JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

BARBARA R. MORGAN
INTERVIEWED BY REBECCA WRIGHT
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The questions in this transcript were asked during an oral history session with Barbara R. Morgan. Ms. Morgan has amended the answers for clarification purposes. As a result, this transcript does not exactly match the audio recording.

WRIGHT: Today is September 22, 2011. This oral history interview is being conducted with Barbara Morgan in Boise, Idaho, for the NASA Johnson Space Center Oral History Project. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal.

Thank you for finding time. We know your schedule is so busy.

MORGAN: Thank you.

WRIGHT: We know you have a long history as an educator, and one of the things we wanted to talk with you about today is when you were a mission specialist on STS-118 that launched in August 2007. On that flight, you shared a lesson with students on Earth. If you could tell us how those lessons and the educational part was very much involved in that mission and your part in helping develop that, and then, of course, the results of what you feel like you were able to do on that mission as an educator.

MORGAN: That's a great question. It goes way back starting with Teacher in Space, when Christa [McAuliffe] was going to teach live lessons during STS 51-L on the Space Shuttle

Challenger. We had two live lessons, and we had several videotaped lessons that Christa was going to be doing. We developed those with the other Teacher in Space finalists and some of the Aerospace Education Services personnel at the Johnson Space Center and Dick [Francis R.] Scobee, June Scobee's husband. I think people may know, June is a tremendous educator. She's taught everything from elementary through graduate school. That flight highlighted Christa, of course, and education. Not just Christa, it was the whole crew, and it was highlighting education. Dick was just terrific about that.

It was interesting to me, going through that, and then many years later seeing what changed, and what had happened over the years. That was 1985 when we were developing the lessons and the Teacher in Space flight was scheduled for 1986. One of Christa's lessons was, "Where We've Been, Where We're Going, and Why." She was a social studies teacher, so she was going give a bit of a history lesson. Her feeling about history and the way she taught her classes was that ordinary people do extraordinary things and it's the history of the ordinary person that makes a difference. She taught a course on women out West and how they made history. You would love that, how she taught that class. But that's how she approached the whole Teacher in Space Project, and she was journaling at the time, too, because she felt that those would be her lessons, would be the journals that she took, that she was writing, throughout the experience.

Her journals were very interesting. They were scraps of paper here and there, and you would find them everywhere, little notes that she would take here or there. I'll always remember one of the things that Christa was very interested in when we were going through the training at the Johnson Space Center was who was doing what jobs. She'd take little data points, and I'm

sure she was planning on sharing those with her students, but observations like, where were the women and what positions did they hold?

Also, especially at that time, it was interesting to see where the diversity lay. You would see more racial diversity at the guard gates at JSC's entrances, and the women at the desks doing more of the secretarial kinds of work. The big meetings where we would be reviewing what was going to be happening on that mission or any of the Preliminary Design Reviews or the Flight [Readiness] Review meetings were mostly men. Christa would always look around and take a little tally of who was sitting at the head table and who was sitting around the outside, and how many females there were in the room compared to the number of males. I just thought that was so interesting. She never really said much about it, but just made observations, and would jot them down.

Her lesson, "Where We've Been, Where We're Going, and Why," was built upon the history of human spaceflight and where we were at in the Shuttle Program and where we were going. She was taking up a model, a little model of Space Station Freedom. That was 1985. Then, in 2007, my crewmates and I were flying to the International Space Station [ISS] on [Space Shuttle] *Endeavour,* the vehicle that was the replacement for *Challenger* and was named by schoolchildren.

The naming of *Endeavour* was one of NASA's best education projects. We had teams of schoolchildren, K [kindergarten]-12, with their teachers, doing research and learning about the early ships of exploration, what they were named and why, and then coming up with what they felt the name should be for the replacement to *Challenger* and why. But they didn't end it with that. It wasn't just an essay project, and it wasn't a curriculum that was all set in stone that the teachers were supposed to follow. It was very creative.

Once the students had done the research and decided what the name should be and why, then they needed to come up with some kind of creative project that would enable them to learn more about space exploration. It varied all across the country from amazing science experiments that students designed with their teachers and carried out on their own—so, real inquiry—to designing a mission plan for a future Space Shuttle mission or a mission back to the Moon or on to Mars, or designing a crew patch for their class and then describing their patch's symbolism. It sparked a variety of creative educational endeavors across the country, from science—from pure scientific inquiry—all the way to more humanities-oriented activities. I thought that was tremendous.

The other lesson that Christa was going to teach from orbit was a tour of the Space Shuttle that also introduced and highlighted each crewmember and the jobs they were doing. Then we had some science education activities that the Teacher in Space finalists put together. These were demonstrations designed primarily for middle school and high school science classes to support classroom content like the teaching of Newton's Laws, and, for example, for the biology classes, for those students to learn about hydroponics. We had a demonstration on magnetism to show magnetic fields in a 3D [dimensional] environment.

Looking back at those, they all look pretty simple now because our crews over the years since then have done many of these types of demonstrations. But at that time, it was quite novel and it was challenging to figure out, for example, how to show magnetism in a 3D environment and do it in a way that the equipment would take up little to no space at all. For that particular demonstration, NASA Aerospace Education specialists helped us design an inflatable, clear plastic cube with iron filings on the inside. The first time we took it in the KC-135 [zero-gravity (zero-g) training aircraft] to test it and Christa pretended she was pulling it out of the locker like

she would be doing on orbit and then she blew into it to inflate it, the humidity of her breath along with Houston's humid gulf air, caused those iron filings to rust very quickly. The clear plastic fogged up as well, so we couldn't get good video views. It was great learning for all of us.

I think the biggest learning and what was so foreign to us as teachers was why Christa had to write everything down. She said, "These are the most scripted lessons I will ever have done in my life." As teachers, that's just something you don't do. You generally have your learning objectives and how you're going to help the lesson move forward, but you don't write down word for word what you or your students are going to be saying or doing.

For that 3-D magnetic field demonstration, for example, we literally had to write down, "Take the apparatus out of the locker, step one. Step two, open up the airway. Step three. . ." And again, we just couldn't understand that, because it seemed so simple, but finally one of our crew trainers explained, and then it made perfect sense to us. If Christa were to get sick or something were to happen and she couldn't carry out the demonstrations, this was part of the mission objectives and needed to be carried out. Somebody else needed to be able to step in and do the demonstration efficiently and on the fly, without having seen the equipment before or without necessarily knowing the demonstration's objectives. That was a big learning experience for us. That was a long-winded answer. But that's back then.

Space Station Freedom was just a model back then. It was on paper. It was still in the design phase. Then coming back to NASA in 1998—and it seems like such a short time between then, 1986, and 1998, when we have our first actual module up in orbit for the International Space Station. Then by the time my STS-118 crewmates and I launched in 2007 on an ISS assembly mission, how big Station was already, and then where it was going three years later,

four years later, to Station complete. To progress from something that was a model and that was strictly American in 1986 to this truly International Space Station and actually have the modules and systems up there, launched and all assembled in orbit was a huge transformation, in what seemed to me to be a very short timeframe.

The other thing back in Teacher in Space days, there was Internet, but it was not an Internet that any of us knew about. At that time, NASA was having satellite dishes installed at a few schools. It was going to be NASA's first time to do an interactive uplink-downlink with students. That was an all-time first.

Then years later, in fact, it wasn't that long after Christa's flight, NASA decided to actually embed more teaching, more education into the Astronaut Office, and they established—I'm going to back up here a minute. A lot of people thought that when we lost *Challenger* [STS 51-L], that was the end of the Teacher in Space Program, and that is simply not true. The flights were put on hold, but it was not the end of the program, and we had the other 112 finalists in the program who were very involved and doing remarkable work to engage their students and schools and communities in space exploration and NASA's missions. Many of them to this day are still designing and creating and providing excellent aerospace education activities and programs in their schools and states and regions. But back then, to have installed a few satellite dishes, and have Christa talk, from space, with students in a couple schools and it was going to be interactive—that was all very new, very novel.

So in that short timeframe between 1986 and a couple years later—I'm sorry I don't remember the date—when NASA established the Teaching from Space Office in the Astronaut Office, a lot more schools, first of all, had satellite dishes. And then when the Internet became accessible and also computer access and computer capability expanded in the schools, these

NASA on-orbit educational opportunities became available to many more schools in many more places. That's a huge change, too.

WRIGHT: Would you like to share with us some of the work that you did with NASA during the timeframe after *Challenger* until you came back to NASA in 1998?

MORGAN: After the *Challenger*, NASA asked if I would continue on and serve—to carry on the work that Christa was doing—as "Teacher in Space designee"—and fly at some time in the near future. This was done on national TV, and I felt it was very important to continue on. Children all across the country were watching, and we needed to show our children what adults need to do when terrible things happen. We needed to make sure that what we are doing was worth it, and find out what went wrong, and more importantly what we did wrong, and we need to fix it and make it better.

I'll always remember it was a really tough time after *Challenger*. We had combined both Christa's schedule and my schedule so that we weren't letting down all those folks that Christa was going to be—we were both going to be sharing the experience, but we didn't want to let down the folks at all the events Christa was scheduled for. The lesson became very different. Rather than sharing the joy and wonder of spaceflight and Christa's new perspectives, it was, "how do you recover when bad things happen and how do you move forward." That was a tough, very sad time for everybody, and teachers were dealing with something that they had never dealt with before.

I'll always remember when we were in Washington, D.C. then, where NASA had moved us to for the post-*Challenger*-accident work. We were there, at NASA HQ [Headquarters,

Washington, DC], about one day a month and on the road the rest of the time, covering Christa's schedule and the events that were already on my schedule. One day, early on, in D.C. we ran into Dick [Richard H.] Truly when he was out there too, and he was so kind and helpful. He said something like, "This stuff is tough, but it's easy to do if you do the right thing" and "you'll know what the right thing is." I was glad to hear that from him, and even though it was a very tough time, it was the right thing to do—to talk with these groups of students and teachers and community members and answer their questions. And to talk with the employees at the NASA Centers.

People were very sad and doubting themselves, and doubting the program in some respects, so being able to move forward and to know that you've got to keep the future open for those kids and for our country—I think that all worked out pretty well in the long run, although the sadness of *Challenger* and losing dear friends stays with you, always.

WRIGHT: At what point were you approached about or given the opportunity to apply for the astronaut program as a full-time astronaut?

MORGAN: What actually happened was NASA said that I'd have a flight sometime in the future, and there were several times we'd get the call saying, "Okay, it will probably be about a month or two, so you might want to think about getting ready." We'd get storage lined up, start preparing for a move to Houston from Idaho and then it would fall through. That happened a few times. That was interesting, and it was interesting how it would happen depending on what was going on politically, I'm sure.

It popped up again when John [H.] Glenn was flying. You'd have to ask other folks elsewhere who were there at the time, but it was my understanding that with John Glenn's flight, there was a lot of discussion about, "Wait a minute, we had made a commitment to the teachers and to fly a teacher when we started flying again, non-career astronauts." I think that's when this all came up. I got a call from Dan [Daniel S.] Goldin and from George [W. S.] Abbey, "It's time to come on down and fly, fill out the paperwork and apply." So I filled out the paperwork and applied and was very lucky to be able to join the astronaut corps.

WRIGHT: That was in 1998? Was that when you moved to Houston [Texas]?

MORGAN: Yes. So in 1998, we moved to Houston, yes.

Christa, she was such a hands-on kind of teacher. She represented the best of teaching, and we tried to preserve and honor that in what we were doing when 1998 finally came around. All of those years, NASA Education had been making plans and putting processes and people in place, anticipating that there'd be more education. The astronauts had been doing quite a bit, and that was through the Teaching from Space Office, and it was all very good.

Administrations change and that brings personnel changes—new people and different ideas. I thought it was very interesting that what the education community had been working on and wanted to do, the education community still at the Johnson Space Center, wanted something that wasn't about the teacher teaching a lesson, but really focused on what the kids do. It's not about the teacher, it's about the kids, and that's what all good education is about in the classroom too. It's not the teacher standing up in front and doing what I'm doing right now, nonstop

talking. It's, "What are the rich educational activities that the kids are engaged in so that they're doing the *doing*, they're doing the *learning*?"

We wanted to get the students thinking about big questions. We wanted to get them thinking about their own possibilities. We wanted to get them thinking about the future, and their future. And we wanted to engage them in this great endeavor—space exploration. We wanted them to get a sense that they can actually contribute right now, that they don't have to wait until they're out of grad [graduate] school to contribute. We also wanted to base what we were creating now on programs that we knew had a good track record—had already worked well in the past—and we wanted to engage as many students and their teachers as possible.

A very successful program from years ago was the Seeds in Space Program, Tomatosphere, and it had been repeated a couple of times. Canada liked it so well that they created a similar program. We took a look at that because it was so successful. We also liked the symbolic aspect, that the Tomatosphere Program's seeds, exposed to the vacuum of space as one of the 57 experiments on LDEF [Long Duration Exposure Facility], were delivered to space on *Challenger* in 1984.

One of the beauties of the Tomatosphere Project was all the students who participated from all over the country, and it involved all K-12 grade levels. All grade levels cover some aspect of plant biology, and plants provide all kinds of learning opportunities. Students are able to contribute in different ways. Little kids can do things like observe, measure, and record stem and leaf growth; older students can design plant growth experiments and learn about controlled and independent and dependent variables, and high school students can start to do some genetic studies. You can really take it from one end of the spectrum to the other; there's something for everybody.

The other thing that's wonderful about seeds is that they're small enough that you can take up, I like to say, a kazillion, into orbit and you can really get something physical—that was the one requirement that I personally really wanted, to get something physical—into many kids' hands. Something physical that represents what they can be doing, and by getting something physical in their hands and just saying to them, "Here's something really cool. What do you think about it? Can you design an experiment? Do the great things that we get to do, experiment, explore, discover, have fun with it, and we're not going to test you on it. We're not going to simply teach you a bunch of facts and then have you take a test on it." Seeds are a perfect tool and metaphor.

So we went back to the Park Seed Company, who had done the original Tomato Seeds in Space Project, and they were delighted to partner on this again. They were the ones that suggested cinnamon basil this time. Like the tomato seeds, they are tiny, so you can take up many of them. We took 10 million basil seeds with us on STS-118.

Also, this wasn't planned this way, but it just so happened the MISSE 3 and 4 [Materials International Space Station Experiment] PEC [Passive Experiment Container] installed outside the International Space Station and we—STS-118—were scheduled to retrieve and bring the MISSE PEC back home with us on *Endeavour*. And the MISSE PEC included 3 million basil seeds that had been exposed to the vacuum of space for a long time, a year. We thought that's a perfect tie-in. There were lots of additional activities, science experiments, that students could do with those seeds along with the STS-118 seeds and ground-based seeds.

Back to the big questions and how to get kids thinking. At that particular time, we were already working on Orion and the CEV [Crew Exploration Vehicle] and other advanced exploration initiatives. The Vision for Space Exploration had been established by this time, and

so it was easy for us to show the kids that we were going to complete the International Space Station, that Space Station was a big steppingstone to going on to the Moon and Mars. We already had a vehicle, not being built yet, but it was being designed, human exploration beyond low-earth orbit was being worked on, and we wanted students to be thinking about what they can be doing right now to get involved and engaged, and that we adults had not figured everything out. We didn't have all the answers. In fact, there are a lot of questions. We have a lot of work to do to find the answers and that's something that they can help us with.

One of the first questions we decided to have them work on, because kids like food—they like to be able to snack in class!—and because we could take all these seeds into space and get something physical into the students' hands, was how do you feed people on long-duration space missions. They could look back to early days of exploration, across our continent, for example. How did the folks in the wagon trains feed their people, and could they take everything with them? And if they couldn't, how did they handle that? There were all kinds of science and engineering and history and writing—and everything else— that they could be doing with this.

Again, we were able to build on the tremendous success of the Tomatosphere Project, but we wanted to take it to the next step. We were thinking about STEM now—Science, Technology, Engineering, and Mathematics education—and the integration of those subjects that was not a part of what education was in 1985. So for us the next step was to also engage the students in engineering and technology, along with science and math, while working on "the big questions."

We put out a call for the kids to design and build a growth chamber for the Moon or for Mars, or for spacecraft, or for their own backyard, and use whatever materials they had at hand and think about that big question. Then after we returned from space, we would send them the

basil seeds that flew with us and that they could test in their growth chamber prototypes. It was a tremendous project. And we had some ideas on where else you could go beyond that. In fact, every mission or every few missions could have a big question for students to be thinking about and then doing something very hands-on to help answer that question.

I thought it was interesting that, at the time and with the personnel changes, it wasn't what everybody in NASA wanted. There was both an internal and an external expectation that this was going to be about the teacher teaching and a show from space, almost like a "Bill Nye, the Science Guy" kind of thing. The words "wow factor" kept popping up and we were continually asked, "Where's the wow factor in what you're doing? Where's the wow factor in what you guys want to do?"

A non-educator recently assigned to NASA HQ Education was put in charge of overseeing STS-118's education plan. This was a big team of people working at this, and it was interesting to watch that whole process and how challenging it was, to help convince or help educate people that in education the "wow factor" is not the show. Give these students, give these children these opportunities to do real work and then let them tell you about it. Let them describe and show you what they've done, and that's where the "wow factor" is, and it will blow your socks off.

To have a team of kindergartners create something that looks like a cardboard shoebox but is a growth chamber. It looks like a piece of junk and you can't imagine that they've gotten anything out of it. Then you start asking them to describe their growth chamber and why they made the design decisions they did; what their challenges were in building it, and how did they overcome those challenges; what are the variables they're going to be working with on their plant experiments; how are they going to do all that; and it will blow your socks off. That is the "wow factor."

It surprised me how challenging it was to make that happen. There were a few folks that really saved the day. There were the folks in the Teaching from Space Office, who very consistently and very kindly and nicely kept working at educating, educating others, and working really hard and not giving up. And there were a couple of engineers and MBA's on the education team at Johnson Space Center who aren't educators themselves, but they understand education and are outstanding managers. They understood how non-educators think and how managers think, and they were able to take the education message and translate it because we educators talk in a language that nobody else understands, just like NASA talks in a language that other people don't always understand.

So Ed [Edward J.] Pritchard was able to take that language and translate it and say to us educators, "When you do talk with this person and this person, here's where they're coming from. Here's what they understand. They don't understand your education point of view, but here's what they do understand." He would give great suggestions on how to translate the message for the other folks, and he would also convey the message himself.

I think our STS-118 national engineering design challenge could have gone a lot farther. We could have had even more great things going on, particularly to highlight nationally the work that these kids were doing, but at the local levels, it was done very well. I'm really proud of the endeavor. In fact, I just checked this morning with Johnson Space Center, with the Teaching from Space Office, to make sure I had the numbers right. The most recent data is that over 2.5 million students designed and built plant-growth chambers and experimented with the seeds, in 150,000 teachers' classrooms. And this is my favorite data, for about 56 percent of those teachers, it was the first time that they had ever done anything NASA-related in their classrooms or even knew that NASA had an education program. So I think it made a big difference, and I

thank all the folks who worked really hard in the Teaching from Space Office, and others, both internally and externally, to make that all happen. Externally, for example, Park Seed Company, Sally Ride Science, ITEA [International Technology Education Association], NSTA [National Science Teachers Association], and others.

WRIGHT: Now you've reached the "wow factor."

MORGAN: And that is the "wow." How can you not call that a "wow factor"?

WRIGHT: Hopefully, they'll find more ways to incorporate what NASA does.

MORGAN: This team had put together a bigger plan, and this would just be the first step. Then from here you'd build another one and another one and another one, and they would all interrelate because they all have to do with human space exploration, current and beyond low-Earth orbit. We were going to have these all designed in a way that they wouldn't have a shelf life. In other words, that question about how you're going to feed people, that can be asked many times and be approached in many different ways. Those seeds, yes, we only had—*only* had 10 million seeds that we sent up, plus the 3 million MISSE seeds. But you could do all kinds of follow-on work, including experiments on second- and third- and fourth- and fifth-generation seeds. It's the type of thing that can continue on, in various, creative directions.

We had also done some preliminary work, and I was really proud of this work. This came right out of the Astronaut Office. I'm pretty sure it was Kent [V.] Rominger who said, "This is good stuff. Why don't we start getting things in place by doing some test ideas at a smaller scale

first." That was terrific, so with STS-115—Brent [W.] Jett was commander and Chris [Christopher J.] Ferguson was pilot, and Heidi [Heidemarie M. Stefanyshyn]-Piper was on that flight and Canadian Steve [Steven G.] MacLean, a tremendous astronaut and very interested in education. That STS-115 crew was very interested in helping us out. They were taking the solar arrays, the big solar arrays, up to Station and they were excited and happy to help us out. The Teaching from Space Office, with Jonathan [D.] Neubauer taking the lead on this one, came up with some outstanding activities that students could do with small solar cells so that they could learn how they work and they could do some designing and building and experimenting. Jonathan and team put together kits for our NASA Aerospace Education specialists to take to the different classrooms to work with the kids and teachers. Then on orbit, Chris and Steve—again, he really understood how experiential education can make a real difference for kids, and it was how he got curious about things when he was growing up—Chris and Steve were terrific, engaging the kids and teachers from orbit, and that was very significant. It was small-scale, a successful education activity tied directly to STS-115's ISS construction work and to a "big question" about energy and space exploration for students to think about.

WRIGHT: When you began in 1998, as part of your task, were you involved in the Education Office? I know you were training to be an astronaut, but yet from what you're describing, it sounds like you were very much involved in coming up with the activities to go up on the missions that even were prior to yours. So were you involved in doing that as well?

MORGAN: Yes, I was involved in that somewhat, but remember there were plenty of years from 1998 to 2007. Except for the first two to three years of ASCAN [Astronaut Candidate] training

when I was focused totally on making sure I learned what I needed to learn to do the job and become an astronaut. Getting to add the education work came later.

Can I tell one funny story about the seeds?

WRIGHT: Sure.

MORGAN: We took up those 10 million basil seeds. They were packaged in a triple layer of thick-mil plastic. It's a pink-looking package. Each package was about 12, 14 inches square. I know Scott [J. Kelly], our commander, was a little concerned, quite concerned about the seeds. You can imagine if there's a rip or hole in that bag in microgravity, it would be horrendous, and so we worked carefully on the packaging. By we, I mean the Education Office and the payload folks. They worked very closely and very carefully with Park Seed Company and with the Payload Office, making sure everything was good to go. So the seeds were triply contained and we had 10 packages, a million seeds in each package.

The 10 packages were packed in a CTB [cargo transfer bag] and stowed on *Endeavour*. We also took up a small example of a growth chamber, and it was an expandable, see-through container, so that it could be filmed.

Let me side-track my story for a moment to explain another goal of ours for the seeds project. We wanted this project to have some longevity and include Station. We worked with the Space Station crew and we transferred that example growth chamber and some of the seeds over to Station. Then Station continued the project. Clay [Clayton C.] Anderson continued with that long after we left, demo'ing the growth chamber for the students and teachers, and filming

the experiment's progress. Clay did a great job, and he also helped show that this wasn't just a quick one, two, and you're done with it on-orbit, Shuttle educational activity.

OK, back to my story. We wanted to photograph and film one of the packages of seeds floating, to show the students that the seeds they would be receiving really did fly in space. Al [B. Alvin] Drew and I pulled one of the bags out to photograph it. It was in the Spacehab where we also had five thousand pounds of cargo that we were transferring over to the Station.

When we unzipped that CTB in the Spacehab and very carefully slid out one of those triply contained packages of 1 million seeds, that entire Spacehab plus the tunnel, that volume of area in the Space Shuttle, immediately filled with this wonderful basil aroma. It was amazing. You know how when you grow herbs and you love to pinch off the leaves and you love to pinch the stems to smell the herbs? Well, I'd grown basil for years and had never noticed a smell from the seeds before, but when we pulled that bag out, and it just, whoa, that aroma just knocked your socks off. Al took one look at me and said, "Barb, I could kill for some lasagna right now." [laughter] He's so funny.

WRIGHT: I think I'd be looking for the tomato sauce right then.

MORGAN: Exactly. And what was fun about that, too, was we were thinking about, for the younger kids anyway, not calling them basil seeds, but calling them spaghetti-sauce seeds. But we didn't. We went with basil seeds.

WRIGHT: That's a great story. It really is.

Talk some more about that mission, if you would. Talk about your crewmates and how you guys trained together and worked together so that these types of activities became very much a part of the mission that you were all involved with.

MORGAN: That one in particular, the education in particular, Al Drew and Dave [Dafydd Rhys] Williams were very keen on the education. The others were fine with it, too, but in particular Al and Dave, Dave from the Canadian point of view. They wanted to do education, as well, and they did some great things.

This was challenging too. We wanted all the education to be very integrated. We wanted it to be seamless so it wasn't a Canadian education program and a U.S. education program, and that was interesting, too, because it was hard bureaucratically to make that happen. Dave and the Canadian Space Agency did some great work creating video CDs on spacewalking, and the chemistry and the physics of the spacesuits, and we were able to share some education resources back and forth, between CSA and NASA.

I thought the sad thing was, for some reason, the seeds could not be sent outside the country. I imagine it's because taxpayer dollars, etc., even though they were donated by Park Seed Company, and I don't know the whole story behind it. But one would have thought that we could have easily shared with our fellow space agencies. That was a challenge. We'll just leave it at that. That was a challenge. It was interesting.

But Al in particular, and Dave and Clay Anderson, too, were the people most focused on the seeds project and some of our other education activities like our interactive downlinks with students. Our other *Endeavour* crewmembers—Scott, Scorch [Charles O. Hobaugh], Rick [Richard A. Mastracchio] and Tracy [E. Caldwell Dyson]—of course, value education

tremendously, but it was Al and Dave and Clay who primarily carried out our education work on orbit.

Those downlinks were fun, and challenging. They're hard to fit in time-wise on these very challenging, packed missions. I wish we could do more of them, they're valuable. But they're hard to fit in, and they're challenging to do well. It is just not the same as being in person, in a classroom, right there, face to face.

A lot of people do online teaching and I'm impressed with how well it's done. In orbit, little things are just challenging, like not having the extra person behind the camera so that we can get better, closeup views of the demonstrations we're doing to help answer the students' questions during the downlinks. We also wanted these Q&A downlinks to be less formal than what NASA usually does. We didn't want the student to spend all the time saying, "Hello. My name is so-and-so, and this is my question," blah, blah, blah, blah, blah, blah, blah, that had been tightly edited or rewritten by somebody else. We wanted this to be more like a real classroom where kids more spontaneously ask questions that aren't edited.

We also wanted to provide as few *only*-talking-head answers as possible. We wanted to be able to demonstrate as many of the questions' answers as we could. So we still collected the questions from students ahead of time, which it would have been nice if we didn't have to do that, but because the on-orbit time was so valuable and because we wanted our answers to be demonstrations and not talking heads—showing, rather than telling—we had to have the questions so that we could pre-stage any available onboard props to answer the questions.

WRIGHT: And that's lots of logistics however you look at it, isn't it?

MORGAN: Yes. I remember we were answering one question with one demo and we needed to zoom in on the particular activity, but while we could remotely zoom that particular camera, we couldn't remotely pan and tilt it. So you could zoom in and then you totally miss what it is you're looking at because you can't pan or tilt it, and you're doing this as Dave and Al and Clay and I are in front of the camera and we're trying to do all this with no one operating the camera from behind. I would say we did the best we could and it was a lot of fun, but I'm sure it wasn't very high quality.

WRIGHT: But the point got across.

MORGAN: I hope so.

WRIGHT: I think that was what was good about the mission, and because you were on that mission, the mission took on a different aspect. There seemed to be some discussion that you were a mission specialist and had been an educator, and *not* the educator mission specialist.

MORGAN: That was a change in personnel at the top. Our NASA Administrator Sean O'Keefe felt it was very important and saw that the Teacher in Space Program goal had still not been completed and he wanted it to happen. Then he initiated the Educator Astronaut Program, and we brought in more teachers to the astronaut corps, which was great; they are terrific. Then the next administrator said, "No, she's not a teacher. She's a mission specialist." That's just the way it goes.

WRIGHT: Yes, it takes attention away from what I guess you wanted to really do and that was to bring the lessons alive.

MORGAN: Yes, you want to bring the lessons alive and you also want it to be good for the crew and the mission. Definitely what you don't want is one individual standing out, and I agree with this—that's another reason why the conceived "wow factor" or the perceived "wow factor" that some folks had in their minds—that was going to make *a* crewmember stand out—was problematic. I think that was likely part of the reasoning behind not having a special category of "educator mission specialist."

WRIGHT: But it was nice to see in the STS-118 crew patch, the design had the flame of knowledge.

MORGAN: We did, and our crew was really good about that. This was an education mission and we wanted to highlight that as a crew. In addition to everything else that we were doing, education was an important part of the mission. People wanted to put an apple on our crew patch, and we talked about that, but we really wanted to honor teachers and students, and past, present, and future. That flame of knowledge actually came from the Teacher in Space Program patch and that was the real symbolism behind including the flame of knowledge, so it was honoring the past and moving into the future. The idea there, if you read that description, is that the orbit that encircles the astronaut symbol starts with that flame of knowledge, so we were trying to symbolize that all of what we're able to do for space exploration. It's all based on

having a good education system and having a good educational foundation, so it all starts with education. That's where it starts.

WRIGHT: Do you feel like the mission went fast. You had all the years and all the thoughts of preparation; then you're up and you are down?

MORGAN: Yes, it does go really fast. Too fast.

WRIGHT: And that was not your only assignment on that mission. You had other things that you were assigned to do.

MORGAN: Yes, and I loved all my jobs. Robotics operator. I love flying the robotic arm on Shuttle and Station. If you like math, it's math in action, and it's very fun to do. It's also very challenging, but the way we're trained is excellent. It definitely prepares you for flying the real mission. So, the robotic arm work, I loved it.

I was loadmaster, and that was a fun job. It was challenging because we had five thousand pounds of cargo that we were moving from Shuttle to Station and then retrieving and returning about five thousand pounds of items from Station back to earth. Al Drew, thank goodness, was my partner on that. Everybody helped, and we were all worker bees helping transfer all that stuff, but Al helped with the organization and keeping the process moving forward.

When I found out I was going to be loadmaster, I went to Wendy [B.] Lawrence right away. Wendy was a master at that, and she had managed very big transfer jobs on several missions. Stephanie [D.] Wilson had also been an excellent loadmaster, so I went to both of

them and picked their brains. That was just before Wendy was leaving the office, and she said, "Yeah, let's sit down," and she walked me through everything and how she organized it, and left me her big notebooks that she had used so I could refer back to them. It was all so helpful.

I think probably the most challenging part of that job was—you would think it would be moving everything and making sure it all fits where it's supposed to go and makes sense, logistically, and then coordinating every day from on-orbit with our transfer ops folks in Mission Control—but it was managing our Flight Data File Transfer Ops books. Those big books, you can Velcro them shut or you can put a clip on the page you're on, and if you need to set it down, well, there's no up or down in space, but when you need to put it somewhere so that you can carry this CTB bag to hand off to someone to transfer to Station, or move this bag yourself, so you cram the book somewhere where it will stay put, and you turn around to do whatever it is you're doing, or you float off and when you come back, the book's not where you left it, it's not there. Things just wiggle their way out.

At one point I saw that book floating in mid-air, and it had been—well, you know those Hallmark Christmas tree cards? The cards you open and unfold completely around, and they're made out of tissue paper folded like an accordion? That's what that Transfer Ops book looked like. It was about a 9-by-13 book about 1-inch thick, so picture that book transformed into one of those Hallmark Christmas trees. There's this big fat 18 or so inch diameter cylinder of pages floating in mid-air where we were working. Then you have to go through all those pages and find your spot again.

We had everything color-coded and we're marking things out in our Transfer Ops book with different colored markers that we've pulled out of one of our lockers and Velcro'd to the wall. And every day, both at the end of the day and in the morning, we'd coordinate with

Mission Control and update both our electronic and hard copy transfer ops records. In the morning, we print out, onboard, the new, updated flight data file pages that our transfer team would send up to us. And you strap yourself under bungee cords, and you cram all the pages under the bungee cords with you so they don't float away, and you change out the pages, one by one, getting rid of the old pages and installing the new pages. Well, to unclip each of those three little rings that hold the book together, and pull one page out and put another page in, for many pages' worth, and doing that in microgravity, that was probably one of the more challenging tasks. [laughs] It was pretty funny. Those papers were everywhere.

WRIGHT: I guess you don't look at notebooks the same anymore, do you?

MORGAN: No. It's a fun memory. You know, I forgot to tell you about my other primary jobs too. One of the other jobs was lead responsibility for of all the photo and TV equipment and setting all that up. That were lots of cables, cameras, lenses, monitors, and other equipment, and making sure that all that was working every day. There's a lot of overhead to managing things in space. All of our little memory cards from the cameras, for example, where you put those, how you make sure that they're all labeled correctly for our ground team. When it's all floating around, if it's not properly labeled and put away, it's just everywhere. Then, another favorite job, it was a real treat to get to serve on the flight crew for reentry and landing, and that was pretty remarkable too.

WRIGHT: Did it meet your expectations?

MORGAN: Very interesting. That's a great question. I think I had some expectations that I would like it all, but I didn't really know what it would be like, for real, other than knowing that we had a lot of work to do and that we'd accomplish our mission goals. And it did meet my expectations.

There were a few surprises right away that I hadn't expected, and one was when we first looked out the window, the blackness of space was a huge surprise to me. After all those hundreds of pictures that I'd seen, those beautiful pictures that we have, other crews' photographs, they don't capture the blackness of space that I saw with my own eyes. They do capture the blackness of it, but it was a black that I've not seen anywhere on Earth, and that was a big surprise to me. It's hard to describe because I haven't seen it on Earth, but it's definitely a flat black; it's not shiny. It looks like it has a texture to it, and this is from my perspective, from my eyes, but it looks like it has a texture to it, but you know it's a vacuum. You can see through it.

When you're on the dark side of the planet and you turn off all your Station and Shuttle lights, and look out and see just millions and millions and millions of stars, they look like pinpoints of light hung on invisible strings. There's a lot of depth, and that vacuum of space looks like it goes on forever, yet it looks like it's got some kind of a texture to it. At first I thought I could describe the texture as maybe velvet, soft like velvet, but velvet is nappy, so it's not like velvet at all, but it looks to me like it has a creamy texture. So the best I can say, and this makes no sense at all, is that it's creamy black. That's all I can say, but it's not like creamy black coffee, no, because that's not kind of black. It's kind of a tough one. So that was a big surprise.

Another surprise, the first couple of days was I wasn't hungry—well, I didn't expect to be hungry—but I wasn't hungry and I knew it was important to stay hydrated. You spend a lot of time the first couple of days—your fluids shift upwards. Your body's telling your brain that you've got too much fluid, you don't need all that fluid in space, and so you get rid of your liquid waste a lot. But you still have to stay hydrated, and so I would. I wasn't hungry, but I thought I'd better stay hydrated, so I'd have only water or juices or soups the first couple days' meals.

I was really surprised that basically my soup or juice would go down to about right here—I'm pointing to kind of high chest—and it felt like that was as far as that liquid went and it would stop. So I felt like I was full from my throat down to the top of my chest. I thought, "Well, that's interesting. I wonder if this is going to be like this the whole flight. That's just something I'll have to ignore."

Our crews debrief each other after every flight, and we talk about all the things that go right, all the things that go wrong, things that we should improve on, and then at the end of those debriefs in the Astronaut Office, we kick everybody out who's not an astronaut and that's when we talk about medical and more personal issues. In all of that time, I didn't hear—I'd heard a lot—so I had at least an awareness of things that you might anticipate, but I had not heard anybody mention that odd feeling, and so I just wondered. I was curious about that, but on-orbit Scott told me—I think I may have asked him, "Have you ever heard of this one before?" and Scott said, yes, some folks that happens to. But that was just something I hadn't heard in any of our debriefs. It was no big deal. When peristalsis starts working again after a couple of days in space, I think everything starts working, and then I never experienced that uncomfortable feeling again.

Another interesting surprise—you might remember this one, it came up in one of the talks at NASA Day at Boise State [University, September 20, 2011]—that upside-down feeling, because I hadn't heard about that, either, prior to flying. When we first unsuited, just after launch, when we unsuited, we had a lot of work to do. I wanted to be able to get the jobs done. I didn't want to get sick, so that I could do the work, and I was trying to be careful and keep my orientation normal to what we'd been used to on earth, and get to work. I didn't have any time to just hang there and experience and think about what weightlessness in space is like. I was pretty awkward at first. In fact, I think I was one of the more awkward people on our crew.

Tracy, I was so impressed with her. We all said, gosh, she's like a duck taking to water. It was like she had been born in microgravity. She just moved around so smoothly and easily. She looked like one of these people who—like our Space Station crewmembers. You can see a huge difference between Space Station crewmembers who've been there a while and rookie flyers. They just move slowly and naturally, and they're not bumping into things. I was always kind of jerky and bumping into things. Tracy, it was like she had been in space a long time. She just adapted incredibly well to the microgravity. It took me a while. I was very awkward, but I just worked my way through it as best I could.

I don't remember now whether it was the first day or whether it was the next day, but the ground team wanted Scott and me to call down and do a downlink for the media—to talk about what launch is like, what it's like being in space. So when we were waiting to come into position with the TDRSS [Tracking and Data Relay Satellite System] and get the good downlink, we were probably waiting there five minutes or so, and that was the first time that I actually wasn't busy working and could just sit there, stand there—I mean float there, rather. [laughter]

WRIGHT: Be there.

MORGAN: Yes, be there and experience what it's like. And it was the oddest thing because I realized—and we had our heads up towards the top of the Shuttle, the ceiling of the Shuttle, and I realized that I thought I was upside down. I felt upside down. I looked. "No, the ceiling's here," but I felt upside down, and that was very odd. And I hadn't felt that until I wasn't doing anything. That upside-down feeling lasted for a couple of days, too, and then that went away. That was a little awkward at first, but once that went away, that's when being in space really got fun.

By this time we had docked to Station, and there are quite a few right angles between the various Station modules and between Shuttle and Station. So it's really easy when you're floating from one module to another, to, well, you turn the corner and you're floating, and what you think should be the ceiling isn't. I thought that you might get quite disoriented doing that, but for me it didn't matter. That's when it actually got fun, when it really didn't matter. Up was wherever your head was, so if the top of your head's pointing to the wall or the floor, that's up. That's ceiling. That was interesting.

So back to the question about the expectations. We had very little time to look out the window, but one of the ways I would steal moments would be to volunteer to put the shade on the mid-deck window for our sleep periods. Scott took care of the upstairs flight deck and covering those windows, and I would put the shade on the mid-deck window. That way, when my crewmates were zipping into their sleep restraints, I could steal a few minutes and peek out the window.

One night when we were getting ready for bed and I was installing the mid-deck window shade, we were on the dark side of the Earth. From that viewpoint, looking out that mid-deck window, you're looking along the length of the Station's truss, and out at the end are the solar arrays, and I could see that because the arrays and truss were in shadow—they were blocking the stars. I could see the stars around it, so I could definitely see that's the truss on the Space Station and those are the solar arrays out there, and they looked like sails out there. It just popped in my head; that's an interesting view.

I was watching, and all of a sudden, off on the horizon, a thin blue line appeared, a thin curved blue line, and it moved up and another thin blue line came up underneath it, and it moved up and another thin blue line. It was thin blue line after thin blue line, stacking up from the horizon. We were approaching the daytime side of Earth, and that was gorgeous, and I noticed a couple of things. One, each of those thin blue lines was a different color blue. On our pictures, when you look at sunrises in our photographs, you see blues and you see oranges, and to me, I can count maybe six, seven, eight layers in the photos. But with my own eyes, not looking through a camera lens, I saw 15 to 20 different layers of blues and they were each a different hue of blue, and that was a big surprise.

As we were approaching the dawn, that sunlight would start reflecting on those solar arrays that track the sun, and that was a sight to behold. They're gold, and when the sun starts to shine on them at that low angle, they start glowing brighter and brighter and brighter—like the filaments in your toaster—only instead of bright red—they become a brilliant Inca gold against the black of space, and they're incredibly beautiful. They look like golden sails.

I'm watching that and going, "Oh, my gosh," and as we get farther around towards the sunrise, from that perspective, with the higher sun angle, all of a sudden the whole Station

becomes awash in a brilliant white light. I looked down—we were fully on the daytime side of Earth now—I looked down and we were over the ocean, which isn't a surprise because you're usually always over ocean, but it looked rough.

This is a long story, but this is all happening within minutes, travelling at 17,500 miles per hour, or 5 miles a second. While I was observing all this, I wasn't holding onto anything. I was just free floating there next to the window looking out. I could hear some whirring and low humming from the Shuttle's fans, but everything else was very quiet. It was bedtime. Ground wasn't calling us. Those looked like sails out there, those solar arrays, and I felt like we were sailing over an enormous ocean, in an amazing quiet.

I'm looking down at the ocean and it looked really rough to me, I was thinking about the early days of the explorers—the earlier ages of discovery—and here we were sailing in this technologically advanced ship of exploration and it's so challenging, but it was so smooth, and it really seemed easy, even though it isn't. It seemed a lot easier than what those early explorers experienced. We weren't bouncing and rolling with huge swells of waves; we were just smoothly sailing over the top. I was thinking about that.

I looked back up at the horizon and, no kidding, there I spotted the crescent Moon hanging right above the horizon. It was a serendipitous moment. And I thought it seems like it would be so easy, we could just yank hard on a tiller and take a sharp right turn and sail right to the Moon. Of course, that's impossible, but it felt like that's what you could do. And this is something I hadn't anticipated, but that's when it really hit me, when I truly understood, that space exploration is a very natural thing for human beings to do. That was probably one of my biggest lessons from space.

One time, we decided as a crew to spend some time together on the flight deck, take a long break and really look out the window. We were observing for quite a while, just oohing and ahhing and everything, but we were doing it quietly so we didn't bother each other. Scott Kelly, at one point, pipes up and says, "You know what? I don't know why we call this planet Earth. We really should call it water." [laughter] It's so true.

WRIGHT: Talk about some of the times that you had as a crew to experience things as a unit. Like mealtime, did you get a chance to sit down and have meals as a crew?

MORGAN: We did twice, only twice. Again, the Shuttle flights are so busy and crammed that basically you're grabbing food on the go. We have planned mealtimes; it never works out unless you're grabbing food on the go. A couple of people might eat together or help each other out, or you might make this quick snack and take it to somebody else. We were going to have two meals together, all 10 of us, for sure. We were going to have the Station crew over and have a Texas barbecue celebration meal on the Shuttle, and then they were going to have us over for a Russian meal full crew celebration.

I thought this was really interesting. When you're on each other's side of the ship, and we're working together all the time, it's not like their side and our side. We're working together all the time. But you treat the Station as, okay, that's the Station crew's home and you treat the Station as we're just visitors. That's the Station crew's home, and you want to be very respectful of that, even though we're all working together and back and forth all the time.

When the Station crew was over working with us on Shuttle, whether they were getting these transfer bags or whatever they were doing, or we were over there on Station, you would

always offer each other, "You want a snack?" And it surprised me that whenever it was close to our dinnertime, the Station crew would always say, "No, thank you," whether it was Clay or Oleg [Kotov] or Fyodor [Yurchikhin], and I just thought that was interesting. I noticed this happened a few times, and it was almost like, I felt like, maybe I was being a pest asking.

I think I asked Clay, or maybe he just told me, I don't really remember, but he said—and this was amazing to me—he said that it's really easy to get isolated on the Station, and every commander runs a mission differently. And he said, "Our commander, Fyodor, he wants to make sure that we are a crew, and regardless of whether you folks are up here or not, we are a crew and we always have one meal a day together. We always have dinner together." So just like you would run a well-functioning home, a well-functioning family. I thought that was remarkable.

WRIGHT: That's a good idea. What about the isolation? Because you're in a contained facility, how could you become isolated?

MORGAN: Station is big enough. It's big, and it's much bigger now; you can go hide out, and Fyodor just didn't want that to happen.

We were going to have our Space Station crew, we were going to have our meal over there together, a full combined crew together, and what happened with that was Hurricane Dean showed up and was headed straight for Houston, so we had to actually cut our mission short. The very last day just before undock, so basically a day early, we very quickly—we had about 20 minutes—and I thought that was really neat of Fyodor too. He said, "We've got to do our meal

together." That was important, so we did whatever we needed to do to complete everything we were supposed to complete a day early and squeeze in that meal.

Well, the Russians loved our American tortillas. In fact, they begged us, if we had any tortillas left, to leave them behind. Scott wanted to make sure that we had enough food on board for two to three days of wave-off, but we did give them as much of our food the night before we undocked, before we closed the hatch, as we could. I think we kept just a few of the tortillas. I really don't remember.

But we did, for that dinner, take our tortillas over to the Russian module, the SM [Zvezda Service Module] where we were having dinner, and they had saved up some of their finest Russian foods to share with us. These were small cans. They looked like tuna cans, and one had a couple of different cheeses in them. One was a caviar. The rest were pâtés, like fish pâté or chicken pâté. They were all quite tasty. There was a bottle, looked like about the size of a tall milkshake container, a bottle of some kind of a sauce. It was a red sauce. It was delicious. I have no idea what was in it.

So they opened up all those cans, set them out on the little tabletop in the service module, and we had the tortillas and we had a wonderful international meal of fancy Russian pâtés on American tortillas. Very fun. We did just a quick, "Here it is," and lots of laughs and photographs, and then, boom, we were out making sure that we had everything on the correct side of the hatch and getting the hatch closed before the end of that day.

WRIGHT: Then the mission turns to preparing for reentry. You mentioned earlier, how busy you were helping the commander on the way coming [back to Earth].

MORGAN: My role was MS4 [Mission Specialist 4], Tracy was MS1, and we swapped out for reentry, so I sat in the seat right behind our pilot Scorch. Rick was our MS2, so he sat behind Scott, behind and between Scott and Scorch. MS2 is the flight engineer, so he or she is monitoring everything that's going on and keeping the timeline going.

One role of the MS4/MS1 seat is to keep track of any malfunctions and then be ready with—we use one of our flight data file books called ref [reference] data. It's full of Shuttle systems' shorthand that covers everything that's been anticipated that could go wrong. It's full of data, for example, so that if you lose main electrical bus A, here is what you can expect to lose. There's a lot of pages to it, and you've got to anticipate various scenarios and put all the various critical systems' puzzle pieces together and then be ready with that information, because the pilot and commander, they're trying to keep that malfunction and it's ramifications in their head, but they're flying the orbiter. They've got a lot going on, so it's not that you say, "Okay, we could lose this or this if we lose this next," but you've got that information ready, in your head and notated on your kneepad, so if we lose this next, or if this happens, or if this happens, you can immediately give the critical information to the commander and pilot when it's needed.

Another task you do is give the landing brief, including a weather brief, the landing conditions, and a reminder of which runway we're using. And, are we going to be an early chute deploy or a late chute deploy or no chute deploy? All that kind of information. Then at a specific point in time during reentry, you give that briefing. The timeline is all tightly scripted out, there's a lot to do, and you're monitoring the cockpit CRT (computer) displays and all the critical data we've been trained to look for. It was really fascinating.

A disappointment for us—we were all excited to see the plasma, that bright glow, when streaking through the atmosphere. The position I was in was also in charge of this little camera

and a Sony monitor to record inside-cabin views. You're looking at the monitor, and then at a certain time you make some cable changes to swap the monitor views from that handheld camera to the camera mounted in front of the pilot's heads-up display. Then you're looking at the monitor and seeing what he or she is seeing. In this case, it is what Scorch is seeing in his heads-up display and making sure that the camera functions are set correctly so that you can get a good recorded view of the approach and landing.

I had planned on, when we started to see plasma, pointing the camera out the window to capture all that, and as we were entering, the way I remember it, we suddenly and all at the same time went, "Wait a minute. We're on a daytime entry, not a nighttime entry, so we're not going to see any of that, darn" which we didn't. I think one of my crewmembers, Rick, may have seen a little bit. Whatever little plasma he might have seen, I missed it totally.

Meanwhile, I had the monitor Velcroed to the back of the seat in front of me, Scorch's seat, and Rick had a pen floating in front of us so we could see when gravity started coming on. The monitor started to droop from the back of the seat. You feel like your rear end is smooshing into your seat. You definitely are aware that you've got a rear end and that it's sitting on a seat, and that's when gravity's coming on.

Well, the monitor got heavy and it kept falling off. The Velcro wasn't holding, and the monitor would fall off, so I'd have to bend over. You're strapped in, and I'd have to bend over the best I could, all strapped in tight, and use my feet to pull that monitor up off the floor and get it working again.

Also the batteries in it kept getting jostled so the monitor would lose power, and I'd have to reset the batteries and controls again. I felt like it was a bit of flail just trying to keep up with making sure that the monitor was working. This inside-cabin activity is okay, but it's mostly for

PR [public relations], but I definitely wanted to make sure that everything was working properly to record the heads-up display views and data when we swapped to that camera. The flailing with the monitor happened about three or four times that I remember, where it would lose power and I'd have to reset the batteries and controls, but, luckily, just at the right time, it cooperated and we didn't lose any of that recording of the heads-up display for our approach and landing.

WRIGHT: And your travels in space ended and you were back on Earth, and you began moving into a different path. You were now in the post-flight work. Were you able to talk more about the mission or more about the educational aspect?

MORGAN: We did quite a bit as a crew and then I did several activities individually. We tried to focus on some of the larger groups, like National Science Teachers Association and National Council of Teachers of Mathematics, International Technology Education Association. And our first outreach event was at Disneyworld. So we supported big events, big venues, for a short period, and then you get assigned to a technical job again. Before I left for space, I served in the Robotics Branch, and I was reassigned to the Robotics Branch. Prior to our STS-118 mission, I was working in support of our more immediate, the next couple of missions. We help out, for example, by reviewing and making sure that the procedures are correct, by identifying and helping solve technical issues, by representing the crew, helping ensure that the robotics activities are going to work, for mission success. When I returned to the Robotics Branch, I was also working on some of the training protocols and how we can help streamline our robotics training flows. It was education, but not K-12 or university.

WRIGHT: No, a different type.

MORGAN: It was a different type. I was also working on crew techniques and protocols and such for the future capture and berthing of the Russian MRM-1 [Mini Research Module] in development for Station, and it was very interesting to get to work on something that far ahead. MRM-1 was launched and added to Station in 2010, after I had retired from the Astronaut Office. It was fun working on the future. And that's like education—it's fun working *with* the future—those kids in our classrooms.

WRIGHT: One of the other things that I believe that you did while you were there, you served as CapCom [Capsule Communicator]. Can you share with us about it? I know one of the times that you worked CapCom happened to be on 9/11/2001. Talk about the training and how you began doing the CapCom and some of the experiences you had on that task.

MORGAN: CapCom was a great job. I remember one of the recommendations was that every flyer should be a CapCom because, first of all, you get to know the people, the rest of your—it's not the whole rest of your team, but it's one of the many critical parts of the team. I think understanding the mission from the Mission Control side helps you when you're on orbit. When things take a while to get an answer back, you have an understanding of what's happening on the ground and how they're all working. And you get to know the Mission Control team as people, and that really helps too.

From serving as CapCom, what you come away with, at least what I came away with, was a deep understanding that Mission Control is your crewmate as well. They—the flight director

and flight controllers, the front-room and all the backroom folks—are part of your crew and it's just that they're not physically there with you. Mentally they're there with you, and in many ways emotionally, too. It's good to keep all that in mind.

Starting CapCom training, I was trained—and they were fabulous—by Sandy [Sandra H.] Magnus and Stephanie Wilson. Sandy and Stephanie really took me under their wing and their job was to train me. I was not very comfortable talking on the loops. I could talk, but I wasn't good at talking, even though we had been working on communications in the [Northrup] T-38 [Talon, jet training aircraft]. Teachers talk very differently than military pilots and people in an operational world. It's different learning how to communicate critical information in a crisp, clear, succinct, done way, and in a way that you know that the people on the other end are going to get the message quickly, clearly, understandably. And yet they'll know—it's that human communication and that interaction—including all the nonverbal communication that goes with it—that's still so important.

Sandy and Stephanie were excellent at training me, and I was very impressed with their capabilities. It turned out that they had become CapComs just a few months before me. That was a real eye-opener to me. You need to learn things quickly and you need to be confident, and then be ready to turn around and teach someone else as if you've been doing this for years. I'll never forget when they laughed and they told me, "I don't know. We just started this ourselves just a couple months ago."

Prior to getting assigned to actual missions as CapCom, you do a bunch of generic sims [simulations] and that's how you learn how to CapCom, and it's great on-the-job-training, and then you're tested. We pass a series of milestones. I remember when I got assigned to my first flight as Capcom, Bob [Robert E.] Castle was the flight director for Station. I hadn't done any

EVA [extravehicular activity] training yet, so I knew nothing about EVA. I didn't know any of the acronyms. I didn't know any of the tools. I didn't know what the connectors were called, this and that. And I was assigned to STS-110 that was taking up and installing the first truss component. This was with Jerry [L.] Ross and Rex [J.] Walheim, who are wonderful people. Just tremendous people and they were so good to me, took me under their wing, which I really appreciate, again.

I'll never forget, it was Thanksgiving week. I had just been assigned and was going to study up on the mission and learn everything I could, over the holiday. All I knew was that we were taking up this S1 truss piece, period. I didn't know anything else about the mission, and they decided to start a sim just before Thanksgiving, early. They wanted to squeeze something in before everyone took off for the holiday, the next day or two. I had just been assigned, so I didn't have any time—I studied as much as I could, but I didn't have time to know what I was doing.

So we're in that very first sim. The EVA team was behind me and Bob Castle's to the left of me at his Flight Director's console, and I'm sitting here, at the CapCom console. Bob and I, I had served as his CapCom for some of our Station Expedition Mission Control shifts, and we had also done some Station generic sims together, but not very much. And I'm sitting there not understanding—I didn't know anything, as I mentioned, about the EVAs, so I was constantly turning around and trying to get information without bothering our EVA flight controllers too much. That was the time I had to learn. I had to do something to be able to serve as a CapCom, so I'd ask a few questions back to the EVA team behind me.

I remember at one point Bob looking to the right, directly at me, and I'm thinking he's probably about ready to call my boss, the chief of the Astronaut Office, and say, "What were you

thinking and what is she doing here?" Because I didn't know any of the stuff. It was that look on his face. And I said, "Bob, I want you to know it's obvious to me, and I'm sure it's obvious to you, that I don't know anything about this mission. I don't know anything about EVA. I've got a lot to learn, but I promise you, by the time we fly I will have this down." He gave me a nod, like, "Okay," but I just felt so bad for him. "Who's this idiot who's sitting here in this job?" But I did learn it, and it was a great mission and I learned a ton from that first real flight.

WRIGHT: Were you on a lot of missions as CapCom?

MORGAN: Yes. I started serving in our CapCom Branch just before we had our first crew on orbit on ISS, so we had a couple of our modules, but we didn't have any Station crewmembers permanently onboard yet. I was CapCom for the very first crew—with Shep [William M. Shepherd] and Sergei [Sergei K. Krikalev] and Yuri [Yuri P. Gidzendo]—in 2000, and continued as CapCom until I was assigned to flight. That was just before *Columbia* [STS-107], so up until 2003. So I CapCom'ed until 2003, and the last full Shuttle mission that I CapCom'ed was STS-113. It was a crew of four with Jim [James D.] Wetherbee, John [B.] Herrington, Mike L.A. [Michael E. Lopez-Alegria] and Paco [Paul S. Lockhart]. And I served as CapCom for [ISS] Expeditions 1 through 5.

WRIGHT: And do you prefer one over the other [Shuttle or Expedition]?

MORGAN: No, I liked them both. They're different paces. They're both very interesting. The Shuttle missions, they're more intense for the most part, due to their short, packed timelines. It

was interesting seeing how Station CapCom'ing changed during that timeframe, too. This was when Station was just coming on, and this was when Steph, and, I told you, Sandy, and others of us were CapCom'ing. We started out doing seven-day shifts, so it was seven days on and then we'd take a couple days off and then do seven days on again. We would be shifting back and forth between the Orbit 1, Orbit 2, and Orbit 3, so lots of sleep-shifting going on and lots of very long days, and then also keeping up with our Shuttle and Station skills, T-38 flying, and other duties. But the Capcom'ing was all very interesting work. I liked it and it was fun working with the different flight directors, the different teams. They all have a little bit different style.

We were also working closely at that time with the IMT, the Integration [Management] Team. It was fascinating working with the IMT. I did that earlier as crew equipment support astronaut when I was working with Kalpana Chawla for both Shuttle and Station Ops and then also as CapCom. We worked very closely with the IMT and how the complexity of whatever you do on this particular ISS assembly flight has to be integrated with whatever's going to be happening five, six, seven flights down the road. How do you balance all that out? We would do weekly meetings there. I really liked that job.

WRIGHT: Almost like lesson plans, isn't it?

MORGAN: Yes, it was solving puzzles. It was putting puzzles together and figuring out how you're going to de-conflict things that otherwise aren't going to work.

I want to tell you a couple things as long as we're talking about CapCom'ing. From a teaching point of view, from a schoolteacher perspective, it was very interesting every time we transitioned to a new increment, to the next Expedition crew, because the expectation from—and

this happens in teaching too. When you're teaching seventh grade, ninth grade, twelfth grade, second grade, third grade, whatever, the kids have grown so much during that year, and you're calibrated at the end of the year to what they're capable of, and you start out a new year and you've got to back way up and remember that the new class is a year younger and they're a year less capable.

What would happen in Mission Control that I thought was fascinating is the Mission Control Team, basically, was made up of many of the same people from increment to increment. You'd rotate some people in and out so some were different, but it was basically the same people. A new increment's Expedition crew would arrive onboard ISS and people were treating that new crew as if they were at the same level as the prior increment's crew was at the end of their Expedition, and the Mission Control folks would have to back way up on their expectations. Every single time we switched to a new increment—I worked through many increments as CapCom—it happened every single time, so it was pretty fascinating to watch. You've got to back up.

It's also interesting, there's just so much information for the crews to learn, and astronauts are very capable people. You'd be in Mission Control and it would be something that the crew was trained on only one time or maybe it was as minimal as somebody quickly saying during a short training meeting, "Okay, here's what you do." So some of the comments you'd hear in Mission Control would be, "Well, we taught them that already," without really understanding that there were many people teaching the crew many things over a year's period of time, and just because they heard or saw it once does not mean that they're going to commit it to memory. So that was interesting to watch.

So, 9/11 [September 11, 2001, terrorist attacks on the US]. We were just getting off shift in the morning. I was on the night shift that night, and the flight director—he or she—always had a couple of TV monitors turned on. The particular flight director that night always had CNN [Cable News Network] on.

The crew had gone to bed, and this was the overnight shift, so we were the planning shift. No, I may be getting this wrong. Frank [L.] Culbertson was on orbit, with Vladimir [Nikolayevich Dezhurov] and Misha [Mikhail Vladislavovich Tyurin]. I remember that. I don't remember whether it was still nighttime or now daytime for them at this time, but we were getting off shift in just an hour, half an hour, whatever.

I remember we just happened to be looking at CNN and watching the plane go through the tower. We were going, "What?" And then that second plane flew through, so several things were going on. Of course everybody's in shock. We're trying to make sure that, without knowing what's going on exactly, what do we need to be doing to focus and make sure that we're doing our job with Station. Of course, we were getting lots of information from the bosses up above.

One of the most interesting things that I felt happened that day, and it was as we were trying to figure out what we're going to do, we went into lockdown. Johnson Space Center, if I remember right, wanted all nonessential people off, but, of course, we needed to keep Mission Control going. We all stayed. The new shift came in, but we stayed to help and make sure we had a really good transition. We actually moved Mission Control to another site on Johnson Space Center that's a backup plan for exactly things like this, emergency situations, and there was a lot of coordination and logistics and protocols that needed to happen.

I will always remember—and this happened just about the same time—the flight director's phone rang and it was SRP. That's the Russian flight director. SRP was calling the flight director and my phone was ringing, and the Glavnyĭ was calling me. Basically, at the same time. They were calling us. Glavnyĭ is the Russian CapCom. They were calling to say, "Sincere condolences," and also to say, "What can we do right now to help you out?" That just kind of stuck in my head, but I didn't have time to really process it.

Later, when I was home and watching the news, it got me thinking that that's, to me, when the International Space Station took on a whole new meaning, because I felt that if we didn't have something challenging that we were doing jointly with the Russians, I think that the Russian reaction to 9/11 would have been very different than what we got in Mission Control.

WRIGHT: I was watching an event from Headquarters a couple weeks ago, and Frank was sharing some of his memories and talked about how good he felt about getting information from Mission Control, that he felt that people in Mission Control were trying to do everything they could to make sure that the people on the ISS were secure in knowing that they were being taken care of and their families were being taken care of.

MORGAN: Yes, we definitely called up right away to talk with them, and that was tough. I also remember Frank telling us how lonely it felt to be the one American off the planet, and he said that was a pretty lonely feeling, but they got right to work too. They got the cameras out, he and his Russian colleagues, Misha and Vladimir. Interesting, too, because they were all military folks, the three of them, and they had been enemies years earlier, and here they were flying together. They got the cameras out and really helped. They were feeding us information, too,

which was both helpful to us and I think it was helpful to them, too. Gave them something to concentrate on.

WRIGHT: Were you also sharing it with the national security folks as well?

MORGAN: We didn't go directly from Mission Control to there. There were layers of other folks. I'm sure that there was a lot going on in the background. Again, it's pretty compartmentalized. We had our job to do, and we took care of that.

WRIGHT: We've talked a lot about education and how you impacted other students, but I was curious if you would share with us some of the education you got in some of your training when you came in as an astronaut member and those first couple of years as an ASCAN. I think you mentioned survival training.

MORGAN: Oh, yes. We'll talk about survival training, it's fun. Yes, the training was all great, even the training that we wondered about, like why would you do it this way? It all ends up working and everybody, I think, is very well trained.

We started out with land survival training and then water survival training. Actually, first we started out with basic T-38 training. There were four of us. I thought this was really neat too. Up until our year, NASA put the astronaut candidates in the T-38s and start the training, and the T-38 is really fast, 500 miles an hour. If you haven't had any prior flight training, prior flight experience, it can be tough to catch up on, but ASCANS did it for years.

All the mission specialists, for years before, who weren't already pilots did a good job, but they decided with our class—this was the first time—to give three of us, who had little or no flying experience, some lessons. So Leland [D.] Melvin, Danny [John D.] Olivas, and I took about 20 hours of flight lessons in Cessna's [fixed wing, single-engine aircraft] with Crip's [Robert L. Crippen] son-in-law and that was good learning. I thought it was interesting, thinking about this years later, that the people in my class who hadn't had prior flying experience were the schoolteacher, the Hispanic astronaut, and the African American astronaut. I just thought that was interesting. That's all I'm saying about that, just thought it was interesting.

That was good training, and then they dropped us in the T-38s. In my case, it was a good thing that we had that Cessna training, first, because Christa and I had only flown in the T-38s years before as a fam [familiarization] kind of flight. It was a lot of fun and it was great learning, and our job then was to learn to trust our commander and pilot, for them to learn to trust us, and to get some experience in high-performance aircraft.

George Abbey was wonderful about that. Christa was supposed to get one flight and then that was it. I think he was so anxious for us, in a wonderful way, to have as much experience as we could so we could take as much as possible back to students and our teaching colleagues. That was the first time in the Payload Specialist Program that the backup got to do that kind of flying too, and we actually flew several times. Mr. Abbey really encouraged us, both in the T-38s and the KC-135, even though you're supposed to have only one fam. Christa was supposed to have one fam, as I mentioned, the T-38. We were both supposed to have one fam in the KC-135 for the zero-g training, but he encouraged us to get in there as much as we could. I knew at the time it was all for education and opening those doors for our students, but looking back at it

from 1998 on, it was the whole operational experience that we were lacking that I think he also wanted us to get tuned into.

When Leland and Danny and I started out with our Cessna flying lessons, I'll always remember when Crip's son-in-law—he was my instructor—took me around the plane and showed me the elevators and the ailerons and such. I already knew basic airplane parts, but that was about it. He showed me how to do a walk-around pre-flight check. Then we got in the plane and we put the earphones on, and he said, "Here, dial up this frequency and listen to ATIS [Automated Terminal Information Service]." He told me, "Don't ask questions during the flight because those hours are expensive, but you'll probably have some questions. Hold them until afterwards if you can and we'll answer your questions. Let's just go flying."

So he tells me to dial up ATIS and I dialed up ATIS. I had no idea what ATIS was, and all I heard was [demonstrates static sound]. Just sounded like a bunch of static, but I was trying to be good and not ask questions, and then he said, "Okay, dial up this frequency and tell them you're ready to taxi with delta."

So I dial up this frequency and I say whatever our call sign was, "We're ready to taxi with delta." And I'm thinking, you know, I could be a monkey, I can dial in the frequency, I know what he's telling me, I can repeat anything he says, but I really have no clue what we're doing. And what is this delta stuff? I know it's not Delta Airlines because they don't fly in and out of Ellington [Field, Houston, Texas]. Okay, it must be a delta. It must be a change, and we're changing locations from where we are now to where we're taxiing to.

Then we went off flying, had a great flight, and I learned a lot. We came back to Ellington and he had to run, I had to run, so there was no time to ask him those questions.

Later on that night when I was telling Clay [Morgan] the story, Clay burst out laughing and he says, "Do you know what you were really doing?"

I said, "No, that's why I need to ask."

Clay, who has flying experience, said, "You don't know the pilots' alphabet, do you?"

And I said, "What pilots' alphabet?"

And he said, "Alpha, beta, charlie, delta." He went out that night, bless his heart, and got a shortwave radio for me to start listening to, to start getting a feel for air traffic control and what all that communication means. And that's when I learned that ATIS, which stands for Automatic Terminal Information Services, is the local weather and current terminal conditions report for the airfield that gets updated every hour, and that the delta just happened to be the identifier for that particular hour. I had a lot to learn before jumping in that T-38. That was pretty funny.

After that, our ASCAN class went for our land survival training, and that was wonderful training out in Maine. It was at the Navy SERE school [Survival, Evasion, Resistance and Escape], but obviously we weren't evading anything, even though we were at the school. We could see the signs in Russian for the different Navy training sessions, but for us it was basic survival training out in the woods, especially if we need to bail out of the T-38s or end up someplace other than an airfield, in an emergency situation.

So the training was terrific. We broke up into small groups and learned basic survival over several days. What equipment do you have on the T-38 that you can use out in the woods? We've got lots of lines, we've got the parachutes, you can build hooches [huts]. Your learn what the flora and fauna of the area is and how you can use that to survive, and what your emergency responses are and how to prioritize them, what do you need to take care of first. We had four days of experiential training. My particular group was being trained by a Navy SEAL [Sea, Air

And Land, special operations force] who was the most incredible person I'd ever met. My sense of this young man was that if everybody on the planet had been annihilated, during a nuclear winter, he not only would be the one survivor, but he would be thriving, and not just surviving, thriving. He would just love it. We learned a lot from him.

We were split into several small groups for this training. We barely knew each other, our classmates, and this was the first time that we were really getting to know each other. Towards the end of that week, we were going to be tested. Our trainers told us that the next morning, "Go into this building over here, and there's going to be a chalkboard with your names on it and find out who your partner is. We're going to give you your maps that you've been learning how to use, and you'll have a compass and you'll have a canteen. You need to get from Point A to Point B and you need to bring back three edible plants. You need to bring back a full canteen of water, and you need to build a cairn so that we can find you the next day; that's your marker. That's going to be your test and we'll see if you pass."

So the next morning I woke up. I entered the building, and at the very top of the list on the chalkboard it said, "[George D.] Zamka and Morgan," and right underneath that it said "[Sunita L.] Williams and Melvin," and underneath that it said "[William A.] Oefelein and [Garrett E.] Reisman." Especially when I saw the "Zamka and Morgan" at the top, I started laughing, because George Zamka is the Marine in our class and he is all Marine, wonderful person, all Marine. Leland is a former NFL [National Football League] football player-chemist who had worked at NASA Langley [Research Center, Hampton, Virginia], so he was a civilian scientist and engineer working on advanced engineering projects for NASA, and Suni Williams, female military Navy helicopter pilot. And the list went down from there, so they were matching up the military with the nonmilitary. It looked like they were trying to pick, from watching and reading

about us, who they thought were probably the most opposite and putting us together, so I started laughing about that.

George Zamka and I were looking at our map and Point A and Point B. We were talking a bit about it. George tells this story much funnier than I do because he has his own perspective on what was going on, and he's a great storyteller. From my perspective, we were ready to go. We had Point A and Point B, and I'm looking at Point B and it's on the side of a road. This is beautiful country out there and it's very much like out here in the mountains of Idaho, just beautiful country out in Maine. I'm thinking, why would we want to get to Point B early and spend all that time on the side of a road when we can be out in the woods? And it didn't look like it was that long of a trip; maybe a couple of hours, with our pacing.

Well, it did take us a lot longer than a couple of hours to get to point B. We actually got lost and then found our way a couple of times and had a great time. I learned a ton about the difference between the Marines and the SEALs, and I learned a lot about how the Marines operate and work. So George was a great partner. As we're traversing along, we were doing what we needed to do, but I was also learning a lot about him and how our United States military works. It was fascinating.

We finally show up at Point B, and they're already there with a fire built and a hooch already made—Leland and Suni and Garrett and Billy O. It turned out that, unbeknownst to us, our trainers had planned for several of us meet at Point B, so we could spend the night together. It rained the entire night. It was freezing cold, it rained, we didn't get any sleep, we were all sopping wet, and we had a great time together.

We built a cairn at the road, and the Jeep came around the next day and picked us up. We had our debrief. We all got cleaned up. We got to the airport and I found Zambo, George

Zamka, and said, "George, I don't know how you felt, but I just wanted to thank you for letting me be a partner with you for our survival test. I learned a lot from you and I had a great time."

Zambo—we called him Zambo. George says, "Well, Barb, I did too, but I want you to know, you and I are very different from each other."

I'm thinking, "No kidding," and I laughed and said, "So how? What do you think?"

And he said, "Me, the Marine, Point A, Point B, you get there. You, the schoolteacher, had to smell every stinkin' flower on the way." [laughs]

I forgot to tell that part of the story. We had broken out into this beautiful meadow, and not only was it easy to find three plants that we had already been taught to identify, but I also recognized some other flora that we hadn't been taught that I know from spending time in the woods here. So I was showing him, "Hey, do you know what this is?" Zambo would say, "Oh, why don't we be Type-A personalities and take more than three samples back." It was pretty funny. You'll have to hear Zambo tell that story.

WRIGHT: Get extra credit?

MORGAN: No, we didn't. We just had George thinking that we're *really* different.

WRIGHT: I guess that's part of that training, is to discover that all kinds can work together.

MORGAN: That's exactly it, and that was the beginning of building the great team, the great teamwork, and that is so important. I sure like that part. The teamwork's great, and from the very beginning, you learn, and you learn over and over again, that these are the folks that you are

going to be flying with. Yes, you'll fly with other folks from other classes, but you are all here as a class, and it's very important that you become a tight class and really get to know each other.

WRIGHT: One of the questions I thought might be interesting for you to answer would be that a couple of times before we've heard you mention that astronauts and educators are similar, so as being one of the few that are both—you're an astronaut and you're also an educator—can you share with us more of the details of why you feel that the two are similar?

MORGAN: Well, I think it would be great to ask Joe [Joseph M. Acaba] and Ricky [Richard R. Arnold] and Dottie [Dorothy M. Metcalf-Lindenburger] their perspective on that, too. But it is all about exploring. It's all about learning. It's all about discovering and doing that with other people, and then sharing that exploration and sharing that discovery and sharing that learning. That is what NASA does. That's what the astronauts do and that's what teachers do, too, so in that respect it's very similar. Of course, one you do in space and one you do right here on Earth, although most of the astronaut's job is also right here on Earth. The flying part is a pretty minimal part of the job.

I think the other thing, too, teachers are working with complex people in complex environments. You are trying to design the best environment that you can for young people, to bring the best out in each individual, and you want to build a team. That team is very important in the classroom, too, and at the same time you want to design that environment where each individual can reach his or her full potential, and that's very, very challenging work.

The work of an astronaut is very challenging, and so is the work of a teacher. A lot of people don't really appreciate that. They appreciate that about astronauts. They know astronauts have very challenging jobs. I'm not sure that people really appreciate that about teachers. I think when people say, "Oh, I could never be a teacher," they kind of appreciate it, but the sense I usually get is that it's "I don't have the patience," or it's their perceived brat factor, "I can't imagine being around kids all day long." But I don't think that they really understand the intellectual and emotional challenges of building that best, high-functioning learning environment and that kind of responsibility that you have for other people, for our young people.

WRIGHT: What do you feel are some of the best lessons that you learned during your time with NASA that you would like for students of all ages to learn?

MORGAN: Oh, goodness. It's a great world out there and it's full of mystery and wonder, and it's for all of us. It's there for all of us to explore and experience and discover. One of the great pleasures I'm having now at Boise State University is we have so many students that are the first in their family to go to college. I've been very lucky. I've had wonderful opportunities come my way. I've had wonderful opportunities that people have gone out of their way to give me. You've interviewed Harriett [G.] Jenkins. I can't tell you enough how Harriett opened so many doors for me, so many doors. Duane [L.] Ross opened so many doors for me. George Abbey opened so many doors for me and many, many, many others over the years. And it's a great pleasure to be able to try to help do the same and create and pass along opportunities for other folks. We've got a lot of very bright, motivated young people, even though they may not think they are bright or capable. The thing that I learned is that everything is possible. You set your

mind to it, you work with a team, and amazing things can be accomplished, like the International Space Station, my goodness, the Shuttle.

WRIGHT: Educators in space. What do you think is probably the most challenging time that you had when trying to continue your work with NASA?

MORGAN: That's a hard one. The whole mission, STS-118, is an example. Everything that we did on that mission was crucial, and so I completely understood that the education portion is a small portion and I needed to focus on the other jobs. I probably frustrated my commander somewhat, though, because I also felt that the education was important, and part of that was that I was carrying—this wasn't about one person—there were a lot of people who, over many, many years, from *Challenger* days and in-between, who had worked incredibly hard to create these opportunities for young people and to follow through with that commitment. Top-notch folks like Dr. Bob [Robert] Brown, Frank [C.] Owens, and Pam [Pamela L.] Mountjoy at NASA Headquarters, to name a few. And many others, both internal to NASA, and external. And also later, Sean O'Keefe, when he became our NASA administrator. I did try, because I really wanted to make sure I was doing my other jobs well, but I could never let go of that other part—the education part.

It was very well set up so that one of our other educator astronauts was able to step in and take on that role so that I could concentrate on the other, but you still keep your ear to the post and try to help ensure things are going the way that the team wants it to go. I think that was probably frustrating—that it could have come easier and been even more successful, but yet, looking back, it was and is very successful. It also would have been easier if the planning and

organizing process could be more efficient, with less bureaucracy, but that's just part of how it works and you just deal with it and move on. Kind of like when any of our crewmates get sick in space, we all know just deal with it, help each other out, and move on. I guess I really can't think of any really huge challenges.

WRIGHT: Do you have some questions, Jennifer?

ROSS-NAZZAL: I thought it was interesting you mentioned that Christa was a social studies teacher, and NASA is, of course, a very technologically oriented agency. Her lectures, as well, were going to be the history of where we've been, where we're going, a tour of the Space Shuttle. Can you compare the type of position that you had when you came on board, to the type of role that she was going to play, the lecture that you gave on [STS-]118?

MORGAN: It was different. I didn't give a lecture on 118. We did a couple of uplink-downlinks that were interactive, students asking questions to us on-orbit. No lecture. In fact, that was what we were trying to not do. Our focus was to engage as many students and their teachers across the country as we could in a NASA engineering design challenge, to design and build plant growth chambers for the Moon or Mars, for long-duration spaceflight, and to test their chambers and do some science with the basil seeds we flew into space for them and the ground-based seeds they also received. In the Teacher in Space Program, there were couple things going on. It was meant to open up space travel to ordinary citizens. It was also meant to pique students' interest in science, technology engineering, and mathematics. Most of all, it was intended to raise the elevation of the teaching profession.

At that time, *A Nation at Risk* [*The Imperative For Educational Reform*, 1983 report of President Ronald W. Reagan's National Commission on Excellence in Education] had been released. It was a very big deal, and it was very negative. It raised a widespread alarm and announced that our schools were failing, our education system's terrible, we're going down the tubes, and it was using a broad paintbrush to paint all of education as bad and all teachers as bad—especially public school teachers—were held in low regard nationally. We kept hearing the ubiquitous saying at the time, "Those that can, do. Those that can't, teach." So it was a very negative time.

This is something I do want to make sure gets preserved historically. I'm very proud of NASA and forever grateful to NASA for being the first federal agency to turn that negativity around, and they did it with the Teacher in Space Program. It made a huge difference. Even the National Education Association [NEA]—and we're—Christa and I—both members and it's a very important organization to us, along with our other colleagues who were in the program—even at first, there was an opinion piece in either *Time* or *Newsweek,* I can't remember which, written by the NEA, that was criticizing NASA for pulling off a stunt, using teachers to pull off a stunt for PR purposes.

Once Christa was selected, people saw her and understood that this wonderful teacher represented good teachers and good teaching all over the country. And when Christa and I showed up at the Johnson Space Center, here's what we experienced, every day—managers or scientists or engineers or other NASA employees would come up to us and want to tell us about a favorite teacher, somebody who believed in them and who had made a difference in their lives, who had changed their lives, and that's why they were at the Johnson Space Center. That happened over and over again.

Christa was such a fantastic representative for education. She truly understood that role, besides just being a great teacher and a great person, she really understood the power of this program, and people started taking a good look at education in a positive way.

After the accident, lots of people decided to go into education, and one of the things that Christa had always wanted—yes, she wanted kids to see astronauts and become astronauts, she wanted them to know that that's there for them, that can be their future—but she also especially wanted our young people to see teachers and become a teacher. And that was successful, because of Christa and the Teacher in Space Program. The NEA became a very strong supporter—because of Christa—and they recognized this was not a publicity stunt, that this was actually very good for education. They gave NASA good support, including after the accident, and still do, to this day.

That was one of the things going on. Like I said, I will always thank NASA forever for turning that around, a very negative environment for teachers and education, particularly public education, into a positive one.

The 114 finalists who came to Washington, D.C., for the next step in the selection process, if that's all we had been able to do, that was tremendous, to get to meet other teachers with similar interests from all over the country. All of us knew that we left a lot of folks behind who should have been there, could have been there, and should have been there instead of us, and we were lucky to get to represent our colleagues back home. And it was such a shot in the arm, such a boost to come away with a lifelong network of teachers from all over the country and people from NASA. It was tremendous.

The other part of it was, NASA had been flying payload specialists, and we were brought on as spaceflight participants but brought into the Payload Specialist Program, so it's a short

training period. It's about five, six months' training period. At that time—we haven't had a Payload Specialist Program since *Challenger*—but at that time the payload specialist training included a lot of familiarization, we were given a big stack of Shuttle systems workbooks to do, to help us become "big picture" familiar with Shuttle and spaceflight basics.

We worked with the 51-L crew, and we came in late in their flight specific training flow. The crew had been working together for six months already, and much of what Christa and I were doing was geared towards what Christa would be doing on orbit—her live lessons and videotaped demonstrations. We trained with the crew on things like habitability and safety systems and crew coordination and integration and on Christa's lessons. We were not being trained to operate the other Shuttle systems—that's the astronauts' job. But we participated alongside the crew in many sims. And we were training to be safe and trusted spaceflight participants. That's the way that program was set up, and it was a wonderful program. We trained with the crew, we were learning as much as we could and absorbing as much as we could, so Christa could do a great job on orbit, and for us to be able to go out and share the experiences and all that great learning, with the public and especially with students and teachers.

Then over the years, many years later, NASA had decided not to—when they wanted to reinstate things or get things moving forward, they didn't want to do it in the Teacher in Space, spaceflight participant, way. They wrapped education into the Astronaut Office, and I think that's tremendous. If you think about it, in the 50 years of space exploration, we had expanded the astronaut selection requirements to include other kinds of people only a few times after the initial program got started. The first time included scientists and engineers who weren't military flyers, and the second time brought in women and minorities, and the third brought in people with experience and expertise in education, in K-12 education. I think that says a lot.

NASA had decided to integrate education into the Astronaut Office. It had been worked out over several years, after Teacher in Space, when they established the Teaching from Space Office. I think it was called Teaching *in* Space, and then the name changed to Teaching *from* Space, but they established that office in the Astronaut Office itself and hired a team of educators who worked directly with the astronauts. It was a wonderful collaboration where they worked together to create educational activities to do on orbit, to engage our young people.

Then with 1998 and the new program, the idea was not to come for a short period of time, learn how to be a spaceflight participant, have the experience, and then go back to the classroom. It was that you are coming to be a full-time astronaut. I called it a lateral move.

ROSS-NAZZAL: I just have one other question for you. You mentioned Harriett Jenkins and how she opened so many doors for you. Would you tell us about that? Were you involved with some of those research centers that she helped to establish? Was that your involvement?

MORGAN: Harriett was NASA, and she was involved with a federal task force on *Women, Minorities, and the Handicapped in Science and Engineering* [Final Report, December 1989] fields. It was a federally funded project, led by the National Science Foundation. The work spanned about three years. Harriett opened up the door, and I don't know who she talked to, but she felt that that it was something I should serve on.

That was such an eye-opener to me. I'll never forget going to the very first meeting and they were talking about the leaking pipeline in science and engineering education. The only pipeline I knew about up until that point was the pipeline in Alaska, the oil pipeline, so that's how out of it I was when we first got started, and I got rightfully teased about that. But what I'm

trying to say is that I had a lot to learn about the issues. But it also it helped the committee to have a classroom teacher on that task force, and I think Harriett was looking at that from maybe both perspectives.

That work was more, great learning for me—another, different opportunity to learn how the federal government works, how you put together these task forces, how you study these issues and make recommendations, got me more tuned into the NSF [National Science Foundation] and its work, as well as NASA and the other federal agencies. There are a lot of university people involved in these issues and endeavors, but it was all pretty new to me. There were folks like the AISES—the American Indian Science and Engineering Society—and other groups like that, folks from FEMA [Federal Emergency Management Agency], a couple of folks who were visually impaired who served on the task force, from FEMA. Over the three years, we went around the country hosting many focus group sessions and collecting a lot of information and data, and compiling and refining recommendations. I learned a great deal from that work, and that, in turn, opened up many other doors.

That's just one of the many things that Harriett did, but you always felt that quietly in the background she had Christa and me under her wings, and she did. I don't know if you know, and I don't know if she talked about this, but she came from an education background herself. She was a superintendent of schools in [Berkeley, California] after being a teacher and principal.

ROSS-NAZZAL: Yes, she told us about how she helped to desegregate the schools and the challenges that she faced when she applied to be a teacher in that school district.

MORGAN: Yes, and she's so amazing, because through all of that she has nothing but kind bones in her body, and that she will turn around and open up doors for people who are of a race who had treated her poorly. It makes me cry to think about it. It's really remarkable.

Maybe other folks have talked about this, but another difference that I found interesting was the difference in how we trained the astronauts early in the program. When Christa and I were there in '85 and then years later, in 1998, things got much more rigorous. Nothing changed dramatically in the learning; it's still basically the same systems. That rigor had always been there, but when I came back, when my classmates and I began our ASCAN training in 1998, rigorous testing had been incorporated, and it seemed to reflect the testing going on in the country in the rest of education. I just found that interesting because we didn't see that earlier in the astronaut program.

What I observed and sensed in the earlier program was the expectation that you—the astronaut candidates—were selected and, yes, there were others that could be here, you happened to be the lucky ones to get to come, but you're here. You were selected because you and the other people who weren't selected but could have been, have what it takes, and you will learn this stuff. You're self-starters. You're motivated. You will learn this, and you will succeed. There was no testing that I saw back then, and I think people learned well, and succeeded.

Later, in '98, one of the first messages to us ASCANS was, "Okay, you guys are going to get tested." It was almost like the expectation was that some of you may not make it, not pointing fingers at anybody, but it was a bit of a different attitude, where earlier on it was, "We expect you to succeed, and we're going to help you get there." A different attitude than, "We expect you to be here, to get there, and you better do it."

WRIGHT: And that does create a different atmosphere.

MORGAN: It does. I think it does, yes. People were still really good—and maybe this was part of reasoning—people were still really good about helping each other out, and that's terrific. As classmates, we took notes for each other, we studied together, we would give each other—the military term—the "gouge" [answers or method of accomplishment], the tips. So maybe that attitude—and rigorous testing—was also designed to help spur some of that helping-your-buddy-out, teamwork attitude too. Could have been.

WRIGHT: Well, thank you for adding that.

[End of interview]