Interviews of the Margaret MacVicar Memorial AMITA Oral History Project, MC 356
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Andrea Sanders – class of 1971

Interviewed by Amber VanHemel, class of 2019

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Margaret MacVicar Memorial AMITA Oral History Project

Andrea Sanders (SB Chemistry, 1971) was interviewed by Amber VanHemel (Civil and Environmental Engineering, 2019) on January 4, 2016 at Sanders' home in Weston, Florida. Among other things, she spoke in detail about what it was like to major in chemistry at MIT, how the Institute influenced her influential career as a chemist, why her varied experiences as a mentor have been so satisfying, and the challenges and rewards of being a woman in science at a time when that was atypical.

VANHEMEL: First, I'd like to know some background. Could you tell me about your early life, your childhood? Is there something about your family that you feel is important to your personal history?

SANDERS: I was born on Jan 15, 1950 to a very loving mother and father, and an older brother – eight and a half years older – who teased me mercilessly. I grew up knowing two grandmothers, a grandfather and a great-grandmother, all of whom had emigrated from Russia in the early 1900s. My mother had six siblings and my father had two. So I had a big Jewish family; lots of cousins, aunts and uncles and of course, lots of love.

We lived in a row house in Philadelphia. Fifty families would be on one block, so you learned how to get along with people and all the kids on the block pretty quickly. My brother and I still can remember who lived in each house on our block. Our playmates were our neighbors; we did not have to arrange play dates. We would just go outside to our street or the common driveway in the back of our homes and find kids to play with. You could always find kids for hop-scotch, dodge ball, building snow men or playing board games. We had a small little house, one bathroom for all of us to share, but it was a happy time.

We walked to elementary school. There were no school buses in those days. My mother or my girlfriend's mother walked us to school when we were young. There were no school cafeterias and we also went home for lunch.

My mother was the president of the PTA when my brother was in school, so a lot of the teachers knew her. When I started in school, I had a mother that the teachers knew, which put a little bit of extra pressure on me. The teachers were all very dedicated. Most of them tended to live within the community

You know the term "It takes a village?" I lived in a community where, if you picked somebody's flowers, there was some neighbor that saw you do it, so you got away with nothing. It was a community that was probably about 50%

Jewish, 50% not. So I got to enjoy Christmas with some of my friends, and they got to enjoy Hanukkah with me.

My father was a veracious reader. He went to at least one library a day, and took me frequently to the library. I had a love for books and learning from as early as I can remember.

When you ask about education becoming important to me, it was just a given in my world. That's just what you did. You did well in school, you did your homework and you got A's. That's what was expected of you. I always assumed I would go to college.

But it was a happy time. My father did have a history degree from Temple University, but he graduated during the depression and he ended up taking a job as a manager of a state liquor store in Pennsylvania. My mother didn't work while I was younger. When I started high school, she went to work as a secretary in the school board of Philadelphia.

VANHEMEL: Did your mother go to college?

SANDERS: No, she did not. She had the commercial degree in high school and she became a secretary right after high school. Until she got married, she worked as a secretary, and then went back to working as a secretary again for the Director of Science Curriculum for the School Board of Philadelphia when I started high school. My mom is still alive. She's 97 and a half, and still lives on her own.

VANHEMEL: Oh, that's great. So you mentioned a very tight knit community and the library you frequented. Were there any particular genres that piqued your interest?

SANDERS: I remember loving to read biographies, particularly of women like Clara Barton. There was a whole series of biographical books that I read. And Nancy Drew was popular when I was a young girl. In high school, I discovered poetry and sci-fi. Robert Heinlein's "Stranger in a Strange Land"and all books by Kurt Vonnegut and Isaac Asimov were favorites.

Another important influence in my life was my grandfather – who came over from Russia when he was a young boy and worked in a women's clothing factory. Though only having about a fifth grade education, he taught himself science – he had a passion for astronomy. Had he been born in a different time and had different opportunities, he would have been a brilliant scientist.

He had a telescope and would show us the constellations in the night sky when we would visit. He took all of his grandchildren to the Franklin Institute, which is a fabulous science museum in Philadelphia. We would spend hours seeing all of the exhibits, to the point that a lot of my cousins would get bored. But it was

always interesting to me. He was ecstatic when I decided to become a scientist. I was the pride and joy of his life! [LAUGHS] I went on to get a Ph.D. in chemistry, and that was a high point in my grandfather's life! He is one of the few people other than my thesis committee to read my thesis cover-to-cover.

VANHEMEL: Was that the first time you knew that you were interested in science?

SANDERS: I would say I was an all-around student. I think from an early age I wanted to be a teacher, so in elementary school, I wanted to be an elementary school teacher. My interest in science and math really developed in high school. Before then, I was more interested in literature and history, and I loved most subjects – except Phys. Ed.

Even in high school, I was probably equally good in everything. I didn't care for foreign language; I couldn't speak it well. I could read and write – that I could do – but the speaking, I couldn't get the right accent in French.

But my passion for chemistry really began in high school. I literally fell in love with the periodic table. I just thought, "Oh, wow! It's so brilliant, and it predicts so much and tells you so much just from the element's position on the table." My chemistry teacher made the periodic table so interesting that I decided I wanted to emulate her and become a chemistry teacher as inspiring as Mrs. Yeager.

All the trends and the electrons can predict so much. Then I became a chemist and realized the interesting stuff involves all the exceptions to the periodic table and exceptions to the laws of nature. So this order that I thought was so magnificent became the thing that I was always trying to defy.

When I graduated from high school, what I probably excelled in more than science, were history, English and writing. I was very involved in the Student World Affairs Council in Philadelphia, which ran an annual Model U.N., becoming VP my senior year. I also took classes at the Franklin Institute. But I didn't enter science contests or science fairs. I wasn't that kind of a kid. I loved math, but there was always somebody better than me in my high school in math, or in physics or in chemistry. I wasn't labeled as the scientist. I was more all-around.

VANHEMEL: How did you know that you wanted to pursue or go to a school like MIT, known for math and science?

SANDERS: I didn't! [LAUGHS]

The MIT story – and this is the true story, since I do have a mother that does remember this – is that I went to an all-girl public school, but it was all college

preparatory. From the time you entered, they were preparing you to take the SATs. It wasn't as stressful as it is today to get into the top universities, but the school prepared you the competition of getting into any university.

At the Philadelphia High School for Girls, if you were in the upper 10% of the class, you were expected to go to one of the Ivy League schools or the Seven Sisters schools. I always thought I might go to the University of Pennsylvania, because it was in Philadelphia. It would be more affordable because I wouldn't have to live on the campus. I even took a college -evel course at Penn during the summer between sophomore and junior year.

Then I got a booklet from our College Guidance Office that had all the colleges listed. I was thumbing through it and I saw MIT, which I'd heard of, of course, but I thought that it was an all-boy school. Remember, at that time, many schools like Harvard, Princeton and Yale did not admit women. And I noticed that MIT had women undergraduates! So I decided to, for the heck of it, send away for an application. And in those days, this was all done by mail. This was before the internet!

I got the application packet and I found out a couple of things that I really liked about MIT. Number one, they did not have any Phys. Ed. requirements for women, because there were so few women. So there was going to be no swim test needed and no Phys Ed classes required, which was a big plus for me! The other positive thing was that my four years of high school French would take care of the language requirement at that time.

VANHEMEL: Now we all take the swim test, and there's no language requirement.

SANDERS: You have to take the swim test? OK. So those got me a little bit more interested, but I was still thinking that I wanted to go to Cornell. The summer between junior year and senior year I had taken two college chemistry courses at Cornell.

Cornell had a program for high school students to take regular college courses during the summer. While there I learned that they had a six-year program that got you your bachelor's and your Ph.D. So I applied to that program thinking I might want to be a college chemistry professor -- that was my stretch program.

I did apply to Radcliffe – and Mount Holyoke, because that was known to have a good chemistry department. The University of Pennsylvania was probably where I was going to go. And applying to MIT was originally a lark. I did not think I would get into a school like MIT that I imagined was for science geniuses, not someone like me!

MIT became more real to me when I had the interview with the educational counselor, who was the Director of the Franklin Institute. Unfortunately, I don't remember his name. But he was wonderful and made MIT sound like a place that I should seriously consider.

When I asked “What is it like for a woman at MIT?,” he said, “If you get in, we'll arrange for you to go up and stay in the girls' dorm.” To make a long story short, I got in! You hear from MIT before you hear from the other schools. It was in middle of March, and my mother and I took our first plane ride ever and went up to Boston. She stayed in a hotel. I went and stayed in the girls' dorm with one of the coeds, and went to some classes with her. One of the kids that I knew through the World Affairs Council's brother was at MIT, so he came over and met me. They took me to Baker House to meet a bunch of his friends.

I felt I found my home-- I mean, it felt like I'd met people that I could communicate with. It was just incredible. And I told my parents, “I don't care where else I get in, somehow we need to figure out how to afford this and make it work.” Then in early April, I was called to the principal’s office – this had never happened before. My educational counselor was there and gave me a certificate which said I was being offered admission as an MIT National Scholar.

It sort of almost didn't matter where else I got in after I had been there and then got a scholarship! So it went from being a pure lark to finding out what an amazing place MIT is. Then, once I got there, it became even more amazing.

VANHEMEL: When you had gotten in and knew you needed to go here, did you know that you would be interested in studying chemistry?

SANDERS: Yes, I was always planning to study chemistry. I'm one of the few people that actually pretty much stayed the course. Sophomore year, I went into sophomore slump, because as chemistry major, you're taking organic chemistry, physics, calculus, a biology class, in addition to a chemistry lab course. I mean, it was nuts. I was stressed out.

I remember thinking, “Well, I'm going to switch from a chemistry major and become a general science major,” which would be fine for teaching.

Of course, I had many friends who were trying to counsel me. I had more male friends and brothers than you can imagine. I wasn't dating them, they were just my classmates. Many lived in Baker House, which was very convenient to McCormick Hall. As I was debating changing majors, one of my Baker house buddies arranged for me to meet with the Housemaster of Baker House, who was a professor of chemistry. (Unfortunately, I can picture him but I don't

remember his name.) He said, “OK, so what's your problem? Why do you want to drop chemistry as a major? “

That was the one time that I really thought about what I wanted. I told him, he listened and said, “Look, any of the courses you're going to take are going to be hard. Just make it through this. It will get better. Don't kill yourself. Don't worry if you get B's instead of A's, it's OK. And remember your love for the periodic table.” He convinced me to just stick it out for the year. He was right, and then it did get better. I did thank him for his encouragement and sage advice when I graduated as chemistry major.

That one semester was just insanity! The organic [chemistry] course was taught by Professor Dan Kemp [Chemistry Professor Emeritus Daniel S. Kemp]. He was a very dynamic teacher who was developing a new approach to teaching organic chemistry and was writing his textbook as we were taking the course. He ended up publishing a book, but we were getting them as Xeroxed notes, as our textbook, one chapter at a time. It was in 10-250.

VANHEMEL: That's still where chemistry is!

SANDERS: Of course! I’m sure it's been renovated since my day. It was in 10-250, so that gives you the idea of the size of the class. Do you know, I still have the binder with all those--?

VANHEMEL: All the chemistry notes?

SANDERS: He was writing his own book, so you needed to have another organic chemistry book as a reference text. The approach he was using was very different than just a memorization of different reactions. It was based on the motion of electron, and where the electrons would move, and understanding energy levels. When I got more into chemistry, this made more and more sense. But it was a novel way of teaching organic chemistry at that time. [CHUCKLES] So that was one issue.

Organic was a bear for almost everybody. It was particularly a bear when you couldn't read ahead to see where this was going, which maybe would have helped at times.

In addition to that, we were the guinea pig class for a new approach to chemistry laboratories. My sophomore year, the chemistry department piloted an integrated chemistry lab course. Before our year, there were lab courses associated with each lecture course. For example, there was an organic lab course where you essentially did various organic chemistry experiments associated with the course material being covered in the lectures that week.

Typically, a simple experiment was completed each lab session. This new integrated approach was novel and ahead of its time. It consisted of only a few bigger experiments that lasted perhaps a few weeks where you were synthesizing something, analyzing it, and then doing some physical chemistry experiments with it.

It was more like real-world projects research. They were five big projects, instead of each week doing a little experiment. That was all well and fine, but it was developed by graduate students doing it in laboratories that were equipped with much different equipment than the rudimentary equipment in the undergraduate labs. So synthesis and techniques for purification, distillation, separation, and analysis that you could do easily in a graduate lab, is very different than what you can do in a typical undergrad lab.

We spent way more time in these labs than the four hours scheduled. If you were chemistry major, you spent a lot of time in the lab, because you wanted to do well. And some of the TAs were really terrific and would work with us until all hours of the night, trying to help us complete the lab experiments.

We were experimenting with the experiments. We were an experiment. I mean, that's the best way to describe it. In retrospect, though, it was incredibly frustrating and an emotionally up and down roller coaster at the time, it was a phenomenal experience, because I learned that things don't always work the way they're supposed to. And that's what real research is about. That is the basis of research – “search and re-search.”

It was not the actual experiment that taught me so much. It was dealing with all the frustrations and all the setbacks that probably taught me more. If the actual experiment had gone smoothly, I probably would not have learned as much as I did from that course.

Even though this was a very difficult course, I’ve kept the lab write-up over the years. One of them was for the synthesis of ferrocene, which is an organometallic compound. Organometallic chemistry was in its infancy then. I think it is ironic that I ended up getting my Ph.D. in organometallic chemistry.

VANHEMEL: Can you give me a general sense of what Course 5 was like over the course of four years? What were some courses, besides organic chemistry, that you were taking? And what was the faculty like?

SANDERS: The faculty was great! There was one other woman chemistry major, Janet Sweetman [Janet Sweetman Arey, SB Chemistry ‘71].

VANHEMEL: Compared to how many men?

SANDERS: I'm going to say maybe 25, because there weren't that many that were necessarily chemistry majors. You have a lot of kids taking organic chemistry and taking the labs that were pre-med. Other courses for chemistry majors were Physical Chemistry, Analytical Chemistry, Statistical Thermodynamics, and Inorganic Chemistry.

Your classes become smaller as you get into the more advanced things. During my junior year I started to do some undergraduate research in organometallic chemistry with one of the professors, Alan Davidson [Chemistry Professor Emeritus]. I believe that this is when UROP was beginning and I received academic credit for my research. Professor Davidson became a trusted mentor and friend of mine throughout my career, until he passed away.

But remember, I was going to be a high school chemistry teacher. I was in no way going on for a Ph.D. In no way was I going into research. I did some research. I had done enough research. That was it. I'm going to be a teacher. But, never say “Never”!

Jeff Steinfeld [Jeffrey Steinfeld, Chemistry Professor Emeritus] was a physical chemistry professor who was very involved in laser research at the time. He's also deceased. I worked one summer for him, doing something with lasers with one of his graduate students. I don't remember much about the technical details, but I remember that because I worked with the graduate students and these professors in their labs, we'd go for happy hour together on Friday afternoons. There was an old diner in Kendall Square that we used to go for happy hour, and the professors, graduate students, and a few undergrads – we'd all be there. It was a community of chemists. It didn’t matter whether you were a professor, post-doc, graduate student or undergraduate, let alone a male or female, we were all equals during happy hour!

As I spent more time with graduate students and professors, I realized what a career in academia would be like. I realized that for me, teaching was more important than research, so I decided to continue to pursue my desire to teach high school chemistry. I realized that I could not get a permanent teaching position in Boston without the appropriate teaching credentials. So I walked over the bridge to Boston University to get a catalog of the teaching classes. As I looked at the course offering, I saw that there was an unusual course called Teaching College Chemistry. I thought, "Well, that might be for teaching assistants." I thought maybe there would be teaching college biology, but there wasn't one. I called up Boston University, and I said, “Tell me about this course.”

It turned out they had a program, federally funded by the U.S. Office of Education, for training chemistry teachers for two-year colleges. There are a lot

of nursing students, in particular, in two-year colleges. It came with a fellowship, in addition to a tuition waiver. At that time, there was no similar financial aid for obtaining a Masters of Arts in Teaching or a Masters of Education. So this program sounded perfect for me! I had one week to complete my application after finding out about this program. I actually walked to Boston University to deliver it before the deadline. I got it in! I got accepted!

As part of this program, I had to do a research project, an internship at a junior college and complete certain education courses in addition to graduate chemistry courses. Essentially, it was like getting a master's in chemistry, with some education courses.

My organic chemistry Professor, Warren Giering, was a young, new faculty member who was a truly gifted teacher. He offered to be my advisor for my master's research project. He was an organometallic chemist who ended up knowing professors that I knew from MIT. Now the happy hour circle gets bigger!

His wife was a graduate student at Brandeis in chemistry at the time. So, he really was gender-blind and a great mentor. I was a very conscientious student and my research project went very well. I was getting interesting results which led to numerous publications in research journals.

During my second year, Professor Giering said "OK, get the master's, but if you want, in two additional years, you'll have enough research for your Ph.D., so why don't you just stay and get that? And then you could decide if you want to teach in a two-year college. All of a sudden, universities, four-year schools, would be open to you as well."

VANHEMEL: Let's get more into your Ph.D. shortly. First, let's go back to MIT, and let's maybe look at more like where did you live on campus, and your social life.

SANDERS: All right. Well, we're back to MIT days. I lived in McCormick Hall. First semester of freshmen year was very crowded, since the second tower of McCormick Hall was not completed until second semester. So I lived in a triple room with two roommates (Peggy Hoffman and Emily Bass). It was like living in a sorority, a big sorority. And the women were just great. Ellen Greenberg, a senior became my unofficial "big sister." There was a lot of energy and camaraderie among the women. You got exposed to a diversity of interests as well. Ellen got me involved in Tech Show. One of my suitemates was in architecture, and was building models in our common area. I remember baking 50 dozen cookies for a McCormick Hall Christmas Party. I also remember someone putting a 1,000-piece, all red, circular-shaped jigsaw puzzle on a table for anyone to try to complete. It took us a semester to complete! It was a great environment.

At that time, we had maids that cleaned up the common area. They became sort of mother figures, which was wonderful. I still remember some of their names, Fran and Norma.

Freshmen year, we also had curfews and men were not allowed above the first floor. There were numerous small study rooms on the first floor of the dorm. Most of the time my lab buddies or problem set study groups were male, and everybody liked to come over to McCormick, so they all came. [LAUGHS] And I'd like to bake. So that would be a way of getting--

VANHEMEL: Incentive.

SANDERS: Incentive in getting some of the guys that were really good in organic chemistry to come over and help. You know, bribery helped!

VANHEMEL: At the time, was there a major that a lot of women graduates gravitated toward? Or was it very diverse?

SANDERS: I think it was diverse. I think there were a fair number that wanted to go on to medical school, and computer science wasn't as big in those days as it is now. Well, yeah, it was in its infancy. We had key punch cards in 6.01. I believe that was called Intro to Computer Science at that time.

The one computer course I took was to learn FORTRAN, a computer programming language. I remember one project was to write a program to sort 20 randomly-generated numbers. We had to keypunch cards and then the cards would be run through the computer during the night. Technology has come a long way since then. I'm in awe of where we are today and that classmates of mine went on to be real pioneers in computer science, and founded highly successful companies and technologies or went on to become experts in academia in computer science. Wow, it was really amazing!

VANHEMEL: Can you tell me a little more about your social life? What did you do?

SANDERS: They had movies in 10-250, and I don't know whether they still do that. At the time, they were, like, 50 cents.

VANHEMEL: The LSC?

SANDERS: Yeah, yeah, yeah, LSC. It's good to hear that it still exists! We went as groups.

Did I date a lot? Yes, I dated a lot. Did I have some longer-term relationships? Yeah, but I also had all these, as I said, different groups of male friends and lots of "brothers." I am still in contact with H.J. Siegel, who is now a Professor at Colorado State University.

I was on the freshman council freshman year, and sold donuts under the great dome in Building 10, in Lobby 10, to make money for our Field Day, for us to have outfits or whatever we needed for Field Day. There were wonderful concerts that either were free or very affordable, shows at Kresge Auditorium, beer blasts at the dorms or fraternities. There were semi-formal dances during my freshmen year, but as times changed, they were discontinued. I remember going to a Judy Collins concert, a famous folk singer. I recently saw her here in Florida; she is now 72, but still has an incredible voice.

VANHEMEL: You mentioned Field Day?

SANDERS: Yes.

VANHEMEL: What was Field Day?

SANDERS: Field Day was a fun athletic competition between the different classes. Each class, freshman, sophomore, junior, senior, competed in various challenges, a tug of war and races. It was held on the big field, which was where the hockey was played, and we got dirty as can be.

Remember we [female students] only had a changing room in the gymnasium area. We didn't have access to the sauna or whirlpool. I remember – we liberated it one day!

VANHEMEL: Oh my goodness, because in the athletic facility--

SANDERS: The athletic facility had few facilities for women in those days. But you know, MIT prided itself and still does, that it participates in so many different sports, probably more than any other--

VANHEMEL: I think we have the most sports of any Division III school.

SANDERS: Right, right. That was true then, but we were never great at anything, OK? So there was little at that time for the coeds, because there weren't that many of us. You wouldn't have been able to get a team together. Even of those that might have been physically agile, many of us were not even interested at that point.

We came from a different generation, a different era, in terms of girls participating in certain sports. But, Maggie Lettvin, the wife of Professor Jerome

Lettvin, started an informal exercise class for women at MIT. Staff, faculty and co-eds attended this high energy class at noon every day. She was a very charismatic aerobics instructor who made exercise fun!

I also remember a few co-eds deciding to become pseudo cheerleaders. We didn't have matching outfits or anything, but we were cheerleaders for the basketball team. Though we didn't have any great skits or choreographed stuff, we had plenty of spirit!

VANHEMEL: Oh, that's great. Did you go and watch a lot of sports games? Was that part of the culture there or no?

SANDERS: Not collegiate games.

VANHEMEL: Yeah, we're not a huge school. We don't have the huge Division I football culture.

SANDERS: But I went to Fenway. I went to see the Celtics. The Celtics were a championship team in those days, at Boston Garden. And in those days, even with meager finances, you could get tickets to go to see the Celtics or to go to see the Red Sox play.

VANHEMEL: I've yet to go to a Red Sox game, but it's on my list.

SANDERS: Going to Fenway Park is a neat experience. And I'm almost sure it was in the days of Carl Yastrzemski, but that could have been in graduate school.

I also went to see "The Barber of Seville." My mother had introduced me to opera when I was a little girl. So I always loved opera, and went with one of my friends from MIT, a coed, to an opera to hear Beverly Sills, who was a prima opera singer. She was the top soprano at that time. And the Artistic Director of the Boston Opera company was Sarah Caldwell. This production was outstanding and very unique in terms of staging and costuming. It remains among the most memorable opera performances of my life, even though we could only afford obstructed-view seats. There were wonderful things that you could take advantage of in Boston. Being in school in Boston was phenomenal for me!

VANHEMEL: Did you take public transportation everywhere?

SANDERS: Yes, I was very comfortable taking the MTA. I didn't drive. My parents never drove in Philadelphia. I didn't get a driver's license until after I got my Ph.D. – and I was much more excited about getting the driver's license! [LAUGHS]

VANHEMEL: Than the Ph.D.?

SANDERS: Well, the Ph.D. I knew I could do. You know, by the time you're going for your thesis defense, you pretty much have it made. When you go for your driving test and the state trooper gets in the car with you and tells you, "Parallel park," you're not so sure. When I called my girlfriend to say, “I got my license, “I was really excited!

So [while I was at MIT] I went all over on public transportation, to Filene’s Basement at Washington St. Station, Copley Square, Brookline, and Logan Airport. I spent a lot of time in Harvard Square, which has changed tremendously since then. In my day, there were wonderful coffee houses that you went to. Some had live entertainment certain nights. I still make gazpacho from the recipe I got from the chef at La Pamplona, a Spanish café in Harvard Square.

All of the little hangouts in Central Square were different then. There were some wonderful little Greek restaurants that served gyros and moussaka, and Joyce Chen’s Chinese restaurant.

VANHEMEL: It sounds very diverse and the vibrant Boston-Cambridge culture.

SANDERS: Oh, it was great. It was fabulous! I mean, Boston, my feeling still is it doesn't matter what school you can get into in Boston, just “Go to school in Boston”!

VANHEMEL: I love it. I love the city. I come here [from South Florida], and I'm like, “Oh, I miss Boston.”

SANDERS: And that's why I stayed there for graduate school. But I mean, I really do believe that whether-- Yes, of course, Harvard and MIT are premier schools there, but there are so many different universities that make it such a young, vibrant place.

I also remember just going into a little café/coffee shop and seeing some Harvard or MIT professors who were Nobel laureates sitting there. You could strike up a conversation with them. They were accessible. You know, the intellectual density in Boston is unbelievable. It is just amazing. And so to me, it's still a very, very special place. And I'm lucky that I have some friends that still live in Back Bay, so I can visit.

VANHEMEL: Reflecting back on MIT, were there any particular challenges you remember? You mentioned the first semester, sophomore year, almost wanting to switch majors. Were there any other times maybe with your role as a woman or any challenges?

SANDERS: Honestly, I mean having been in a generation where doors were just opening for women and the Women’s Lib movement was becoming strong, by the time I

was getting my Ph.D., there were companies literally soliciting me to apply because I was a woman. Not just because I was a good scientist. No, now it was being a woman was an asset, not a liability.

Later on, when I got into the real world and started working in the corporate world, there was a lot of learning on everyone's part of what it's like to have women in the workforce. I mean, all of a sudden men are now having to compete with a woman who are now they're equals and they're not used to it. My education gave me credibility, but I was now viewed as a threat and intimidating. So now I had to be aware of the being put under the microscope by my male colleagues, the secretaries and the lab technicians.

And not only did some of them have problems with it, but in the beginning their wives had problems with it. And their wives had problems if you were going to be traveling to a customer or going to a conference with their husband. Thankfully, I found some men (and their wives) who became friends and mentors.

VANHEMEL: There was a disconnect?

SANDERS: It was very interesting. And you didn't have that many women mentors in those days to tell you how to play the game. I mean, literally, it was like, you're all of a sudden in the middle of a rugby game and you have no clue what rugby even is. And it's like, please, teach me the rules, you know, maybe I'd have a chance of surviving. There was no guide book to follow.

VANHEMEL: Did you have any female faculty?

SANDERS: There were a few women faculty. There was a woman dean, Emily Wick [Ph.D. Chemistry ’51; first female faculty member at MIT to earn tenure], and of course, Mildred Dresselhaus and Margaret MacVicar. I remember these pioneers being true role models and speaking at McCormick Hall in the large living room and encouraging us to pursue our dreams. Also, the women staff members at MIT were also very supportive. But we were all, in my generation, going to be “firsts.” I was the first woman VP in a company. And we would have a luncheon meeting, and they would go, “What is that that you ordered?" "It's a salad." "Ooh!” [LAUGHS]

I learned in time how to make it not be only about the fact that I was a woman. That was only one part of it. The other part of it was that I was the only scientist at the table. I went to MIT and was the only Ph.D. on the Executive Committee. So the education that gave me professional credibility and got me to the executive position also made me intimidating to my colleagues.

It took awhile to realize that I could use my team-building skills to build alliances with the other executives and gain their acceptance. At Findley Adhesives, I asked the VP of Sales/Marketing to help me sell my capital budget to the executive committee, since the equipment was needed to develop the new products for our largest customer. We gained mutual respect for each other, obtained the funding, and had a very successful project with our key customer leading to doubling our revenues in one year. This initial team success led to the entire company restructuring to a cross-functional team model.

VANHEMEL: It's about all the different parts that make it work.

SANDERS: It's about all the different parts, and all the different people and their unique abilities that make for a highly productive and successful team.

VANHEMEL: After MIT, you were-- You talked talk a little bit about going to BU, and then after, in the workplace--

SANDERS: After considering opportunities in academia and industry, I decided to take a job with Shell Development Company to do chemical research and new product development research in Houston, Texas. And that's when I had to learn to drive. I actually got my license before I moved to Houston, and bought my first car.

There were 2,000 scientists on that campus for Shell at the time. I was the first woman that had been hired in years and years and years. There were lots of eyes on me, to say the least.

They did not have women's lab coats. They only had male lab coats, which all had sleeves that were too long for women. I bought my own lab coats and had them laundered, but there were lots of women lab technicians that couldn't afford to do that. So it started, I thought, as a simple request, and it took two years of memos to finally get women's lab coats.

And the president of Shell Development finally came to my office to say, "OK, what's the deal with this women's lab coat thing? I want to get to the bottom of it." And I said, "You know, it is a safety thing." And I modeled the oversized male coat and my woman's lab coat. When he saw the big differences, he quickly understood that there was indeed a real problem and that it was not just a matter of women wanting to be stylish. And he goes, "You've answered my question. You will have the lab coats by Monday."

VANHEMEL: Wow!

SANDERS: It took two years of memo writing.

And I became a heroine to the women at Shell. When I left, they gave me a framed photo of them in their lab coats with an inscription reading, “You are our inspiration.” It is among my most cherished possessions. And I still am very, very close with two women that I worked with at Shell.

I loved to work with the customers of Shell products. Applied research and new product development was where I found my passion. I worked with P&G to develop a proprietary surfactant for them to use for their new dishwashing liquid “Dawn”; this was in the 1970s.

Another exciting project was working with scientists and engineers at Kimberley Clark to develop a proprietary polymer for a revolutionary nonwoven cloth-like material that eventually led to the first Huggies Pull-Up and Depend Adult Garments.

Though these products led to enormous financial success for Shell, my contributions were not valued at that time. However, their customers took notice of my abilities and when there would be job openings, headhunters would call me. And one of the customers of Shell's that knew me, and knew some of the things I had worked on, ended up contacting me through a headhunter.

And then there was a great leap for womankind! I went from being a small fish in an enormous ocean called Shell,to becoming a Vice President of Research and Development in this much smaller, privately held company, Findley Adhesives in Wauwatosa, Wisconsin. It was my first real break.

Findley was a company that could use my skills and valued my experience. I realized my unique skills were that I could communicate across the functional lines, and that I could translate the end users needs into specific properties that we needed to develop into our product.

As scientists, it is critical that learn how to communicate to non-scientists, because the people that you have to talk to with at a customer are usually not scientists. They may be people in purchasing, or in sales and marketing. They don't know the technical terms. So they can talk in terms of the features and benefits they want in their final product. For example, they may say, "Oh, I need the baby to be able to breathe. I need the diaper to be able to breathe, or not be too tight." So I needed to translate that into terms a polymer chemist could understand, "Oh, you need a different hysteresis curve." I didn't necessarily need to synthesize the polymer. I needed to translate it to the brilliant chemists who knew how to incorporate that property into the polymer.

VANHEMEL: It was that back and forth.

SANDERS: Yes, it was an iterative process. At Shell, I finally realized what my unique strength was compared to my peers. They might have been able to do the chemistry better than I could, but I could communicate across functions as well as translate customer needs into product specifications.

And I did get an MBA while I was working at Shell, because I wanted to go into management. I decided that was where my skills could be used better. But at that time, Shell valued pure technical accomplishments, more that the other softer skills necessary for successful product development.

VANHEMEL: I feel that's even overlooked sometimes today. Oh, if you can crank out the work and do all the technical stuff, then the people skills will come, but that's not always the truth. It's like that you want the best of both worlds.

SANDERS: It took me quite a while until I finally figured out what my strength was. And I should've left Shell a lot sooner than I did.

VANHEMEL: How long were you there?

SANDERS: Thirteen years. Things eventually work out the way they should. After that first leap for womankind, I would be getting calls from headhunters all the time. And it was just a question of finding the right opportunity and challenge.

After Findley Adhesives, I went to work as Director of Technology at Sherwin Williams, the paint company. That was a great opportunity. And then I got called by somebody else, after I was there just for a few years. And that was an even bigger, greater opportunity. I became VP of R&D a Rhone Poulenc North America, a French-owned chemical, pharmaceutical and life sciences company. Within 18 months, the chemical company had gone through three major changes of the top management and organizational structure. Then they announced that the pharmaceutical division was merging with a German pharmaceutical company and that the chemical company was going to be spun off. This was in the late 1990s.

I had worked for 24 years at that point, and I decided, "I've had enough of this." I had to lay off 25% of my staff. It was a lot of people who had worked hard and through no fault of their own, were going to need to find new jobs. This was very difficult to do, but I tried to do it fairly and worked hard with Human Resources to assure that they got the assistance they needed to find new jobs.

So after working for 24 years in the chemical industry, I decided to retire from the corporate world, and that was it. I said, “OK.” And I didn't want to send a resume out. I was getting calls. I needed a break. "Thank you for your interest, but not at this time."

I am so glad I did that, because I saw what was happening in the chemical industry. There were major changes going on for a variety of reasons. New production capacity was being added in India and China.

I've been retired for almost 19 years and I've never regretted the decision.

VANHEMEL: So you retired at that point?

SANDERS: Yes, I've been retired for almost 19 years and I've never regretted the decision. I started my own consulting company. I decided that, with little projects here and there, I could stay mentally challenged. And I could choose the projects to work on!

I did some very interesting work on innovation; the innovation process and methodology for evaluating projects at the idea stage. With a client that I worked with on this project, we established an LLC called InnoValuation. I also did some pro bono work with some startup companies that was fun. It wasn't as much about making a lot of money. It's how you define success, and it was happiness and making a difference that was my priority rather than income.

VANHEMEL: I also remember reading that you went on to do some things with education, and women in leadership.

SANDERS: I still have that passion. I did pilot programs in a few graduate schools that I think is still necessary, to teach the soft skills that are difficult to put into the traditional curriculum.

MIT may now be doing much more of this than I'm aware of, particularly with IAP and some of the other things that you've talked about. Male or female, kids don't understand the diversity of career opportunities that are out there. And how a career is not just about what courses you take, but also about what excites you and what your special personal strengths are. Then the challenge is finding the right match with a job, a company or an industry.

It's wonderful that we have all have different skill sets, interests, and preferences in what we like to do. And there's a spectrum of opportunities in almost any field you can think of. For example, with a chemistry degree from MIT and work alone as a sole researcher in your own little lab or become become an analyst on Wall Street for chemical companies.

VANHEMEL: The idea that you're conveying is the idea that just because you have this one degree, there's so many opportunities that you have with it.

SANDERS: And that you need to understand what they are. You need to understand the range of opportunities that might be out there – and then have the ability to say, "Which of those really excite me, and what do I want to avoid?"

If you don't like to deal with lots of people, you don't like public speaking, you don't need to put yourself in a job where that's what you're going to have to do; there are so many other opportunities. And then the other part of this is how to try to craft not just a job, but start thinking in terms of the right kind of company that could use what you love to do – with your technical skills and your personal talents. Finding the right match is a key to success.

VANHEMEL: So getting back to the mentoring the kids—

SANDERS: When I first stopped working, I collaborated with another woman who had been a VP of R&D in some companies, and her husband also had been a Director of Research. The three of us created a one-day workshop that included team-building and communication exercises, in addition to a brief self-assessment tool to identify behavior preferences. We presented this pilot program do chemistry graduate students at Penn, Harvard, Cornell and Carnegie Mellon. After, personally financing the pilot program to prove the success and need for a "soft-skills" workshop, we were unsuccessful in getting grants or financial support from corporations to fund this program.

I continued to mentor some of the seminar attendees through resume writing, interviewing and job decision. It was very rewarding to give these students the opportunity to have informal contact with women in the chemical industry.

I modified this program for high school girls in the Princeton area and it became part of the L.A.M.P. (Leadership And Mentoring Program) presented by the Association of Women Scientists in Central New Jersey.

I still mentor high school kids. A couple of years ago, I actually helped mentor a MIT InvenTeam that had funding from Lemelson-MIT.

VANHEMEL: I'm not familiar with it.

SANDERS: They give grants to different high school teams to develop an invention, and then come up to MIT. I read about Northeast High School [Oakland Park, Florida] receiving the grant in the local newspaper. When I contacted Randa Flinn, the teacher-sponsor of this team, she was very enthusiastic about my helping the team. It was a privilege for me to support a teacher who put her heart and soul into this thing and made a huge difference in the lives of these kids. The following year the remaining team members (several had already

graduated), were invited to go to the White House with their invention for an Earth Day event.

VANHEMEL: That's great!

SANDERS: And there's a film clip shown on CNN in which President Obama is riding on their bike, which was generating the energy to purify water.

One of the kids on this team started out as a very quiet – I want to say a little bit of an outcast kind of gal. She ended up gaining a great deal of self-confidence as a member of this team. She went to a summer program at U of F [University of Florida] because of this teacher, and because of this InvenTeam experience. She ended up getting a Gates Foundation scholarship for college and graduate school. She was the first in her family to attend college. So there are wonderful, wonderful stories like that that make mentoring so gratifying.

It's very difficult to do much in the public schools. Because of the focus on standardized tests, they don't have the time in the curriculum. Safety and funding are also barriers to doing unique programs.

When I lived in New Jersey, I participated in a “Breakfast with Scientists,” which enabled students to interact with scientists and engineers from various disciplines to learn more about careers in STEM on a Saturday morning. I proposed this idea to members of the School Board in Broward County [Florida]. They were very interested, but it is a back-burner project for them. Someday, I hope this will happen!

But, you know, you can do things at different levels. I did a fun thing for second or third graders, when my great-nieces were at that age. We made silly putty from glue and Borax. I wanted them to really understand what they were going to be doing, so I made them into 'polykids.' I had them form three lines of alternating boys and girls holding hands. Each line was a ‘polykid’ and I had them move around the room. I said, "You are like the Elmer’s glue – you can move easily.” And then I took some kids and designated them ‘cross-linkers.’ Then I had the cross-linkers join hands to connect between the middle of the ‘polykid’ rows. They had less ability to move, now that they were cross-linked.

VANHEMEL: That's great.

SANDERS: These kids still remember that when they put the Borax (the cross linker) into the Elmer’s glue (‘polykids’) that the mixture began to thicken into silly putty. So all of a sudden this became more real to them. It was fun, and they remembered it.

VANHEMEL: The week before school started, I went to a camp at MIT. We were doing STEM activities with kids, targeting underprivileged children in the area. We did a similar thing, playing tag, but it was to model the blood system. We had viruses, and white blood cells and red blood cells.

SANDERS: Oh, how cool is that!

VANHEMEL: And they were having a blast. And they're like, "Oh, this just feels like recess." And then we went back in and did an activity with it. They're like, "Oh, I was the virus, and this is what I did. This makes sense." It's just like so cool to see when the connection is made.

SANDERS: Yeah – and that you made it, and they could understand it. And now they're not going to be afraid of something that says "science." Or talking to them about baby diapers and pull-ups and stuff like that! For various reasons, not by intent, I ended up working on lots of different parts of baby diapers, so I know more than you ever wanted to know about baby diapers! [LAUGHS] And yes, you have to use artificial pee and poop. The kids loved this – they loved it.

VANHEMEL: So what do you say is the next step for women? What do you think are the next hurdles to overcome or the next leap we need to make?

SANDERS: I think when we talk about how far women have come; we've come a long way in the 46 years since I've been at MIT. But not as far as computer technology has come!

There are women-owned companies and women CEOs, but more women need to be on the board of directors. We haven't made that much progress in the last 40 years. But look, there are some basic facts. Women have the babies. OK? And, very honestly, it's tough. We're the ones that have to do a lot of juggling and a lot of balancing.

I think the men of today, of the millennial generation and younger understand. It takes a double income now to really support a family. And sometimes the wife may make more than the husband. And in today's world, that's OK. It wasn't way back.

VANHEMEL: There's still a little bit of taboo around it today.

SANDERS: Gloria Steinem summed it up in her book "Revolution from Within" when she quoted an anonymous feminist that we could now "become the men we wanted to marry." In other words, I was brought up to marry a Jewish doctor but I became the Jewish doctor (Ph.D.) instead.

VANHEMEL: That's awesome.

SANDERS: Like you said, women are struggling with it. Guys are struggling with it. The roles are getting changed a bit and it is being discussed.

There's nothing wrong with being a mother. That's the one regret I have, that I never had children. I never met the right guy. It's not because I made a choice to go with my career. I just happened not to meet the right guy.

I think that young people are figuring out ways to make it work. And I think I look at it as, "What does success mean to you?" And for different people, it's different things.

There was an old board game that I had that they don't make anymore, called “Careers.” At the beginning of the game you decide on formula for success. You divvy up 60 points between dollars, hearts (for happiness) and stars (for fame or recognition). And if you think about it, it's a simple formula. Some players put all 60 points into happiness, others put all 60 points into dollars, some wanted to win the Nobel Prize and put all 60 points into stars, but most divided the 60 points among the three.

VANHEMEL: It's about choosing.

SANDERS: It's about choice and priorities. When applying this to real life, I view the choices as being integrated over time. It's the area under the curve over time that needs to be maximized. And it's some unique function of those three variables and other variables for each individual.

The unfortunate thing is men don't have the biological clock that the women have. And as bad as it is in industry, it's far worse in universities. I know MIT is doing a lot to try to help that. But the whole tenure track thing is counter to having a family. For seven years, until you get tenure, it's "publish or perish" – a time of maximum output. And that's just when you want to be having babies, biologically.

VANHEMEL: Well, we see that women are having children later, statistically. It's because sometimes there are decisions that have to be made. You can't have everything at the same time.

SANDERS: Right, right, and stuff happens.

In my day, there was much more loyalty of company to employee than in most companies today. In your generation, you're going to have worked for many, many more companies than I did, so you need to be in charge of your own destiny.

VANHEMEL: If there was something you would change now about MIT, or is there anything that you think you would have changed back then?

SANDERS: Well, again, I think that giving students the opportunity to take workshops in Team Building, Communication Skills, Decision Making, Creative Thinking, and the Innovation Process is important. Perhaps this is available during IAP.

I think that MIT is such a unique community and such a unique group of people. We all understand when I say to you, "It's random." You know what that means. Or "It's all about the delta." You know what that means. We are quick thinkers. We can think analytically. We understand numbers. When you're at MIT, you're in this truly rarified atmosphere. And it's impossible to totally appreciate that the rest of the world doesn't understand our lingo, so communication skills are so important.

VANHEMEL: It's hard to explain unless you're in that environment. When I come back from break and I'm talking to my parents, it's hard to explain everything that's going on, and all the types of people that I've met and interacted with. It's hard to come back and explain this to someone who's not having those interactions in that environment.

SANDERS: And what I found about MIT was that everything is done to the max. Whatever their passion is – I remember phenomenal musicians at MIT, for example.

VANHEMEL: Yes, there still are.

SANDERS: They do it to the max. We are not talking about people that just have casual hobbies. Their casual hobby is done at a level that you can't explain to anybody else.

VANHEMEL: Yeah, I agree. I definitely agree.

SANDERS: That is not true at all schools. But it is so amazing at MIT. It is so clear when you're a student there.

And you get to the real world, and it is very disturbing to realize that there are people who don't work up to their capability, when you've seen such extraordinary effort at MIT.

And you feel it, even when you go back. I went back for the graduation of one of my friend's sons, and the second I was on the campus, I felt it. Keeping a connection with MIT since graduating has been a source of energy for me. In Houston, I became active in the local MIT Club, when Bill Lenore, a former astronaut, was president. That was very exciting!

Being an MIT Educational Counselor has been a very rewarding experience. Interviewing the next generation of scientists and engineers and seeing their passion and enthusiasm makes me feel good about our future.

VANHEMEL: So looking back, could you picture yourself anywhere else for undergrad, other than MIT?

SANDERS: No! Thank goodness I happened to notice that MIT took women – that I opened that book to that page and saw it. And thank goodness I was willing to be average at MIT, assuming that everybody there was smarter than me.

VANHEMEL: Yeah, if you think about it, too, there's a higher percentage of valedictorians. And when you take the valedictorians from all these different high schools and put them in a room, odds are there's not going to be one that's the smartest person in the room anymore. So you move from the top your class to just being average.

SANDERS: And that's OK. If your definition of success is to be number one in whatever school you go to, don't go to MIT; if it's to be average at MIT, where you're with a very elite group, that's OK.

VANHEMEL: We get a lot of the impostor syndrome, too. You're an impostor, because you're seeing all these people, and "Oh, they're so much smarter than me." But you have to be OK with that. There's the idea that you have to accept.

SANDERS: That's interesting. I've never heard the term 'imposter syndrome.'

VANHEMEL: I remember reading one of the admission blog articles talking about imposter syndrome. It's a very real thing. And I've experienced it, I can say, in certain classes I was taking.

For example, I've never seen this type of physics before, but I have friends that maybe saw it in high school. And they're like, "Oh, you didn't learn this in high school?" And I'm like, "No! This is now new to me." Maybe I have to devote an extra three hours on that piece than they do, and I have to be OK with that. And maybe next week we'll be doing something that I just get more naturally.

SANDERS: Right, right. And you have to be mature enough and self-confident enough in yourself to be OK with that. And learning that at MIT is also really important.

And then the other thing that we all learned at MIT, through the problem sets, is how to think. We could have been number one in our class or gotten great grades or whatever, but a lot of that can be almost rote memorization. And the problems you tended to get on tests in high school were ones that you had seen

before, if you did all your homework. So if you knew how to do it and you could remember the facts on how to do it and you could get an “A” on the test.

That's not true at MIT. I remember getting a test freshman year and reading the first question and thinking, "I must be in the wrong room.” This doesn't sound at all like anything that we studied or did!"

And then, I start thinking, "OK. I can approach it this way. I do have some of the knowledge to an answer to this question." And that's, in a sense, how problems are solved in the real world. It isn't based on the book that you studied. You need to figure out how to new solve problems with innovative approaches.

VANHEMEL: And sometimes there’s a need to take a leap, a mental leap. And that you might have to do something novel that you've never really done before. But the idea is that you know the way to think, and how to think, and that enables you to do it.

SANDERS: The other big thing I learned by doing research was to learn something from every experiment I did, not just those that give me the result that I expected. When I was trying to synthesize a particular compound, I did the analysis, and I didn't make that compound I expected. I started it again. I tried it again. And I got the same result. And finally, I got smart enough to say, "What am I making?" Instead of "I wasn't making the right thing," it was, "What did I make? What are the results trying to tell me?" And then I realized I had made something far more interesting that became the basis of my dissertation.

So it's stopping and thinking, and asking questions. And realizing you're determined to get answers. It's going to be a challenge, and you take it as a challenge. And I think MIT gives you the confidence to take the leaps, to open the doors, to go down the bumpy road, to take a little bit more risk in life, or in your approach to something. And those are phenomenal life skills to have in whatever career choice you take.

The way technology is moving so quickly these days, who knows what jobs will be available when you graduate? They may be very different in a particular area than what you thought they would be. But if you have the basic “critical thinking skills” and communication skills you can apply them to any field.

I learned how to THINK at MIT, and I honestly do not believe that there are too many other schools that teach you to think like that. I also believe that is one of the reasons so many startup companies got started at MIT.

VANHEMEL: Yeah, I'd say I have a high number of friends, an abnormal number of friends, probably statistically, that have already started startups, or are taking a

semester off to try to work on their startup. You're just like surrounded by it, all that innovation.

SANDERS: Is some of that also because of Shark Tank, the TV show? Or is it because of the MIT atmosphere?

VANHEMEL: I'd say probably a lot of the friends that I have, they have developed a product for a class or some program at MIT, and then decide, "Maybe I want to try this as a startup."

SANDERS: Cool, very cool.

VANHEMEL: Yes, is there anything you would have done differently?

SANDERS: I still would have gone to MIT. I would have majored in chemistry and management and then received a master's at Sloan. And then probably have gone on and become an analyst on the chemical industry for an investment firm. That's what I may have done in an alternative universe.

VANHEMEL: Is there anything else you'd like to add?

SANDERS: You're wonderful.

VANHEMEL: Oh, thank you!

SANDERS: You're going to do great in whatever you choose to do. And know that you can do it. You can be successful in whatever you choose to do; just have the courage to open the door.

When I talk to some of my dear friends that I've had from all the different phases of my life, what we regret is the risks we did NOT take. And we all say that “Taking the road less traveled has made all the difference.”

And I met the right man for me at the right time. I have a wonderful stepdaughter, who's now married. She had lost her mom when she was 13, so I got to be a mother of the bride, which was delightful. And someday, hopefully, I'll be a grandmother.

So things work out in time.

VANHEMEL: Thank you again.