# Don Pettit Oral History Interview, March 26, 2014

## Title
"The Frontier of Space - Where the Answers are not in the Back of the Book"

## Date
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## Location
Johnson Space Center, Houston, Texas.


## Summary
In the interview, Pettit discusses his upbringing in Silverton, his decision to attend OSU, his first impressions of campus, and the positive impact that OSU faculty - including Charles Wicks, Octave Levenspiel, Tom Fitzgerald and Wendell Slabaugh - made upon him. He also notes research projects that he conducted while an undergraduate, technologies that were important to chemical engineering students during his time, summer jobs that he undertook to help pay his way, and his participation in the OSU gymnastics club as a form of exercise and a break from his studies.

Pettit then relays the story of his graduate studies at the University of Arizona, his employment at the Los Alamos National Laboratory and his acceptance into the NASA space program. His experiences in space are a noteworthy component of the interview, including description of three space walks and his lengthy first stay on the International Space Station - a mission extended from two months to more than five due to the Space Shuttle Columbia tragedy. Pettit also reflects upon his time spent in Antarctica and his invention of a zero-gravity coffee cup before concluding his interview with advice to students of today.


## Interviewee
Donald Pettit

## Interviewer
Janice Dilg

## Website
http://scarc.library.oregonstate.edu/oh150/pettit/

## Transcript

**Janice Dilg:** I'm just going to do a little introduction. This is Janice Dilg with the Oregon State University oral history project. Today is March 25th, 2014 and I am here with Donald Pettit at the Johnson Space Center. Welcome. And perhaps you'd like to say exactly where we are.

**Donald Pettit:** Okay. Well, my name is Don Pettit, I'm one of the lucky guys that get to fly into space. I work for NASA. We are here in Houston at the Johnson Space Center in one of our training facilities. This is a mock-up of Space Station, the International Space Station. We are in Node 2 and this is one of the connecto-lego blocks of Space Station. It's a short, squat cylinder that has six docking ports, so that you can connect six other things and link them together on Space Station. And it also functions as a place where the crew sleeps and it has a number of life support pieces of equipment in here and we also use it for storage. And so anyway, we're in this mock-up facility where we do a lot of training, and we're going to be talking about Oregon State University and how it was an integral part of my education.

**JD:** So why don't you step back a little, you weren't always an astronaut. Talk just briefly about where you were from and kind of how you ended up at Oregon State University.

**DP:** Where am I from? My roots are firmly established in Oregon. I came from Silverton, Oregon, born and raised there, born in the local hospital, and it's a great farming, logging town in which to grow up, where you can go out in the woods and learn what you need to learn about staying alive in the woods, and you can play and you can work really, really hard in the summer times in the fields for the farmers. When you are a little bit older you can work for the logging outfits. Oregon was a great place for me to grow up. Silverton was a great place for a kid like myself to grow up.

**JD:** And so when it came—you finished high school, how did you decide to choose Oregon State as the college you would attend?

**DP:** Oregon State University, why I decided to do that—and of course the people from University of Oregon call Oregon State "Oregon Straight," and of course it's the cow college and all of that, but that's where all the engineering is, and I was interested in engineering. I had an older brother that went to Oregon State University, majored in mechanical engineering. I was interested in chemistry. Chemistry became my passion in high school. I had a chemistry teacher who was really good, Mr. Hunnigs and it turned out he had a degree in chemical engineering, and when I was talking about majoring in chemistry, he suggested that I might want to major in chemical engineering.

**JD:** And so, describe arriving on campus and what your first impressions were. This was the late 1970's.

**DP:** Yes, and I arrived on campus, I was still in high school, my senior year, and this was the senior field trip to Oregon State University so you could check out the campus. And I got lost. And at that time I was going to be a pre-med major. My dad's a physician and so it seemed natural. Yeah, I was interested in biology and all of that, and the chemistry aspect of biology. I thought "yeah, I'll be a pre-med," and on campus I got lost. I couldn't find the pre-med, "welcome to the pre-med" part of the festivities going on and the building I happened to walk into was the chemical engineering building, by mistake. And there I ran across Dr. Charles Wicks, and he put his arm around me and showed me a map that told me where I could go, and we talked a little bit and he found out I was interested in chemistry and he found out my high school chemistry teacher was a chemical engineer and this and that, and by the time I left that building I had signed up for chemical engineering and forgotten all about that pre-med stuff.

**DP:** So talk a little bit more about professor Charlie Wicks, I know he was kind of a legend on campus and he certainly factored and played an important part in your college education.

**JD:** Yes, Dr. Wicks was the department head [0:05:00] of the Chemical Engineering department when I was there and he was really student-oriented. Some departments at other universities are so bent on doing graduate level research that the undergraduate students sort of get lost, and it's not that way at Oregon State University. They have their main focus on their undergraduate student education and that was very much apparent with Dr. Wicks.

**DP:** And so, talk a little about some of the specific courses that you took with him or projects that you worked on with him.

**DP:** With Dr. Wicks, there was a number of little projects that when an opportunity knocks, as a student you can decide to either take advantage of that opportunity or go off and do something else, and Dr. Wicks had a research project involving recovering uranium from the ocean, from the sea water, and it involved scuba diving and putting samples down and getting samples up and going to the Oregon coast off of Newport and it's like "wow, that's a neat thing," and it involved chemical engineering and the analysis of the data. So Dr. Wicks asked if I wanted to participate in that and I said "sure," and so that was one little project that tickled my imagination when I was an undergraduate.

**JD:** So you actually learned to scuba dive for that?

**DP:** No, I'd learned to scuba dive—this is one of the neat things, you have to take PE even in college, at least at that time, and I found that I could get PE credit for doing scuba. So I signed up for a scuba class a couple years before that, so I was already scuba certified, which was something that Dr. Wicks was looking for in an undergraduate student helper for his research project.

**JD:** And was this a project that happened during the summer or during the school year?

**DP:** During the school year and during the summer.

**JD:** Okay. And I know there were a couple of other important professors. Perhaps if you want to just talk a little bit, I can say their names, or if you want to just kind of go through who were—

**DP:** Other professors in the Chem E department: there was Octave Levenspiel, Professor Octave Levenspiel, an amazing fellow, and he's still a professor emeritus there and I see him every so often when I go to OSU now. And he would really tax your imagination with working on projects and homework assignments, and a standard homework assignment dealing with entropy might be "you've got gas molecules in a vessel and they're confined to one half of the vessel and you pull the divider out and they expand, what's the change in entropy?" these kinds of things. Good stuff to know, but kind of boring. And Levenspiel would have homework problems like "I've got three canaries in a cage and they're restricted to only one third of the volume of the cage, I pull out the divider, what's the change in entropy of the canaries?" And a lot of students see that and they have no idea how to attack that problem, but what Levenspiel was trying to get you to think about was those canaries each could be thought of as an ideal gas molecule, and so now you have an expansion of an ideal gas with three molecules going from one third to full volume containment, and once you realize that then you can calculate what the entropy and enthalpy change would be for the canaries. And so Levenspiel was really good about having you think outside of the basket, and he also had research projects on the side and he conscripted me to help work on his research projects. Professor Levenspiel, along with Professor Tom Fitzgerald, they were working together.

**JD:** Mhmm. And so, how common was it for undergraduate students to be doing this type of research and this close work with professors?

**DP:** How common is it? I think it's not that common, maybe ten percent of the students will get involved with research projects with their professors. But again, it's one of these things where opportunity is there. The professors that I found at Oregon State University were really open to having undergraduate students work in their laboratories, and from the professor's point of view it's free slave labor. From the students' point of view it's exciting because you're learning new skills and you're applying in a research environment—I mean genuine research, not just homework problem, cookbook lab stuff, but this is real research projects that you get to do and make [0:10:00] a difference in, and it's available throughout the campus.

I was working on botany projects with Dr. Fredrickson, and I wasn't a botany major but I was taking some botany classes just 'cause I was interested in it and I got some ideas and I was talking to him after class and he invited me into his lab to look through a microscope and then I said "hey, how about doing this and that," and next thing I know, I was set up in his lab, doing some botany experiments with insectivorous plants. And then, same thing with some of my chemistry professors. Not Chemical Engineering, but Chemistry professors in a different department. Wendell Slabaugh, Professor Wendell Slabaugh was another amazing mentor of mine, an outstanding student teacher at the undergraduate level, and he had a research lab where he did BET thermal isotherms; BET Isotherm absorption studies was what he did in his laboratory, where you basically determine how much surface area were on highly porous samples. And next thing I knew, I was working in his laboratory. It involved glass blowing, there was a glass blower in the department and I started to take evening classes on glass blowing, and the next thing I know, I was working in this chemistry lab doing glass blowing and working on these BET isotherm absorption experiments.

And again, these are opportunities that are always there, and you as a student can decide whether or not you want to take advantage of them and it just means that you won't have as much time to throw Frisbee in the mall or maybe chase the girls or something, and you need to decide "what is my prime objective in college?" Is it to focus on your studies and learn something, or is it to goof off? And realize there's always going to be time to chase the girls or the boys after you graduate. Hang on here, there's—okay.

**JD:** There's activity going on in the bay behind us.

**DP:** Yeah, there's activity going on and there's no other hatches we can close, so we'll just have to live with the noise.

**JD:** I think it's fine.

**DP:** Okay.

**JD:** Not to worry. So technologies change, whether you were writing student papers or the kinds of equipment that you were using in laboratories, talk a little about what technologies were important when you were at OSU.

**DP:** Actually, when students are studying, I think the technology is still basically the same as what it's been for the last hundred and fifty years. You basically have a classroom and you've got a chalkboard or maybe now it's a whiteboard, but you've got something that the lecturer can write on and you tediously go through examples that you—work out examples and sample problems, and then you get assigned a whole bunch of homework and you go back to your dorm room or apartment and you do your homework. And some of the fields have changed, but the tools of learning are not that much different. And we, just as an example, we had computers and we wrote computer programs and we used our computers to do calculations. Nowadays you still use computers but they're more powerful, they're more abundant, you do use your laptop computer instead of a mainframe in the computer science building. You don't use punch cards, you type in with a keyboard, you've got a GUI interface, but the calculations that the computer are doing are still the same calculations. If you're doing a finite element analysis for some fluid dynamic problem, the nuts and bolts of solving that problem are still the same. And technology does not replace the need to understand the fundamental axioms of your field.

**JD:** And you talked a little in a kind of a pre-interview conversation that we had about learning the fundamentals at Oregon State University, that you've used your entire career.

**DP:** Yes, I think it's important in your education to make sure that you learn the fundamentals of your technical field. And important: don't forget the fundamentals. You have to keep going back. And just something as simple as your introductory double E, your electrical engineering classes. I took only two of them as a chemical engineer. I only had two semesters of double E, however I have used what I learned [0:15:00] in those two semesters almost weekly ever since, and something as simple as Ohm's Law and being able to calculate the power in a circuit. You never want to forget that. You want to be able to do that just like that, because you never know when you're hooking something up, "am I going to overpower this circuit? How much current's flowing in this wire? If it disconnect it while it's powered, is it going to arc?" All these questions can be answered with fairly simple knowledge gained from these courses. So just 'cause you haven't had an advanced course in a subject doesn't mean that you can't expertly apply the knowledge. And an example on Space Station; you're plugging in equipment, here we are in Node 2, we've got our electrical outlets, there are 120 volts DC and you got to think "what would happen if I forgot to de-energize a circuit before I made a disconnect with an outlet, and is that different compared to 120 volts AC?" And understanding your electrical fundamentals will give you the answer to these questions. Being able to know what the current and the power capability of your spacecraft is and the boxes you're plugging in and you need to be able to quickly calculate in your head "okay, how many watts is this, how many watts is that, what's the current, this and that? Yes, I can plug it in or no, maybe I better unplug something else before I plug this new box in." And so you're always thinking, you're always applying your fundamentals and I've just used this with electrical fundamentals, but you could do the same thing with your thermodynamics, as an example, understanding the difference between an auto cycle and a diesel cycle and a Brayton cycle. I run across these all the time in what I'm doing here at NASA and to be able to understand the difference in these things and why one cycle is better than the other for certain applications, I find that it's good to know this stuff, the fundamentals. And don't forget 'em.

**JD:** And so you talked a little about some of the research you were doing that went through the summer, were there other summer jobs that you had that helped support being at college?

**DP:** Oh, summer jobs. When I was going to college, college was still considered expensive; however you could make enough in the summer to pay your way through college. And I did that working for a construction logging outfit in my home town. And I worked as a heavy equipment mechanic and a welder and I primarily worked in the shop, either welding up new equipment or welding up equipment that had been broken and torn apart on the job, or overhauling big diesel engines or transmissions or whatever piece of equipment broke. Sometimes the equipment would break up on the job and you'd have a skidder or a cat or a yarder on an incline like that, up against an old rotten stump filled with carpenter ants, and then I would have to crawl underneath that thing and try to fix it. And anyway, it was great work, it was highly skilled mechanic and electrical work, metal fabrication work, and it was a good break from doing all the brain work in the Chemical Engineering department, and I think the two complemented each other and the skills I learned during the summer work are skills that I use today when I'm on Space Station, because much of what we do is electrical mechanical maintenance repair work, and the skills I learned as a mechanic directly apply to that. And then the school year stuff, all the academic stuff, you can't discount the need to understand the fundamentals of math and science and engineering.

**JD:** And while you noted that you were enjoying and immersed in the research that came your way and that you were able to be a part of, were there other activities that you did around campus to kind of balance things out when you were at Oregon State?

**DP:** Well mostly I focused on my classes and learning. I didn't goof around. I wasn't out throwing Frisbee on the mall, I wasn't chasing girls, I was studying my classes and doing all these extra projects in the research lab, which I found fascinating. And there was an opportunity to do gymnastics as a gymnastics club. The gymnastics team [0:20:00] had been unfunded a few years before and all the equipment was there and there was a gymnastics club, and so I could participate in the gymnastics club for any number of activities. I loved the trampoline and the parallel bars, were the two things I liked to do. But that was just playing around as a diversion to get a little exercise in between running around between classes and sitting in your dorm room studying.

**JD:** And where would you go do that, where were the apparatus set up?

**DP:** It was in, I forget the name of the building, it was right across from the student memorial union and it was the PE building and there was one room in the PE building that was all decked out for doing gymnastics equip—doing gymnastics routines and we would do that.

**JD:** So the seventies, things had perhaps slowed down a little as far as unrest among student populations than they had been in the sixties, but what was campus culture like in the 1970s when you were there?

**DP:** Oh gosh, you know I can't remember. Again, I was so focused on my studies in terms of campus culture, I was so focused on my studies I didn't care whether there was a bunch of people out on the mall demonstrating about this or that, I was apolitical at the time. I was focused on learning and these other student, what should I say, student sort of protesting, whatever kinds of things, I just didn't pay any attention to that.

**JD:** So clearly you were focused and you went on to get your PhD in chemical engineering at the University of Arizona. How did OSU prepare you and how did you sort of move forward in starting your career upon graduation?

**DP:** I found OSU, as an undergraduate education, prepared me well for doing whatever I wanted afterwards, graduate school and then my career at Los Alamos after that. A lot of what you do out of school depends on how well you understand the fundamentals. Again, it's the fundamentals. Do you know the difference between enthalpy and entropy, what can you do with a Carnot cycle on a temperature entropy diagram, and which Carnot cycle is better for the particular application you have? Why are jet engines an open Brayton cycle and why do we have Rankine cycles for closed turbines and what happens with ideal gases and what's the difference between heated combustion and heated formation? And all of these basic things you need to understand and not forget, and those are the things, understanding the material from the axioms, are what's going to prepare you for the next phase of your life. If you learn by recitation, a parrot learns by recitation; memorize all the facts, be able to go into your class and go "bleeb bleeb bleeb bleeb bleeb bleeb," and you can repeat all the facts, and the professor gives you a circled A, and then two weeks later you forget all of that stuff, or else you can't apply it, if that's the way you are studying, then you're not getting the maximum benefit from your education. If you've learned the axioms and then can apply the axioms to a new situation, then you can conquer the world.

**JD:** Along with all the practical experiences and opportunities that your professors were giving you, did you have conversations with them about what you might do with a chemical engineering degree, or directions that you might go?

**DP:** I did have conversations with my professors about what I might be able to do in the future. And if you listen to professors that you lionize; professors you really care a lot about, they may actually be able to give you some good advice. And professor Levenspiel gave me some good advice and he actually suggested that I go to University of Arizona, and I applied to a number of different universities. Fortunately I was accepted at all of them and I was also accepted at University of Arizona and I even paid out of my own pocket at the time, which was a lot of money, to go down to the University of Arizona and actually check out the campus and I liked the professors there and so I decided to go to University of Arizona as my graduate school choice, and that started with a conversation from one of my professors [0:25:00] in the Chemical Engineering department.

**JD:** And what was it about Arizona that he thought would fit your needs?

**DP:** Well first, being from Silverton, Oregon and then Corvallis, they're all small towns and Tucson, at that time, was about 200,000 people, which was to me a big city, but it was still kind of a rural feeling big city, so the environment felt right. But more important, the department; there were a number of professors in that department that I took an immediate liking to, similar to the professors that I had taken an immediate liking to when I first, as a lost high school student, walked into the doors of the Chemical Engineering department. So the main reason I chose the graduate school in Arizona was because of the faculty members I'd met when I went there to tour the department.

**JD:** So talk a little about, you mentioned Los Alamos, the National Laboratory there, when did you think "I would like to be an astronaut?" And was this part of a path, going to Los Alamos and then to the synthesis group? Kind of how did you end up at NASA?

**DP:** Okay, how did I end up at NASA, why did I become an astronaut? As a little kid I saw John Glenn go up and I was fascinated with flying in space and it's something that "wow, I'd like to do that!" I never really thought that I could do it at that point in time, but it set a bit in my mind. And then years go by and I liked math, I liked science, I liked engineering, I liked all these things that allow you to do cool things in life. And I like to tell students that math and science and engineering are the key to doing all the cool things in life. And about the time I was finishing up graduate school, I realized I had all the requirements for becoming an astronaut and there happened to be an astronaut selection coming up and I thought "well, why not put in an application?" And so when students ask me now what you need in order to become an astronaut, I tell them that you have to have something technical that you do, something technical that's your passion, so you do it very well, and then you need to put in an application, because a limousine is not going to pull up in front of your house with men coming out, giving you the secret handshake and welcome you into the astronaut program. The only way you're going to get into the astronaut program is to hound NASA's door, or maybe commercial doors in the near future, and put in an application and not take no for an answer when the first reject or two happens to come in.

**JD:** So you finally were accepted in 1996, or you were accepted in 1996.

**DP:** Mhmm.

**JD:** And you've been on three expeditions, walk us through just kind of the outline of it.

**DP:** Okay, well in terms of my selection with NASA, I applied four times over thirteen years and got three rejects. And you would get a letter in the mail that would say "thank you for applying to the astronaut program. Due to a large number of highly qualified applicants—" and when you read that part in the letter you know the rest of it isn't going to be very good, and you know, "blah blah blah blah blah." And so I got three of those letters and then I finally got actually a phone call from the head of the selection office, asking me if I would still be interested in coming to NASA and training to become an astronaut, and of course it took me about three nanoseconds to tell them "yes."

**JD:** And what was the process, what kept you reapplying?

**DP:** I got bit—I kept reapplying to NASA after the first reject because I was bit by the space bug. I knew it was something that I wanted to do and as long as I was medically qualified, I was not going to give up.

**JD:** So you [0:30:00] get accepted, what are some of the next steps that happen?

**DP:** Well what you find out as soon as you walk through the door at NASA, you find out that you are once again a student. Because remember now, I had my undergraduate degree, chemical engineering at Oregon State, my PhD at University of Arizona, thirteen years now of work experience at Los Alamos National Laboratory, doing research as a scientist and an engineer, and so at that point you feel like you're pretty high on the food chain. You know, "wow, I've accomplished a lot in my life, I'm a go-getter, everything I do has always turned to gold," and then you get all these rejects, which is a humbling experience, and now you finally get your foot in the door and you show up at NASA and you find out that you are a freshman. And you go through basically Astronaut 101 and it's a two year training program, full time, eight hours a day. So think about—and that's eight hours a day of classes and you're expected to do all your homework and study and after you've spent eight hours a day doing your classes, the year around. So in that two year period the intensity of the training was so great, that was equivalent to at least four years of college. And so it was going through the basic astronaut training at NASA. The basic astronaut training at NASA was equivalent to a four year engineering degree, in my opinion, and it was an eye-opener. You came out with as much new knowledge as you had from being a senior graduating from high school, versus a senior graduating from Oregon State University. And you think about how much growth, and how much have I learned, how much smarter do you feel when you're a senior graduating from OSU versus a senior when you're graduating from your college and that's how I felt after two years of this intense training at NASA.

And so now, they had a little graduation ceremony, they gave us our astronaut wings, which I thought was a little interesting because wings do you no good in the vacuum of space, they should have presented us with rocket nozzles, and I pointed that out and some of the people were scratching their heads thinking "yeah, maybe we ought to have rocket nozzles instead of wings on our patches," but anyway. So we were presented with our astronaut wings and then you find out that you're at the bottom of the totem pole one more time, because now you're eligible for flight assignment but there's a whole cadre of people who have flown in space two, three, four, five times, and are rich in real experience, not academic experience, not classroom experience, but rich with the experience of actually having been there and done that, and you find that once again you're on the bottom of the totem pole, and you roll up your sleeves and you work really hard and you will get you first flight assignment, and then you fly in space as a rookie and you think "ah, I'm so well-trained, I know this stuff, I've got my stuff together," and it turns out there's a reason why rookies are called rookies, because you may think you know it all, you may think that you're well-prepared, but there's still a heap of learning to be done simply by doing it.

And think about going on a long backpack camping trip, and the first time you've done that, and you may bring stuff that you packed around in your backpack for a week that you never use, and at the end of the camping trip you say "why did I bring three pairs of shoes?" And then the next time you go on a camping trip you bring one pair of shoes and those are the pair of shoes that you're walking in. And so there is a big difference between a rookie and a seasoned person with experience, and you rapidly find that, and eventually after being with NASA now for eighteen years, I guess I'm no longer a rookie.

**JD:** Well, and I think perhaps even the more crucial element would be not that you have too much but that perhaps you didn't pack the right thing or enough of something, as you've commented. You used some interesting terminology, "the frontier" being one, and you talked a little about "it's important to have your information correct and everything in line when you're in the frontier," [0:35:00] talk about what you mean by that.

**DP:** Frontiers, talking about frontiers is something I really like to do. A frontier is a place where your normal intuition does not apply. A frontier is a place where the answers are not in the back of the book, where you have to figure things out for yourself. And there are frontiers like this all around us. It could be under the stage of a microscope, could be through the eyepiece of a telescope, could be in the stratosphere, the bottom of the ocean. My frontier is space, and I'll guarantee the answers are not in the back of the book. In fact, the very questions you go there to seek answers for may not be the right questions, and you may not even understand that you've asked the wrong questions until after you've been there and come back and you say "gosh, we asked the wrong questions, but now, we're going to change the questions that we ask, go in and seek new answers," and this never ending spiral between questions and answers and questions and answers, this circle spirals into knowledge, and that's what exploration, that's what frontiers offer us as human beings.

**JD:** And so as I said, you've gone up three times, you've done some space walks, you even did some construction in space, as I understand?

**DP:** Yeah.

**JD:** Could you expand on those a little?

**DP:** Yeah, what have I done in my three missions to space? My first mission was to the International Space Station to live on the Space Station for two months. It was considered a long duration mission at that time, because shuttle flights were about eight to ten days and to stay two months was a long time. And we launched on a space shuttle. They dropped us off at the Space Station and then the space shuttle went away and then the space shuttle was going to pick us up in two months. And at that time Space Station was a construction zone. We were actively building it. And think about living in the house while you're still building it, and you've got a table saw set up in the dining room and a bucket where the kitchen sink is supposed to be and then you find out that you have to entertain the boss for dinner. And that's like trying to do science on the Space Station at the time we were building it, and we still manage to do some science on Space Station during these early expeditions, but the primary focus was on building the Space Station.

Now during my first mission, unfortunately the space shuttle Columbia disaster happened and the shuttle that was going to launch to bring us home stayed on the ground for two and a half years while NASA figured out what the issues were with Columbia and so our mission was extended to almost six months and we came home in our Soyuz space craft, which is a vehicle that is always kept docked to Space Station for contingency crew return, and we were well trained for flying our Soyuz and so it wasn't that big of a deal for us to come home flying in a Soyuz and we actually enjoyed having more time on orbit. It gave us more time to explore in this wonderful frontier environment. The reason, of course, for why we had the extension was certainly an unhappy situation, but the fact that we spent almost six months in space instead of two months in space was a welcome spin off from that.

**JD:** And often when you—one of the, I believe the first expedition that you went on, you were the science officer?

**DP:** Yes. That—it turned out the science officer was sort of a political title that they, you know somebody on the crew had to be a science officer whether or not they knew anything about science at all, and I happened to have that title and I took it seriously and I tried to focus, I tried to expand and make the public aware of the science we were doing on Space Station through a whole series [0:40:00] of educational demonstrations that I did, that became known as Saturday Morning Science.

**JD:** Which I've watched several of those. They're incredibly informative and I think part of it is it helps give just a slight glimpse, perhaps, into what the different atmosphere is—I'm probably using the wrong term here—of being in an entirely different environment. I've watched a video of one of your fellow astronauts, Sunita Williams, did, taking everyone around inside the Space Station. Nothing quite looked the same that we're used to on Earth. Perhaps computers, talk a little bit about just orienting yourself when you're working in this completely different environment.

**DP:** Okay, let me go back for a moment to the Saturday Morning Science that I did. The Saturday Morning Science helped illustrate that you truly were in a frontier, that things do not operate according to the way your intuition operates, and that the answers are not in the back of the book and that you are in an environment where you have to figure things out yourself, and this environment happens to be rich in discovery. Now when you see one of these recorded tours of Space Station, where the camera's following a crew member around, they're pointing out all the different features and the items on Space Station, one of the things that I see when I watch these is, I think "wow, that's my home away from home and everything looks normal," but if you've never been there, it looks a little bizarre, and again, this is something, a trait, that you will find in a frontier.

And for example, we're here in Node 2 and we have sleep stations, and over here is one sleep station. Over here is another sleep station, and they're about the size of a phone booth, however today when I explain that to students, they give me these blank stares so I have to explain that they're about the size of a coffin. But then if you look up, here is another sleep station, and this is a good example of how you use a volume in a weightless environment. You can have somebody sleeping on the sleeping, you can have two people, each sleeping what looks like standing up, and then we also have a fourth sleep station, which is not mocked-up here because we'd be tripping on it, but it's in the deck. So here you have these sleep stations, overhead, deck, port and starboard, and we use ship coordinates on Station because it's closer to a ship than anything else, and you're sleeping in all of these odd orientations, but you're weightless and it doesn't make any difference at all. And the same thing with the use of the overhead. You can set up a computer work station on the overhead, simply because it's out of the way, you've got the space, and more important, you can, 'cause you're in space, and so you utilize the volume in Space Station in a different way than you utilize the volume of vessels and rooms and things that you're used to here on Earth.

**JD:** And so the...how much of it were you documenting how things work differently in space and how much of the Saturday Morning Science series—and there was a Saturday On Ice series too, which you might talk about a moment—how much of it was to educate people?

**DP:** Well, if you look at explorers over the last hundred years that have gone into frontiers; Arctic, Antarctic, sea explorers, one characteristic of everybody that does exploring is that they come back and they write about it. They take pictures, they show the pictures, they make films. If you go on an exploration and you don't share it with the rest of the world, it's as if that exploration has not even occurred. Nobody knows about it. And so as an explorer you are obligated to describe your experiences and your discoveries with everybody else that didn't have the opportunity to go on that exploration with you, and space is no different. And NASA, fortunately, has the resources to do an outstanding job of [0:45:00] sharing the knowledge, the information, the imagery, the stories from exploration. And on Space Station on my missions we would have a variety of still cameras, a variety of video cameras and we were encouraged to take as many pictures as we possibly could and to make as much video as we possibly can and to downlink all of these and share the stories and the imagery with everybody on the planet.

**JD:** And talk a little—how has your perception or your approach to science or living when you're back on Earth, how has that been changed or shaped by being weightless or being on the frontier?

**DP:** How has the way I've conducted my observations and my science been changed by my space experience? To first order, I don't think it has. I still make observations all around me in the same way that I did when I was at Oregon State University. If I'm walking across the sidewalk and I see a row of ants doing something, I go "oh, isn't that interesting, what are they doing?" And then I might get down on my hands and knees, I might look at them for a while and say "oh, they're carrying things, they're going from point A to point B. Why are they carrying things from point A to point B, what are they carrying, what are they going to do with these things once they get them to point B?" So it's a curiosity, it's observation driven by curiosity and then you park all that information somewhere in your brain and then you never know when it's going to pop up in some useful way for some piece of engineering equipment or some other kind of scientific study, and I've been doing that all my life and I do that when I'm on Space Station or on space missions, and I do it when I come home from space missions, and being in space, per se, I don't think has changed my ability to do that. It's given me an amazing opportunity in which to expand my ability to make observations and park little snippets of knowledge in my brain, and then now that I'm back here on Earth, I can continue to reach back into some little cobweb corner in my brain and pull out these little nuggets and try to make something useful out of it.

**JD:** And when you're on the Space Station there's often astronauts from other nations on-board as well, how does that factor into how you see the world or what you all exchange as scientists?

**DP:** The International Space Station is called the International Space Station because it is an international space station, and there's many European countries, a whole consortium of European countries. There's Russia, there's Japan, there's Canada, all of these countries working together to build this facility and keep it running and you get the opportunity to fly with any number of astronauts from any of these countries and you get the opportunity to train with them too, and you'll actually be training with international astronauts more frequently than actually flying with them, because you're training on the ground. You may cross paths with five or six other missions that are either ahead or behind you, and they will invariably have international astronauts on them, so you've got this cadre of international people that you're constantly working with and what it does is expose you to other ways of walking and talking on this planet.

And it also lets you know that working with explorers, who are professional, are all focused on getting the mission done, yet they each bring their own cultural flair with that and it adds a delightful bit of human interest to not only training but to your mission and a delightful flavor to the whole act of space exploration.

**JD:** So are there other [0:50:00] thoughts or experiences that you want to impart about being in space? I was going to ask you something about Antarctica, but I don't want to move on too soon.

**DP:** Space, a couple of points, things that I've learned being at NASA that would be hard to learn any other way. One of the key things that I tell students: "never walk to a high performance jet or a spacecraft without first passing by the bathroom." So that's one thing that I've learned, and that's kind of tongue-in-cheek, but it's a practical thing. You would never learn that sitting in an academic class, right? You could learn all about high performance jet planes and flying them and their aerodynamic stability, you could learn all about rockets and a rocket equation, and thrust vector control, and all of this stuff, but nowhere in your classes is your professor going to tell you "before you walk to your rocket, you better hit the head before you go in, because you might be strapped in there for a long period of time." And so NASA teaches you the practical things that are needed to live and work in this frontier environment, in addition to amplifying the need to understand the axioms, the fundamental information, the basics. And universities are great for learning the basics, but there's nothing like being in the real world, particularly the real world on a frontier for learning what you need in order to thrive.

**JD:** So, you've mentioned earlier that there are a variety of frontiers, and you did go to another one when you went to Antarctica searching for meteorites. Talk a little about being in a whole different type of frontier.

**DP:** Yeah, Antarctica is an amazing place. It is a frontier, it's here on this planet and it's accessible to people. If you want to be a tourist and go to Antarctica, you can go to Antarctica. And I went to Antarctica on a joint mission that's sponsored every year by National Science Foundation and NASA to search for meteorites. And we go to the interior of Antarctica, typically a couple hundred miles from the South Pole, and we live in Scott tents, which is a modern equivalent of the same tent that Scott used in his 1911 Antarctic expeditions. Which, by the way, he froze to death in one of these. But it's a good tent, it's a timeless design. And we camped out in these tents for six weeks, searching the blue glacier ice for meteorites, and there are spots in Antarctica where meteorites, when they do fall, they get concentrated and we would find up to about ten meteorites per square kilometer, and we'd search with snow mobiles. During the course of six weeks we found 850 meteorites and all of these are collected and kept frozen and shipped straight to the NASA Johnson Space Center, here. And they go into the Lunar Receiving Laboratory, which is still operating from the Apollo days, and these meteorites are treated with the same degree of care as the lunar rocks were, 'cause they are extraterrestrial material, and they've been kept frozen in the Antarctic ice for probably 40,000 years. So you'll have a chunk of rock which is several billion years old, that's been on Earth for 40,000 years, and then it goes into the Lunar Receiving Laboratory and is characterized there and ultimately ends up in the collection at Smithsonian.

And so I had an opportunity to participate in this expedition, and again the parallels to being in space are strong. You're in this frontier, you're with a small group of people, you're on your own, you have to use common sense. If you horse around with a snow mobile and get in an accident and break your leg, you could very easily die because it might be days, maybe weeks before they could get you out. And you have to have your wits about you, you have to intelligently apply your knowledge, and then of course you have to stay focused to your mission and get your work done. And all of these lessons can be learned in [0:55:00] space and they can be learned in any number of environments, whether the bottom of the ocean, stratosphere, in Arctic or Antarctic region, under the stage of a microscope, all these lessons can be seen in numerous frontiers here on Earth.

**JD:** You've also done some inventing in space, as I understand, including a zero-G coffee cup?

**DP:** I've got a number of little widgets and inventions that have been spalled-off from my space travels. One came about post-Columbia for some tools to work on the leading edge of the space shuttle while you're in orbit with a space suit and some special drills and some special patches that can go on the leading edge, that can withstand the high temperatures of entry, to keep the wings from burning off like what happened with Columbia. And so I've got a number of inventions that were spawned from my direct technical work. But then being on Space Station, we—the environment is different enough that things don't work the way you might like them to, and so if you come up with an invention to make life a little more comfortable or to allow you to do something to a higher degree of expertise, then it's an environment ripe for that kind of discovery.

So my coffee cup came about from that. We—my coffee cup came about from that necessity. In a space environment we take all our liquids by sucking them through a straw from a bag. It's kind of like the juice box that you see the little kids drinking from. And it's a perfectly fine engineering way to get your liquids but it lacks a certain amount of what it means to be a civilized human being. And so I was trying to figure out a way that you could have an open cup, an open container, and drink from it in a manner not unlike drinking from a cup on Earth. And some of the surface chemistry I learned at Oregon State University, and when in Dr. Wendell Slabaugh's lab and in my chemical engineering courses, applied to the environment in space allowed me to design a cup that used wetting angle and surface tension forces to not only keep the fluid in the cup when you're moving around, but also allow the fluid to kind of creep up one edge of the cup and just park itself next to the rim so you can just daintily sip it and have a nice cup of tea while you're on Station. And so this now allows human beings in a space environment to have a communion with your crew mates, a celebration in a manner that's commensurate with how we do things on Earth.

And I might say that in 400 years nobody will know even that I existed. Entropy will have completely erased the effect of my efforts here on Earth. However, I surmise that in 400 years human beings will be using and drinking beverages in weightless environments using cups of my design.

**JD:** That's a great—that's a great thought. So I'll wrap this up here. I wanted to give you an opportunity to offer advice to current OSU students.

**DP:** Okay, advice to students. And you have to remember this is free advice and you get what you pay for. I think it's important to understand the difference between a passion that's a hobby and a passion that's a profession. And there's a big difference and sometimes the two get muddled. You can have a passion that's a profession and that allows you to make a living, and you can have a passion that's a hobby, that sometimes can be a profession, but most of the time will not allow you to make a living, [1:00:00] and it's important to distinguish between those two. Just an example: you may love to do magic, love to stand on a stage and do magic acts. At the same time, you might have a gift for math and enjoy working with machines and mechanisms, and so now you have a decision: do I become a professional magician or do I become a mechanical engineer and do magic as a hobby in my free time? And so I just throw that out—everybody has to make these decisions for yourself, but I do think it's important to differentiate between a passion that falls under the category of hobby and a passion that falls under the category of a profession.

**JD:** Any other final thoughts you'd like to impart?

**DP:** College is a wonderful environment to be in. One of my professors said "it's the only time in your life when you can focus on just one thing, which is studying and gaining knowledge." And I didn't—I thought "what do you mean 'focus on one thing?' I've got stoichiometry, I've got calculus, I've got physics, I've got optics, I've got English, that's more than one thing." But what my professor meant was you're focusing on your studies and learning knowledge as opposed to writing business plans, writing proposals, trying to get paper study, balancing your checkbook, figuring out how to get the lawn mowed, your kids are doing a recital, I mean all these other things that you're juggling. So college is an amazing time when you can focus on yourself and your studies, and don't blow it. Don't waste your time doing other things. Focus on that, because there's plenty of time to golf or chase girls or boys or play Frisbee. There's plenty of time to do that after you get out of college, but college is an important time to focus in on these activities. It's only four years and then you're done with it and you can get off to the next phase of your life.

**JD:** Thanks so much for sharing your enthusiasm and your recollections.

**DP:** Oh, my pleasure.

[1:02:27]