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OF THE UNITED STATES AIR FORCE
Wings & Things Guest Lecture Series

STS-123 Final Report

NASA astronaut and USAF colonel Gregory H. Johnson highlights his time as pilot of STS-123 Endeavor from March 11-26, 2008, which was the 25th Shuttle/International Space Station assembly mission.

[Applause] Thank you.

I see a lot of familiar faces, and unfortunately, many of you have heard a lot of my sorry jokes, so I'll try to refrain from those.

Who out here is seven years old in the audience? Any seven year olds? Stand up! If you're seven years old, stand up. There's a couple of you out there. When I was seven years old, I was up in Michigan, in Carroll, Michigan – you know Michigan looks like a hand, and I was right there at my grandparents' house, and I was watching a black and white TV with my brother. Here's my brother – he's no longer seven. Can you stand up, Gary? Okay, I've embarrassed my brother. But when I was seven years old, my brother and I and my sister and grandparents and parents watched Neil Armstrong step on the moon. It was 1969, and at that time we looked at each other and we said, Wow! Wouldn't it be cool to be an astronaut?"

Well I've been flying airplanes for most of my career. I really love math and science, and that got me interested in maybe designing airplanes, and why not fly airplanes if you want to design them, and this led me to the place that I am today. In summary, it took me 40 years to figure out how to fly one space flight, okay. But it was worth the wait, and I told my boss right after landing. He said, "Well, it took 10 years. Was it worth it?" And I said, "It would have been worth 20." So it's a wonderful, wonderful flight.

We were the 25th assembly mission of the International Space Station, and the Space Station when it's complete is going to look like that fella right there. We took this little guy up there – the Japanese Logistics Module – and we took a little robot that you can't see in that picture. This picture is an earlier picture and kind of gives you a sense of how small the Space Station was, and that was about eight missions or so of assembly. It started off with just two little modules – an American module and a Russian module.

So today I'm going to talk a little bit about the flight assignment. Those of you that were here about, I guess it was almost two years ago now, I talked about some of the training we were going to be doing, and you'll remember some of those slides, and then I'll show you photos from orbit and some cool videos.

Well this is, this is what I looked like on the left in high school, Fairborn Park Hills High School, now part of Fairborn High School, so we're all alumni with the bakerwhos, but yeah that's what

I looked like, and my son, my 15-year-old son reminds me of what I looked like when I was in high school so I can't really yell at him about his hair because he looks just like that. Went off to pilot training and I really passionately loved flying, and that really was a great part of my trip to becoming an astronaut was I just loved flying, and this is the birth of aviation and I know there's a lot of folks in the audience here that love flying as well. I was talking to the general today about his flying experiences. I'm not going to tell you the things he did on final when he was in pilot training; we'll save that for another time. Got to fly a lot of my time in the Strike Eagle and got to serve the country overseas. It was a wonderful lead-in for me because at Edwards we did some testing on red, white and blue airplane that had some of the avionics in the Strike Eagle, the active aircraft, and that was the thing that got me tied in with NASA and maybe allowed me to have the opportunity to be an astronaut.

We had a class of 31, eight pilots and the rest mission specialists. There's really two kinds of astronauts – the pilots and the smart ones, and I was a pilot. Of course, what we're doing in the Space Shuttle, with the exception of the Hubble that is hopefully going to go later this year – we have one more Hubble repair mission, is to build the Space Station. As you saw, here we are, this is about six or seven years ago, and this is the completed station.

And this is the crew I was assigned with over two years ago to take two wonderful pieces up to the International Space Station. Well, I talked to you about the smart guys, and these really are the smart guys, although he happens to be a pilot as well. He's a naval pilot – a P-3 test pilot – but these guys were the ones who went outside and did all the work. We had five spacewalks on this mission; that's a record for an assembly mission. We also had a whole bunch of robotics, and I was able to fly both the Space Shuttle and the Space Station robotic arms. That was one of the reasons that I was assigned to this flight. Takao, he's our Japanese astronaut, because we took the first Japanese piece up to the International Space Station. He was part of our crew, and then of course, Dom Gorie the commander over there, a Naval Academy graduate, and we had lots of talks about that since I went to Air Force. Garrett Reisman, the guy upside down, all five-foot-four of him, we took him up to the Space Station and left him there. If you might have recalled the toilets that broke aboard the Space Station – he was the one that enjoyed that experience, and I truly was not enjoying it. I called him, actually, I was watching a movie, I had been back from space for almost two months, and I called him, I was in line at the movie theater. No, I didn't call him, he called me, that's right, he called me on my cell phone. I'm standing in line at the movie theater, and I get ready to pay and I get a call on the cell phone, and I said, "Oh, I gotta step out of line. This is from space." Of course, the lady goes yeah right. *[laughter]* But Gary ... I said, "How's it going?" "Man, the last two months have been wonderful until just last week, man," and he's telling me about the toilet and it was not a good deal. *[laughter]*

Okay, back to seriousness, this is the Japanese Logistics Module, and it looked kind of tiny when I pointed it out earlier here, but you can see a person working on the JLP, and it's quite large. And the Japanese Logistics Module was part of the Japanese Lab System. This piece went up on the flight after us, so it's up their now, and these pieces are going up a little later.

We also took up Mr. Dexter. Mr. Dexter came in 11 different pieces in a shuttle launch platform, and our spacewalkers assembled Mr. Dexter on orbit, so that's why we had so many spacewalks. We had three spacewalks just dedicated to putting Mr. Dexter together.

Here's a picture of us training, and Mr. Bob right here, he was our all-purpose MVP kind of guy, he did spacewalks, he did robotics, and he has a really bright smile. He always has that smile, see him over there with that smile, he's smiling.

Here we are at the neutral buoyancy lab at Johnson Space Center. It's a huge pool, and we're training for those spacewalks. Each of our five spacewalks had about five to seven dress rehearsals with a lifelike Space Station. These guys go under water in real gear. You can see them. They have all the same stuff that they took on orbit except for the little booties. Those were just to protect their feet when they're walking around. But we're there going through the whole drill of spacewalks, so you can imagine we spent many long days, you know an eight-hour spacewalk times 35 practice sessions ... we spent a lot of time at the pool and you can see water on Mike's face as he's just exited the pool. And this is a photograph of the pool – it's about half the size of a football field and 40 feet deep, and if I could take you under the water, you'd see a life-sized mock-up of the Space Station.

And there is the toilet [laughter], but it's a working toilet. It's a toilet that it was my job to operate, as the pilot of Endeavor, and I was very proud of that duty. We kept it clean and I enforced good hygiene. It did not break. Here we are before flight trying out different cuisine. Takao is handing me some Japanese food. We had excellent food on our mission; we had an array of Japanese food that had never been taken to space. There were Russians up there that had taken food, and maybe the Russian food wasn't quite as good as the Japanese food. We had a Frenchman – he was the guy who took Garrett's place. When we deposited Garrett, we brought back the Frenchman, and you'll see him in some of the photographs. So we ate some French cuisine, and then of course, we have some really good food ourselves. We have great shrimp cocktail.

All right, so that was prepping for the flight, and now we're going to transition to the flight itself. We walked out, the launch time was 2:30 in the morning, and this is about midnight, and it looks very bright, but that's just because there's lots of lights as we are stepping out to the orbiter. When we lifted off, it was like sitting on a wild animal leaping off the ground. It was unbelievable, it was violent, and it was shaking, and for those first two minutes and 10 seconds or so, I honestly could barely see the panel in front of me. We had an overcast deck and the light reflected off the clouds into the cockpit so there was a big orange glow inside. It was the most amazing experience of my life.

We entered in the clouds about a mile up, took us about 28 seconds to get there, and so I had about 300 guests there that went all the way down to Florida just to watch 30 seconds of launch, but it was a pretty exciting 30 seconds.

Okay, I've got a video here. It's going to kind of summarize the flight and then I'll get back to the photos. *[Begins video]*

[During video] This is the commander Dom Gorie speaking.

Can we dim the lights just slightly, is that possible?

Those are the solid rocket boosters as they fall away, and after just eight minutes, we're going 17,500 miles per hour around the earth.

Just prior to rendezvous when we join up with the International Space Station we do a flip maneuver, so they can look at the underside of our vehicle to make sure there is no major damage.

This is the docking mechanism on the Space Station.

The first entrance to the International Space Station.

What was funny is we just got there, went through a 30-minute safety briefing and went to work. It was weird ... I was an arm operator – I'm actually moving the shuttle launch palette with Mr. Dexter in it, but it was weird walking into the Space Station and getting to work in somebody else's house right after you get there.

That's Takao, our Japanese astronaut. He operated our robotic arm, and it was just wonderful event for Japan and for Takao to put that first Japanese piece on.

We had Rick Linneham, our veteran spacewalker and veterinarian. We have lots of different occupations that are represented in the space program. He was our medical doctor too; we are a bunch of animals, yes I know.

Now the JLP is, the first Japanese piece, the Logistics Module, is sitting on the Space Station, and now we're putting Mr. Dexter together. Here's his body ... here's his hands. Using the robotic arm, with Rick on the end of the arm, Rick on the end of the Space Station robotic arm, he's grabbing Mr. Dexter. I'm actually pulling him up with the robotic arm while they install the robotic arms on top of Mr. Dexter.

Now a completed Mr. Dexter after three long spacewalks and his first movements in space.

There's Mr. Dexter sitting out on the lab, and the JLP, the Japanese piece we took up with us, is sitting right there.

Russian, I'll point them out in a photo later, but there were some other guys up there that were up there when we got there.

This series of photos is fun for me because it reminds me as the pilot, I got to do the undocking and fly around, that's one of the hand flying tasks the pilot gets to do.

And now you see the Space Station as we left it after STS-123. All the little pieces and parts are melded into the hull, an absolute adventure. [Ends video]

Okay, I'll continue on here I'm getting a little winded. Okay, here's a picture of us as we're coming aboard the Space Station, and you can see Mr. Dexter is happily sitting in the payload

bay of the Space Shuttle, and here's the Japanese piece, and there's some other odds and ends that we brought up with us. This is a little closer view. You can see the Shuttle's robotic arm, and we also have a long boom that we grab with this arm to make a really super long arm that we can inspect the underside of our vehicle. There's Mr. Dexter hanging out, ready to get put together, and then there's the JLP. There's somebody looking out the window right there. There's Endeavor when we're docked, and you saw how that all worked.

In this photo, we'll be able to see Yuri Malenchenko – he was our Russian, he was on the Space Station. Everybody in green is a Space Station crew member, and they are staying on the Space Station for two to seven months. So this guy and Peggy, the commander – she was a toughie, and then Leo the Frenchmen were the three that were up there when we got there. We took Garrett with us, but now he's already got a green shirt on, and then all the blue-shirted guys are the ones that made the round trip. So we brought the Frenchmen back and we left that guy.

That's what it looks like inside the laboratory where we operate the robotic arms. There's always two guys working, and I was the primary operator here and Bob is backing me up, and Leo's hanging out to watch. We're very perplexed about the procedure, but Bob has a Ph.D. and he's going to keep me straight.

The one thing I was surprised about when I went to space was not the geometry of the equipment or the Space Station that we were working on, but it was the backdrops behind all that equipment. In the simulator, you just got a digital picture of a view or whatever, and you are concentrating on what you are doing. We had these backdrops – these are the mountains in Patagonia, South America, absolutely breathtaking – and it was distracting. We are trying to do our work and we saw wonderful views all over the planet, as the earth is rotating and we are zipping around every 90 minutes, we would actually see almost every piece of the surface of the earth. The urge that I had mid-flight was that, I just can't wait to go visit those places, but you never could, you know, but it was absolutely fascinating.

Here's the JLP, it's hanging out on the lab, or actually on the node, I'm sorry, but that kind of doesn't mean anything to you. What's more relevant is that you have various pieces and parts put together like Tinker Toys, and we actually temporarily stuck this JLP on a little Tinker Toy ready to be moved somewhere else when the next piece came up for it.

There's Rick, our primary spacewalker, and I'm actually operating the robotic arm with him on the end. Notice he's attached by his feet, and you can see the reflection, if the lights weren't quite so bright, you'd be able to see the reflection of the Shuttle launch platform right there in his visor.

And there's Leo and I working, moving Rick around.

I love this photo, and the reason I love it is because you can see a whole bunch of really neat things on the visor of this astronaut and I think this is Garrett. He's taking a picture of himself, so we are giving him a little bit of a hard time about that, but you see the camera that he's taking a picture of, you see the Space Station behind him and then you can see the Earth. They tell me it's

the most breathtaking thing as they step out of the airlock and go out into outer space, with nothing between them and the planet. It's unbelievable.

This is a tough picture to take, all these videos and the photographs that I'm showing you tonight were taken by an astronaut on board, there's no press up there to help us out, and this is a hard photograph to take because it's exposed inside the space shuttle, but outside it's so bright that you have to do a trick with the camera, and it's a very, very good picture. Rick is out here carrying a yaw joint, it was a spare yaw joint that we were installing on the Space Station, and I guess he was eating grape jelly or something, it looks like. Anyway, Mike took this wonderful photograph and then our boss posed, so that's one of the coolest photos I've seen, where you have a guy inside smiling and then somebody working outside. We used to call Dom "Gator" because all he did was float around and eat food *[laughter]*. I don't think he'd like me saying that, but that's because he's Navy *[laughter]*.

Okay, anyway, here we've got Mr. Dexter on the end of the Space Station robotic arm, and this robot increased the complexity of the arm. Mr. Dexter is kind of like fingers on the end of an arm so he can do a lot more things now, as the arm before Mr. Dexter arrived.

I took this photograph because I thought it was really cool how the shadow was described on the solar arrays. What the photograph doesn't show you is how huge those solar arrays are. As we were sitting there out the window looking at them, you couldn't even see half of the solar array in your peripheral vision, they're just enormous. The whole Space Station is about the size of a football field, so as we approached the Space Station, there was a pretty significant amount of time where you lost the whole borders of the Space Station. You'd actually feel like you're going into something, kind of like the Death Star or something from Star Wars. It's really cool.

Okay, working inside, I took this photo one morning because Mike didn't know I was there, and he was upside down, and this kind of shows how comfortable we were in zero gravity. I actually am taking this photograph right side up. We kind of have a right side up and upside down. All the writing is this way, and this is the orientation that we're usually operating in the Space Shuttle. Mike was upside down, he's reading a procedure and just happy as a clam upside down.

Dom is doing some work, that's great, I'm just kidding. No, he was a wonderful mentor to me. It was his fourth Space Shuttle mission. He flew twice as a pilot and twice as a commander, and I really learned a lot from him. It really was a joy flying with Dom Gorie.

I have protective goggles on my eyes because when we bring new modules to space, there are often little bits of metal or debris that are inside the module. They try to get it all out, but as a protective measure, we wear goggles. Unless, of course, you are Peggy, and she's so tough as nails, she doesn't have the goggles on. Actually, I was in the module working and then I came out and posed for this picture with Peggy.

There's Takao, he's doing a little roll in the Japanese Logistics Module. He was really proud of his country, Japan, so he put a big flag on the back of the JLP, and he actually drew a border where you're walking into Japan on the deck. *[laughter]* One of my two objects, personal objects that I got to take up there with me, one of them was a flag that my dad received when he retired

from the Air Force, and it was a full-sized flag. I took it in there one day and told them that Dom wanted me to tack it onto the wall, you know, so that we'd have an American flag and a Japanese flag on the JLP. Well, Takao was not happy about that at all ... his mouth got dry and he started shaking, and so I just told him I was just kidding. We really had a lot of fun up there.

That's working on a laptop. It looks like I'm attached to something, but I'm really not. I'm just floating in mid-air with a laptop connected to the Velcro in my pants. I was able to send lots of e-mails to my family and friends, and some of you in this room probably got an e-mail from space.

Okay, living in space. I told you the Russian food was horrible, and here's an example. It's a little can of Russian food, and you can see the expression on my face ... it was not good. It was something, you know, somewhere between Spam and Alpo. *[laughter]* Right here though, this is good stuff. This is shrimp cocktail, and there's some really neat foods. There's a magnetic table here that the Russians used to stick their food onto an eating surface. We used Velcro and we had little trays with Velcro and attached those to ourselves and then we could eat. I really enjoyed eating on the ceiling though because you kind of get out of the way, and remember up is down and down is up when you're in space, so you could find little volumes in a module that you might not expect on Earth.

There's Takao in his workout outfit.

This is a neat photograph taken by our veterinarian. We were playing around with water, and one thing that I loved in high school was just physics, just raw physics, and in space you just have physics all around you; everything is fun. We were drinking water one day, and we started making these bubbles of water, and you'll note this bubble of water, the surface tension of the water makes it a perfect sphere, and as long as you don't jiggle it – of course, if you move that straw right there, it'll deform it a little bit but it'll end up being a ball of water again, but right now it's attached to the end of the straw so it's just kind of staying there. Rick had the camera and I was looking at him, and I go "What?" and he goes "Stay there," and he took a picture. You can see my face is kind of upside down in this ball of water. It was kind of like a lens, turns your head upside down, pretty cool. So then we started playing with water, and here's a piece of dental floss that we can use to maneuver a smaller ball of water around because seriously, the ball of water, if it gets going, it will float, and once it touches something, it's stuck to it, you're never going to get it off your hand. We used dental floss to kind of maneuver the ball around and get it stable, and everybody's all sitting around looking at it. Then I started tossing M&M's into it, and the M&M's – I didn't know what was going to happen, I thought maybe the M&M's would hit the ball and break it in half or something, but instead the M&M's went right into the ball. Then somebody else threw an M&M, so we have like three M&M's that have collected inside this little ball, and right after this I walked over, floated over and drank it. It was pretty funny. *[laughter]*

Okay, here's space graffiti and on the International Space Station, we put our patch – STS-123 patch in sticker form. We stuck it there and then we all signed it, so that Space Station graffiti is flying over our heads as we speak.

Okay, a few candid shots and we'll be done. This photograph just illustrates everybody was working on a different wall but we all came together, and everybody's happy. Bob's upside down. We're really comfortable in zero gravity, it took a couple days to get used to it, but once we were used to it, we had no use for gravity. And of course, then when you get back, it takes two days to get used to gravity again, and that's a different story.

All right, that's my favorite window, that's where I used to hide out. This is on the Russian side, some of the backdrops of the transition slides have this picture. I really enjoyed this window because I actually got some solitude, like 10 minutes at a time, where I wouldn't be bumping into another person. It's also got some neat views outside of it.

Okay, here we are playing around doing the zero gravity thing, and no the guy up here is not working any harder than the guy down here. We're all just floating around.

This, this is on the cover of a Japanese magazine. We visited Japan after we landed, and I was laughing to find this photograph on their equivalent of Aviation and Space Technology.

All right, so I'd like to show you a short video of some shots I took on Easter of last year. I tried to convince my buddies that it's not just about work, but you have to have fun and we had half a day off. So here we have some dyes from the International Space Station. *[Begins video]*

[During video] Bob was the first guy, and being a Ph.D., he was really serious about this. Got a little roll in there. It's hard to get a pure transition in space because you have six degrees of freedom, roll, pitch, yaw, and then up, down, left, right and forward, aft. You're just trying to go forward, aft, and it's really hard to do.

Now Rick is on his fourth space flight; he's pretty good at it. Just a nice straight dive, just like Superman. *[laughter]*

Takao, on the other hand, did not have the degrees of freedom ... frozen.

And there's our Frenchmen, and that's not a very good dive at all, Leo.

And this is me just brown-nosing my commander, okay, that wasn't that good; he's kind of going down.

You might note Peggy is working back there while were all doing this, and there's Garrett back there working as well. Now this time, I did get the pitch right, got a little pitch going on. Notice Bergman; we're all Astros fans, so that was one of his personal items he brought with him.

Now Rick shows me a perfect aileron roll. That's pretty good.

Takao is going to try a second time to get those degrees of freedom frozen. Ooooh, it's better but not so good. *[laughter]*

Yeah, I threw the Kermit back. I said, "That was not a good dive, do it again, I toss it back to him." *[laughter]* He's going to give us a proper dive.

Mike keeps trying but he doesn't have his feet together, you know.

Okay, this is my last try and it's not very good either. Whoa! This is funny. Look up here, look at the top of your picture, that's a Japanese camera he took out, and that kind of ended our diving for a couple of minutes, and Mike said, "Okay, I'll do one more." This is his last one and notice he has a different outfit on. It's not good.

Tumbles are really hard to do because if you push on one side of your body, you have to push down on the other, to make it so you don't float to the ceiling or hit the floor. It makes it very difficult to get a perfect roll.

This is a pretty good one right here, or a perfect tumble I should say.

Everybody wave to Kermit. *[Ends video]*

Okay, well we did mess around for a half day on orbit, but it was a 16-day flight so we had a lot of time to get good work done, but we also looked outside, and when we had spare moments in between activities, looking outside was one of the favorite pastimes of the crew. Right here is South America again. We launched at night time and we landed at night so a lot of our passes over the United States were at night. But we flew a lot of day time over the southern hemisphere, and this is South American at Patagonia and you can see these beautiful glacier fields. This is about a 40 foot cliff, and you can see little chips of ice floating through this beautiful water basin, absolutely beautiful breathtaking.

We go up as high as 51.6 degrees latitude on each orbit, and we often would pass over southern Canada and the very top of the United States, and we looked to the north and see these beautiful aurora borealis.

This is a nice picture that shows thunderstorms from space and you can see the atmosphere does not extend very much higher than the thunderstorms. These things are about 60,000, maybe 50,000 feet, something like that, and the atmosphere is only maybe three or four times that. Of course, it extends a lot higher than that, but it gets very, very much less dense as you get up to about 200,000 feet and above. This kind of gives me a sense of how fragile our atmosphere is. You know, as you look at the whole planet and you see how thick the atmosphere, and you realize it's about the thickness of an orange peel compared to an orange, and you really would want to protect that.

This is a picture out my favorite window. This is the Space Shuttle right here, and you can see we're pretty far away from the Space Shuttle, maybe 150 feet, and in the foreground is the Russian Soyuz, you can see the Cyrillic writing. See Mr. Dexter is hanging out on the lab, and you can see how far away from my buddies I am when I'm in my favorite little hiding spot.

And here's a close up picture of the Soyuz.

This is Mount Everest from space.

And this is the wonderful metropolis of Houston, and I live right in this area, and the Hurricane Ike that just hit us recently blew right over my house, it was really something. House was fine, a lot of houses in the neighborhood were not, but mine was fine.

Okay, so coming home we have to undock, it's really a sad thing. You've spent two weeks in orbit with a whole bunch of wonderful associates and friends. We're leaving Garrett; we've been training with him for about a year and a half, but the moment that you undock, it's almost like you're in a different universe. You're completely separated and you're not going to see those guys again for quite some time. So it was a very emotional moment as well as a very thrilling moment for me, as I got to operate the Space Shuttle and fly all the way around it. It's kind of like a victory lap. You're looking at the Space Station from all angles to get photographs that aren't normally taken and also to look at the configuration of the Space Station as you're leaving it at that moment in time. The Space Station is now bigger; it's now got that Japanese lab on it and some other stuff from STS-126, and as the Space Station floats away, you remember those two weeks of wonderful adventure on the International Space Station.

So the shuttle comes back it lands. We landed at night. We meant to land at day, route 249, on our 249th orbit, we were hoping to land, but the weather didn't cooperate so we landed just after sunset. Space Shuttle Endeavor, on speed landing. Dom had one of the best landings in recent years. There's the six of us who made the round trip. Note the Frenchmen, he's been up on the Space Station for about three or four months, and his body just can't handle gravity quite yet, and we're all pretty wobbly as well. You can see us all kind of hanging on to each other, and we're very dehydrated. It's interesting when you go into space, your body gets rid of a lot of fluids, so even though we drink quarts of water before we come in for reentry, we're still all very dehydrated as we stand underneath Endeavor. And that's the end of my pitch.