 1986. He worked in many positions at NASA's Johnson Space Center before his first flight in 1992. A veteran of four space flights, Mr. Duffy logged a total of 40 days, 17 hours, 34 minutes and 59 seconds in space. His space flight experience includes:

Pilot — STS-45 Atlantis (1992), the first of the ATLAS series of missions to address the atmosphere and its interaction with the Sun.

Pilot — STS-57 Endeavour (1993), which retrieved the European Retrieval Carrier with the Shuttle's robotic arm and conducted microgravity experiments in a commercial module flying on the Shuttle for the first time.

Commander — STS-72 Endeavour (1996), which worked to test and evaluate techniques for later assembly of the International Space Station.

Commander — STS-92 Discovery (2000), which attached and configured a portion of the International Space Station in preparation for future resident crews.

Mr. Duffy retired from NASA and joined Lockheed Martin in 2001. Today he is Vice President of Military Space for Lockheed Martin Technical Operations.

What is it like to eat in space?

Eating in space is a lot of fun. You don't have to eat upright. I ate most of my meals upside down sitting on the ceiling. I figured I'm always upright here on Earth, I can do that any time, so why not eat upside down on the ceiling while I was in space.

Another favorite spot to eat was at the window looking out at Earth. I'd wedge my foot into a spot so I wouldn't float away, and I'd eat my meal and look out at Earth. It was a great view.

How is it different than eating on Earth?

You have to be careful the food doesn't float away from you, because there is no gravity to hold the food in the package. A lot of the foods need to be rehydrated with water. You add water and mix it well so the food sticks together.

On Earth, things like bread crumbs aren't a big deal, because they just fall to the floor. In space, you have to be careful, because the crumbs can float around and cause a problem if someone gets one in their eye or if one gets into the equipment.

Do you have a choice in what you eat?

Yes. Astronauts select their meals before their flight, so they know what they are having for every meal. The meals are packed in trays by meal and by flight-day. That way, the person responsible for preparing a meal can find everyone's food right in the same spot.

There is a list that shows what each person ordered for each meal. The crew members pass the list around before mealtime, and if there's something you don't want, you cross it out with a pen. That way it isn't prepared and not eaten. You really need to minimize your trash in space.

Did you have a favorite food in space?

I liked the shrimp cocktail and the cocktail sauce, which had a lot of horseradish and was really spicy. I also liked the chicken with mushrooms, the spaghetti and the beef tips. The food was really good.

Most of it tasted the same to me in space as it does on Earth. People tend to like spicier food in space. Your head is full of fluid the first few days, so it feels like you have a head cold. Your taste is not as sharp during those days, but then everything goes back to normal and the food tastes the same in space as on Earth.

What was the clothing like that you wore in space?

You select the clothing yourself, and once you're on orbit you generally wear golf shirts (either long sleeve or short sleeve) with your mission patch on it and shorts or long pants, depending what you're most comfortable in. Everything has to be 100 percent cotton and fire retardant, and it all is certified for flight by NASA. All of your clothes are packed in a clothing locker.

After you return, your clothes are washed and returned to you. It's fun, because you get to wear the clothes you wore in space. I recently gave my son, who's 24, the shirt I wore when I rendezvoused and docked with the International Space Station.

What does it feel like when you launch?

The pressure suits astronauts wear during ascent and re-entry are cumbersome to move around in, but astronauts get used to wearing them because they practice in them in the simulators when they're training for the flight.

During the launch, the cockpit is pretty tight. When you're on the launch pad and it's T minus two minutes, you close and lock your visor, and you're pretty much alone inside that suit. You can hear voices on the radio, but mostly you just hear your own breathing inside the suit.

Once you're on-orbit, the other crew members can get out of their seats and out of their pressure suits almost immediately, but the commander and pilot stay in the seats — and their suits — for about an hour or so because they have a lot of initial tasks related to flying the spacecraft.

What does it feel like in zero gravity?

It is a wonderful feeling. It's euphoric. I have a big smile on my face whenever I am up there. There are no pressure points and everything is comfortable. You get used to floating in space just like you get used to sitting in a chair on Earth. It's so comfortable floating that after a while you don't notice you're doing it. It becomes second nature.

What was your favorite mission patch?

The ones with my names on them! No, seriously, every mission patch is special in its own way. The crews design them. As a group you agree on a shape and on what symbols will be used to represent the activities occurring on your mission.

For example, on my last mission, we were carrying pieces to add to the International Space Station. It was going to look different when we left than when we got there. We included that on the patch by having a large outline of the Shuttle, and in the center of the patch we included what the Space Station looked like beforehand in one color and the pieces we were adding to the Station in a different color.

Patches are important to the crews and to NASA, because not only are they symbols of the crews and their missions, but they also become part of history. As long as there is interest in space flight and the history of space flight, that patch will be part of history. It will last well after we're gone.

Do you have any funny stories about your patches?

Sometimes crews are able to include little personal things in their patches. On my second mission, we included the initials of all of the crew members' spouses and children and hid them in the Shuttle payload bay on the patch. That was interesting, and it was something not many people knew. I was able to point out our children's initials to them. My son was 11 and my daughter was 9 at the time, and they were excited to show their initials to their friends at school.

How did your children feel about their Dad being an astronaut?

They just thought it was normal. That was my job. I joined the astronaut program and we moved to Houston when they were 4 and 2. They didn't remember me doing anything else. By my last mission they were older and recognized the danger involved, but they always were supportive.

The kids were at every launch. There were a lot of delays on my last flight. It took a whole week to get off the ground, but the family stayed and was there when I launched. It's an event that families don't miss.

What would you like students to know about your experiences in space?

One of the most important things is that all of the subjects we study in school are used in space, even subjects like reading, writing and foreign language. Space flight is becoming more international, and being multilingual is better than speaking just one language. It helps you communicate with your crewmates. I flew with a Japanese crew member. He spoke perfect English, but I learned basic Japanese so we could communicate in his native language, too.

The other thing that's important is that there is a place in the space program for everyone, not just astronauts and engineers but also artists, marketers, people with skills that aren't related to math and science. The space program needs every skill, every talent to make it the best it can be, and everyone can be a part of it — no matter what their skill.

Sidney M. Gutierrez

***Director, Systems Assessment and Research Center
Sandia National Laboratories***

Sidney Gutierrez became an astronaut in 1985. He served in a number of technical and management positions at NASA, including as an action officer who coordinated requests from the Presidential Commission and the U.S. Congress during the Challenger accident investigation. He also participated in the recertification of critical components of the Space Shuttle before NASA returned to flight after the Challenger accident. He logged more than 488 hours in space on two flights. His space flight experience includes:

Pilot — STS-40 Columbia (1991), a space and life sciences mission that studied how humans, animals and cells respond to microgravity and re-adapt to Earth's gravity.

Commander — STS-59 Endeavour (1994), which studied the Earth and the atmosphere around it. The crew took more than 14,000 photographs of Earth and recorded enough data to fill 26,000 encyclopedias.

Mr. Gutierrez retired from NASA in 1994. Today he is Director of the Systems Assessment and Research Center at Sandia National Laboratories, a U.S. Department of Energy facility managed by Lockheed Martin.

What is it like to eat in space?

Eating in space is a lot like eating on Earth. Because of surface tension, moist food continues to cling to forks or spoons, so you can fix something in weightlessness and eat just like here on Earth, as long as you're careful.

Did you have a favorite place to eat on the Shuttle?

Not really. At dinner, we would eat together and talk about the day. We'd discuss issues and figure out what we'd done right and what we needed to do differently the next day. Dinner was like the debriefing session of the day.

I ate breakfast and lunch on the go. As commander and pilot, I ate breakfast while I performed beginning-of-the-day activities on the vehicle. Lunch was usually catch-as-catch-can as I was doing things. I ate lunch wherever I happened to be working at the time.

What did you do on the vehicle at the beginning of the day?

I'd have to do things like purge the fuel cells, set the correct attitude and the attitudes that we should maneuver to in the future, and perform the wastewater dumps. I'd do the alignments of the inertial measurement units and things like that.

Did you have a favorite food in space?

Shrimp cocktail, spaghetti and meatballs, and sliced ham all were good. In general, I preferred the ready-to-eat meals to the ones that needed to be rehydrated with water.

What is launch like?

Launch is like riding in a washing machine. The first stage is very rough and you're shaken around a lot. Because the vehicle is still in the atmosphere, you are riding on the solid rocket boosters, and it is rough — much like it would be inside a washing machine.

Once you're outside the atmosphere, it is smoother. That's the second stage. Once you're off the solids (rocket boosters), the ride — since it's solely on the liquid engines at that point — feels more like an electric drive. If the Shuttle is repositioned, it sets up a vibration and that can alter the perfectly smooth ride!

The other way I describe launching is that you accelerate, accelerate, and accelerate. In the Shuttle, you accelerate for 8 minutes and 33 seconds, more than anywhere else. It's like being on the end of an explosion and you're just barely ahead of it.

What did you wear at launch?

We wore partial pressure suits, and they are next to unbearable. We also wore thermal underwear, which got warm and uncomfortable. So, that aspect of the launch wasn't much fun.

On my second launch, the pilot and I wore experimental long underwear with tubes woven into them. The tubes had cold water in them, which helped keep us cool. They worked well.

What were the highlights of your flights?

On my first flight, one of the highlights was seeing Mir pass by a few nautical miles away. Another was that one evening, several of the planets aligned and we could see the moon and several planets at the same time. I tried to get a picture, but the exposures weren't right. Those were two amazing things.

On my second flight, we passed through the Southern Aurora, or Southern Lights. Everyone tried to get their work done ahead of time, and we turned the lights out to see them better. As we were flying through, it was like flying through something that was alive. It was literally all around us. It only lasted a few minutes, because nothing lasts long when you're going so fast. (The Space Shuttle moves at 17,500 miles per hour.)

What does it feel like in zero gravity?

It looks different but it doesn't feel different. On my first mission, I was still strapped in my seat and working at the controls. I saw a mission specialist floating past, and that was the first time it hit me that we were in zero gravity. Physically, I didn't feel any different. Actually, it feels very natural. The transition back to Earth is more difficult, because it feels unusual to be confined by gravity.

What is it like when you're back on Earth?

It takes a little while to get used to gravity again. I made a point to take a mechanical pencil and to drop it to see how fast it fell down as we started experiencing gravity. I heard one person did that with a camera, which wasn't good because they already were back in the Earth's gravitational pull.

Do you have a favorite mission patch?

Yes. The patch from my first mission. The pilot often is in charge of the patch, and I had a lot of input on that one. I like it best. Actually, the patch for my second mission was coordinated by the mission specialist, Tom Jones. That one is nice, too, but I still like my first one best.

Do you have any funny stories about your patches?

I don't, really. Everyone had some input on the patches. It was a coordinated effort, and everyone wanted to work together to reach an agreement.

What do you need to do to become an astronaut?

Get a good education, and study what you're interested in. People tend to do well at things they're interested in. Become an expert in your field, then apply to the space program.

Education is the key to being able to do what you want to do. What I was able to do in space was very interesting and very exciting, and it was made possible because of education.

What would you like kids to know about your experiences in space or training for the mission?

It takes teamwork to get an astronaut into space. There are a lot of people involved in each mission. Not everyone can be an astronaut, but there are a lot of opportunities to be involved as a member of the team.

What makes a good astronaut?

A team player. Being a team player makes a great astronaut.

What does Earth look like from space?

From space, you see Earth from a totally different perspective. You can see so much more of it. You can see half a continent at a time. You see why things are the way they are. You see mountains in South America and the effects of the oceans on both sides of the mountains.

A lot of the Earth is ocean, and a lot of it is clouds. One of the things that struck me most is that a lot of the Earth is covered in inhospitable terrain, and that we are fortunate in the United States to have a beautiful part of the Earth with mountains, rivers, plains and coastlines. Another thing that struck me is that the atmosphere appears as multiple shades of blue from space. I remember flying over Spain and remarking on how beautiful the atmosphere was

Richard J. Hieb

Vice President – Program Management

Lockheed Martin Information Technology & Global Services

Rick Hieb joined NASA in 1979 after graduate school to work in crew procedures development and crew activity planning. He became an astronaut in 1986 and worked in a number of technical positions before his first flight in 1991. A veteran of three space flights, he logged more than 750 hours in space, including more than 17 hours of space walks. His space flight experience includes:

Mission specialist — STS-39 Discovery (1991), an unclassified Department of Defense mission in which he operated the Infrared Background Signature Satellite.

Mission specialist — STS-49 Endeavour (1992), which was the maiden voyage of the Space Shuttle Endeavour. He and astronaut Pierre Thuout performed three space walks to capture and repair a communications satellite. The third spacewalk also included astronaut Tom Akers, making it the first ever three-person space walk.

Payload commander — STS-65 Columbia (1994), which was a 15-day mission that set a flight-duration record for the Space Shuttle program and conducted more than 80 materials and life-sciences experiments.

Mr. Hieb retired from NASA in 1995. He joined Lockheed Martin in 2001 and today is a vice president with Lockheed Martin Space Operations.

What is it like to eat in space?

Eating is always good as far as I'm concerned! One thing I found was that I ate more slowly in space than I do on Earth, because if you eat too quickly, the food starts flying and gets away from you. If you slow down and move each forkful or spoonful slowly, it works better. I enjoyed eating in space because it was always a relaxing break in the day.

Everyone plays with their food in space. You can't resist it. It's fun. You also carry drinks around and make yourself drink more than you do on Earth so you don't become dehydrated.

Did you have a favorite food in space?

I liked the beef tips with mushrooms, the shrimp cocktail in cocktail sauce and the irradiated steak. I loved that steak. I liked M&Ms and shortbread cookies, too.

One thing I found was that I had to eat my vegetables first. I didn't like them much in space, and I found that if I ate the other things first, I wouldn't eat my vegetables. So to be sure I ate them, I trained myself to eat them first.

And, eventually, I learned that when I followed the instructions for preparing the food, it tasted better! When I waited the appropriate number of minutes to heat things up, it was fully heated and tasted great.

What was the launch like?

It is a little bit scary. The fact is, it is dangerous, and if you're not a little bit scared, something is wrong with you. We are doing things that are state-of-the-art in terms of our technology. There are things that can go wrong, and those things cross your mind when you're on the launch pad.

The busier you are, the less nervous you are. I was flying as a mission specialist, so I had less work to do at launch than the pilot and commander. I had a little more time to worry. It is scary, but at the same time it is tremendously exciting, exhilarating and a lot of fun.

I also have a tremendous amount of confidence in everyone working in the space program, and I knew as I sat on that launch pad that they had minimized the risks as much as possible.

The risks drop dramatically once you're on orbit and you shut down those engines. When the engines shut off, there's always a big cheer.

What does it feel like in zero gravity?

It's fun. Fun all the time. It is fun to play with stuff that is floating. It is fun to float and to do flips and somersaults. The first few days, that can be a problem for people experiencing motion sickness, but they're happy to do it later in the flight. Floating is just as good as you'd imagine it to be. At the end of the mission I'd always say, "I'm going to miss floating."

How do you train for a space walk?

You do dozens and dozens of runs in the Neutral Buoyancy Tank, a large, deep swimming pool that simulates the space environment. In your space suit, it is hard to manipulate things because the suit is bulky and your dexterity is reduced. You have to practice all of your tasks a lot so you know exactly what you have to do and how you have to do it.

You have to train not only to learn the tasks but to get to the point that working in the suit is second nature. One day after about my 25th to 30th run, I was waiting by the side of the pool for someone else to finish his preparation. I suddenly realized that I wasn't noticing the suit, that it wasn't totally dominating my thought process. I realized then that you're not really ready to do a space walk until you reach that point, and that takes hours and hours and hours of training.

Did it feel different when it was the real thing and not just training?

Yes it did. When you go for a space walk, the suit is lowered to one-third the normal atmospheric pressure. In the water tank, you can't lower it to that pressure. When it was time for the real space walk, I noticed my voice sounded squeaky and my lips felt funny, because it was not the same amount of pressure I was used to.

It was an odd feeling, and that was when it hit me, “Yes, you really are going on a space walk. This is different than training. If something goes wrong, you can’t just pop your helmet off.” But then I told myself I just needed to do things exactly like I’d prepared for them and that everything would go according to plan, and it did.

Your space walks lasted four to eight-and-a-half hours. Could you eat or drink anything during the walks?

Yes. Water and food are packed into your space suit. The water is in a pouch that fits between your chest and the front of the suit. There is a straw that comes out of the suit. When you suck on the straw, a valve opens and you can take a drink of the water. When you stop sucking, the valve closes.

The food is limited. There is a food stick that is like a fruit roll-up or a group of them smushed together. It is 8 to 10 inches long and about an inch wide. It is covered with rice paper, and when you want to take a bite, you have to grab it with your teeth and pull up on it. You can’t get it with your hands, and you need to be careful to pull it far enough that you’ll be able to reach it again.

You don’t always know how much is left. On one of my walks, when I took my last bite, I didn’t realize how much was left and I pulled too much into my mouth. It was hard to chew because there was so much in my mouth. As I chewed it, I was hoping Mission Control on the ground didn’t call up and ask me a question, because my mouth would have been too full to answer.

What did you see from space?

When you come outside the hatch, the view really isn’t very good. We worked our way around the back bulkhead of the orbiter, and then all of a sudden we could see Earth below us. We had agreed not to say anything, because sometimes the first things people say when they see the view can sound a little silly. I had to bite my tongue, because I realized I was about to say the same kind of thing everyone else does about how unbelievable it is.

I was awestruck by the overwhelming beauty. It felt different than having seen it from inside the Shuttle, almost like it’s different to see a vista from the mountaintop as opposed to from an airplane. The beauty and the expansiveness of it all is incredible.

What have you learned that you’d like to share with students?

If you want to be an astronaut, study math and science and work hard in school. I also tell kids not to focus so hard on being an astronaut that they would never be happy doing anything else. There are very few astronaut positions but a great many exciting jobs in the space business.

The best goal you can have is to make a difference. Maybe the chance will come along that you can be an astronaut, and that would be great. But there are many, many jobs where you can make a difference. If you can look back on your life someday and say, "I set out to make a difference and I did," that's the measure of true success.

Bruce McCandless II

***Retired Chief Scientist, Advanced Space Technology
Lockheed Martin Space Systems***

Bruce McCandless became an astronaut in 1966. He was a member of the Apollo and Skylab programs, and he worked in a number of important technical positions before flying his first (Shuttle) mission 18 years after joining NASA. He logged more than 312 hours in space and was the first human to fly untethered in space. His space flight experience includes:

Mission Specialist — STS-41B Challenger (1984), which marked the first checkout of the Manned Maneuvering Unit (MMU), a “backpack” propulsion system that enables astronauts to move away from the Space Shuttle untethered and to propel themselves as needed on the spacewalk and back to the Shuttle.

Mission Specialist — STS-31 Discovery (1990), which deployed the Hubble Space Telescope (HST), operated observation cameras and conducted numerous experiments in the middeck of the Shuttle. He had worked part-time for the previous 12 years on perfecting the on-orbit serviceability of the HST – a feature that has enabled four servicing missions to improve and repair the HST so far.

Mr. McCandless retired from NASA in 1990. He currently is Chief Scientist, Advanced Space Technology, at Lockheed Martin Space Systems. He will be inducted into the Astronaut Hall of Fame in April 2005.

What is it like to eat in space?

People tend to make a big deal out of eating in space, but to me there was nothing out-of-this-world about it. The food is prepared and packaged for the flight much like you’d prepare for a back-country camping trip – a lot of it freeze dried.

One thing that’s different is that if you were going into the back country, you’d find water, boil it and use it to rehydrate the food. On the Shuttle, astronauts use hydrogen and oxygen combined in fuel cells to generate electricity, and the byproduct is drinkable water. You get water from the electrical system, then you reconstitute the foods and heat them in the food warmer.

Can you eat whatever you want in space?

There is a large menu to choose from, and the specialists in NASA’s food lab work with you before the flight to introduce you to what’s available and to help you make your meal selection. They work hard to keep the crew happy, because psychologically it helps to be eating food you like. But if someone wanted steak every night, the food specialists would discourage that because they’ve found that people need variety.

Did you have a favorite food in space?

I liked the shrimp cocktail, which had a lot of horseradish in the cocktail sauce. I also liked the irradiated beef steak, since it tasted like “real” steak, not beef stew.

What was the clothing like that you wore in space?

On my first flight, for launch and re-entry I just wore an airplane flight suit. My second flight was after the Challenger accident, so we wore the partial pressure suit that also served as a water survival suit in case we needed to bail out of the orbiter during ascent.

Once you're on orbit, the number one dress requirement is that you take off your boots. That's so when you're floating around, you can't accidentally kick the equipment and damage it by breaking glass instrument faces. Crew members could be stocking-footed or in a moccasin-sock combination.

One interesting thing about the clothing is that it has a lot of pockets. In space, everything floats, so you have to carry things like pencils or small tools in your pockets, and you have to zip or "Velcro" them closed to be sure what you're carrying doesn't float away.

What did you do with the Apollo program?

I joined NASA at the end of the Gemini program, and I was in a group of 19 Apollo astronauts selected in 1966. It appears I was to be named to a late Apollo flight, like Number 19 or 20, but they canceled the program before I got to go to the moon. I was the CAPCOM (spacecraft communicator in Mission Control) for Apollo 10 & 11 and Apollo 14.

Then I was the backup pilot for the first Skylab flight, but the prime pilot remained healthy, so I didn't fly that mission.

I was named an astronaut in June 1966 and I flew for the first time on the Shuttle in February 1984. It was a long time, but there was never a dull moment. I always tell students, if you persevere you eventually will succeed in what you are trying to do.

You were the first human to fly in space untethered. What was that like?

My partner on that spacewalk was Bob Stewart. He did the exact same work I did, so he deserves equal credit. I happened to do the first test of the manned maneuvering unit (MMU), because I helped develop it, but we were both out there together.

The MMU gave me a lot of freedom to move around. I went as far away as 320 feet from the Shuttle, and I wasn't tethered (or tied) to anything. I was just flying free and powered by the MMU. The Shuttle and I both were moving at 17,000 miles an hour but there was little relative speed between us. It was like two airplanes flying in formation – a high airspeed, but essentially no relative motion between them.

One thing that surprised me is that I got cold. The pressure suit was designed to carry off some of your body heat if you were working vigorously on the spacewalk. Flying the MMU was not a physically demanding task, so I actually became cold. As I flew away from the Shuttle, my teeth were chattering and I was shivering. We had never

considered shutting off the sublimator that carried off the heat, but eventually Mission Control suggested it because I was so cold. I turned it off for 15 or 20 minutes, then turned it back on when I was warm, and that worked just fine.

I also was really surprised that the sun, when viewed during a spacewalk, is a brilliant white color, not the yellow or orange colors we see from Earth. It was just pure white and extremely bright.

Were you nervous when you did the first MMU spacewalk?

We'd been on-orbit for four days, so we'd gotten accustomed to the sensations of weightlessness and seeing the Earth over our head, under our feet, in strange positions. It was a gradual transition from the cabin of the Shuttle, to the air lock, to the half-open payload bay, which was a familiar structure to us, so going out into space wasn't shocking to me.

People often ask how I knew I was going to get back to the Shuttle when I was flying the MMU. My answer is that I had confidence in the laws of physics. Isaac Newtown laid down many of those laws, and they haven't changed.

Maybe someday someone will fly into a black hole and have the confidence they'll come out the other side based on scientific and mathematical analysis.

Another thing is that I figured there was no point in worrying about things during space flight. I decided beforehand that what we were proposing to do was worth the risk, and having made that decision, I was not going to worry about it anymore.

How do you get dressed for an EVA?

The process takes five or six hours, and it actually starts the day before the spacewalk. You have to verify that the life support system is properly serviced, you need to coat the inside of your helmet with anti-fog compound, possibly re-size the arms and/or legs, and check everything very carefully so that there will be no unexpected delays on the day of the EVA.

The day of the walk, you put on the biomedical sensors (heart rate and breathing rate) and everything you need for the suit. Then, depending on the specific situation, it takes 20 minutes to four hours of "pre-breathing" — breathing pure oxygen inside the suit — to get rid of any nitrogen in your body from the Shuttle atmosphere. It is important to get rid of the nitrogen to be sure you don't get decompression sickness, which is also called "the bends."

What would you like students to know about your experiences in space?

There are several things I think are important to know. The first is that the space program is a team operation, and it takes the hard work of many people to be successful. In the "high school" set on the television show "Sabrina the Teenage Witch," they showed the well known picture of me flying around in space untethered. It shows me by myself, and it's really not accurate, because I didn't do it alone. Bob Stewart was

out there with me and there were three guys back in the orbiter, a couple hundred people working in Mission Control, and tens of thousands in NASA and contractor facilities all pulling together to make it happen.

Another thing I tell students is that in our society, you can achieve whatever you want to achieve if you put your mind to it. If you do well and work hard, anything is possible. The fact that “Mommy did this” or “Daddy was a something or other” is not a restriction in our society. You can pursue whatever job you like, AND you can change your mind later if something more to your liking comes along. And just because you graduate from high school or college, it doesn’t mean your learning is over. There is always more to learn and always additional opportunities that present themselves as you learn more.

Another important thing is that in the space program, we work with people from a lot of different countries, and you learn that while people’s approaches to challenges may be different, their thoughts and aspirations are the same as ours. Diversity is a strength. When you’ve got a problem, there is a better chance of solving it when everyone has a different way of tackling it. Learning a foreign language, no matter which language, is important because it brings home the point that there are many different perspectives on life – all of which are “right” in different cultures.

Kenneth S. Reightler Jr.
Vice President – Strategic Planning
Lockheed Martin Systems Company

Kenneth Reightler became an astronaut in 1988. He worked in numerous technical positions at NASA's Johnson Space Center, and he logged more than 327 hours in space on two flights. His space flight experience includes:

Pilot— STS-48 Discovery (1991), which deployed the Upper Atmosphere Research Satellite that collected data on the upper atmosphere's chemistry, winds and energy inputs. The crew also conducted experiments to study how fluids and structures react in weightlessness.

Pilot—STS-60 Discovery (1994), the first joint U.S./Russian Space Shuttle Mission, which conducted biological, materials science, earth observation and life science experiments. The crew included Russian cosmonaut Sergei Krikalev, who remains one of Mr. Reightler's best friends.

Mr. Reightler retired from NASA and joined Lockheed Martin in 1995. Today he is President of Lockheed Martin Space Operations.

What is it like to eat in space?

The first time you get ready to eat, you have a little bit of concern. You know you can do it, because others have done it, but there still are questions in your mind: What will it feel like? Without gravity, how will the food move from my mouth down to my stomach? What will it be like to chew? As it turns out, the process isn't any different than eating on Earth. You have to be careful with the food so it doesn't float away and make a mess, but your body handles the food much like it does on Earth.

I found that I liked my food spicier in space. Also, on Earth I don't like sweet drinks, but in space they were quite pleasant.

I liked the food a lot. It always was fun while eating to take a break and look out the window. I loved eating while looking outside.

Did you have a favorite food in space?

I had two favorites: Steak, which tasted and smelled like it had just come off the barbecue grill, and shrimp cocktail. I had each of them twice during my missions. For breakfast I enjoyed the pastries, which were sweeter than I like on Earth but which tasted great in space. And brownies were my favorite dessert.

On my second mission NASA was testing an experimental refrigerator/freezer to determine if it could operate in space, so they sent real ice cream along. It's rare to have real ice cream on the Shuttle, but we had ice cream bars and individual containers. We tested the freezer during the first part of the mission, so we had to be sure we ate all of the ice cream before we used it as a refrigerator. The contraption did work, and they have used it on the Shuttle since then.

What kind of clothing did you wear in space?

There are some options — long pants or shorts, golf shirts that are long- or short-sleeved. The crews try to have one day when they all wear the same shirt so they are dressed alike for the crew picture.

One thing NASA offers is slipper socks. The crew members don't wear shoes with soles, but your feet can get cold because in zero gravity you don't have as much blood in your feet. Most of our crew wore slipper socks for extra warmth on their feet.

What is the pressure suit like that you wear for ascent and re-entry?

The suit is bulky and heavy, and there are a lot of different things built into it. The suit is designed to protect you from very hot temperatures as well as from cold temperatures in case you need to bail out of the Shuttle into the ocean after the launch. They started using the suit after the Challenger accident.

There are various pockets with survival equipment like a knife and mirrors and flares for signaling. There also is a parachute pack with a one-person raft inside it that you harness onto the top of the suit before you crawl in the hatch of the orbiter. The suit can help you breath, and you can pressurize it so it helps your body function when you get back into gravity.

Astronauts practice a lot of simulations with it on, so they are used to it. The helmet limits your ability to look up. When you want to look left or right, you have to take your hand and turn the helmet so you can see through it. If you don't turn the helmet with your hand, your helmet won't move and your head will just turn inside the helmet.

What does it feel like during the launch?

You spend a lot of time — a couple hours — strapped in and waiting for the launch to begin, then all of a sudden things happen very fast. A lot of the time you're sitting there waiting, there's not much to do. Then, during the last nine minutes, there is quite a bit of activity.

Up until that point, it seems like a simulation. Then, once the engines start and you feel the tremendous power, you realize it's not a simulation anymore. There is lots of vibration, lots of noise. You feel the noise more than you hear the noise. It feels like the vehicle becomes alive, and there is lots of raw power that you feel through the seat.

As you're moving toward the sky, there is quite a bit of vibration, almost to the point that you have to strain to read the checklist and look at the instruments. You can't see much of Earth after the first few seconds. You see the sky and it's changing from light blue to dark blue, then it eventually becomes black. After the first two-and-a-half minutes, the solid rocket boosters expend off the side of the Shuttle and then things get very calm. At that point, it's smooth and there's little vibration. Over the next three or four minutes, the acceleration picks up and you're pushed back in your seat really hard again. At that point, you're at about 3.2 Gs and you have a hard time speaking or moving your hands. Once you reach orbit, it becomes calm again.

What does it feel like in zero gravity?

It is hard to describe, because it is unlike anything you can refer to on Earth. The closest sensation is floating under water. The first day in space, your body is getting used to it and you have strange feelings, almost like you're sick to your stomach. It takes about two days to feel close to normal again.

Coming back to gravity is a transition, too. When you're coming back in the atmosphere, you're strapped in your seat and you feel the G forces coming on you. You feel very heavy and it's hard to keep up your head.

What was your favorite mission patch?

The patch for STS-60 was my favorite. It is blue with gold around the outside. It was the first time it was truly Navy blue, and as a graduate of the Naval Academy, I liked that. We also picked a very interesting design for the wings. One of the wings is the colors of the American flag and the other is of the Russian flag, which symbolizes the two countries taking a flight together for the first time.

Do you have any funny stories about your patches?

People joke that the hardest thing about going into space is getting five to seven people who are very strong-willed and independent to agree on one design. They joke that once you get past that, going into space is easy.

Crews are particular about their mission patch, and they all have ideas of what it should look like. Crews usually ask the junior member to work on the design, then the commander has final approval. It also goes through NASA approvals to be sure the agency is comfortable with it.

What would you like students to know about your experiences in space?

It is important for students to know that things as complicated and as difficult as flying a Space Shuttle can't happen without going to school, going through training and learning the process. If you spend enough time doing that, the most difficult things become easy. The message there is to study hard. When you put time into anything, you can be successful. Even the hardest tasks imaginable become much easier in time.

The other important thing is that when people work together as a group, it's easier to achieve success. The value of teamwork and cooperation really is demonstrated in the Space Shuttle missions. When people work together, anything is possible.

Links to More Activities

Teachers Guide for NBAA's AvKids Program can be downloaded in PDF format at www.avkids.com

Civil Air Patrol's Aerospace Education Program at www.cap.gov

Discovery Channel School's Astronomy/Space Lesson Plans Library grouped by Grades K-5, 6-8, 9-12: <http://school.discovery.com/lessonplans/astronomy.html>

Space: A Journey to Our Future exhibit's Educator's Activities at: www.spaceexhibit.com

NASA's Educator Resource Center – to find the Center that serves your state, go to NASA's website:
http://www.nasa.gov/audience/foreducators/informal/contacts/ERCN_State_Listing.html

NASA Education Website: www.education.nasa.gov

The National Space Grant Site: <http://calspace.ucsd.edu/spacegrant/>

The "Map" and links to all Space Grant consortia, by state:
http://calspace.ucsd.edu/spacegrant/webmap/sg_homepages.html

Challenger Center for Space Science Education: <http://www.challenger.org>

Other Cool Websites

NASA Real-time Sightings (When can you see space station over your town?):
<http://spaceflight.nasa.gov/realdata/sightings/>

Quest Project: <http://quest.arc.nasa.gov>

Women of NASA: <http://quest.arc.nasa.gov/women/intro.html>

The International Women's Air & Space Museum: <http://www.iwasm.org/>

Smithsonian Air & Space Museum: <http://www.nasm.si.edu>

Smithsonian Air & Space Magazine: <http://www.airspacemag.com>

Students for the Exploration and Development of Space: <http://seds.lpl.arizona.edu>

Mars Society: <http://marsociety.org> <http://www.kidsastronom>

Current Events: <http://spaceflightnow.com>

Sky and Telescope: <http://skyandtelescope.com/>

Lockheed Martin: <http://www.lockheedmartin.com>

Boeing Aerospace: <http://www.boeing.com>

American Institute of Aeronautics and Astronautics (AIAA): <http://www.aiaa.org>

American Society of Mechanical Engineers (ASME): <http://www.asme.org>

Society of Women Engineers: <http://www.swe.org>

Astro for Kids: <http://www.astronomy.com/content/static/AstroForKids/>

Astronomy for Kids: <http://www.frontiernet.net/~kidpower/astronomy.html>

Kids Astronomy: http://www.kidsastronomy.com/solar_system.htm

NASA Kids: <http://kids.msfc.nasa.gov/SolarSystem/>

NASA's Planetary Photojournal: <http://photojournal.jpl.nasa.gov/>

NASA's Solar System Exploration Homepage: <http://solarsystem.nasa.gov/>

The Nine Planets: <http://www.nineplanets.org>

Space Kids: <http://www.spacekids.com/solarsystem/>

Star Child:

http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level2/solar_system.html

Voyage Online: <http://www.voyageonline.org/>

Welcome to Astronomy for Kids!: <http://www.dustbunny.com/ark/>