Coordinator: Thank you for standing by. Today’s call is being recorded. If you have any objections you may disconnect at this time. Thank you. You may begin.

Kay Ferrari: Thank you very much. Good afternoon everyone this is Kay Ferrari from the Solar System Ambassador’s Program and NASA Nationwide.

In keeping with the theme of today’s program, Women in STEM. This will be an all-female program. And I am pleased to be introducing our speaker who is going to facilitate today’s program.

Jessica Kenney is an education outreach specialist at the Space Science Telescope Institute. She is the Program Director for Space Astronomy Summer Program and she will be facilitating our program. Jessica, welcome.

Jessica Kenney: Thank you Kay. Thank you for your delightful introduction. It is my honor to introduce you guys to the Universe of Learning Science Briefing today entitled, Women in STEM: Hidden Figures, Modern Figures.

It is a pleasure to have everyone on the call today. And because we have a full schedule we will go ahead and jump in with our first speaker, Kim
Arcand. She is the visualization lead of NASA’s Chandra X-Ray Observatory which has its headquarters in the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts.

She was nominated as “Change Maker” for the White House State of Women Summit in 2016 and recently won the Smithsonian Achievement Award in 2016.

Arcand is also an award winning producer, director and author. She currently serves as the President for the Greater Boston Chapter for Federally Employed Women. I will turn it over to you Kim.

Kim Arcand: Thank you so much Jessica. That is a great intro. I am very happy to be here today to talk with everybody and I am going to start with just a quick overview of the state of Women in STEM.

Going through some statistics that I think might be helpful as you are thinking of possible programs to create as to sort of the whys. I am going to try to power through them to get to the resources quicker.

But if I am going too fast at any point please just let me know and I am happy to slow down or just, you know, give a little bit more detail.

Jessica Kenney: Kim. I am sorry I apologize for everyone.

Kim Arcand: Yes.

Jessica Kenney: [Slide 2] Because we are doing these presentations virtually can you please just state the number of slide that you are on and I am sorry I skipped the
second slide which had additional resources for everyone on the call for you guys to look at later.

So if you Kim and all the other presenters as you are going through your slides when you go to the next slide can you please just say what slide number you are on. Thank you and I apologize for interrupting.

Kim Arcand: No definitely. Thank you. All right so we are going to dive right into Slide 3. That is my contact information. So if anything I talk about today isn’t clear or you want more information please feel free to get in touch with me via email, Twitter, whatever you prefer.

Moving on to Slide 4. What I am going to concentrate on talking about is pretty much a brief overview of where we are in STEM but looking specifically in the areas of computers science and astronomy.

Which I think is, I guess, useful since Hidden Figure has been such an amazing phenomena and success. It is great to be able to look at those types of areas more specifically.

So on Slide 5 we will start by looking at how many -- the percentage women STEM workers in the United States. Which from the U.S. Census Bureau is about 26% as of 2011.

So considering women make up about half of the workforce, or just slightly less than, that’s a kind of a small number.

On Slide 6 we will see that computer science specifically is the only field in STEM, science, technology, engineering and math in which the number of
women receiving their bachelor’s degrees has actually decreased since 2002. Even after it showed a modest increase over the past years.

So for example, in 1985 women earned about say 37% of computer science undergraduate degrees and as of about 2016 it was hovering about 18%.

So if we go to the next slide, Slide 7, some of the reasons that contribute to this. Well mostly it comes down to cultural biases and stereotypes. But also the gender disparity in tech starts pretty young.

And when you look at, for example, just the number of students that take advanced placement courses in computer science, last year, 2016, about, I think, it was about 30,000 students took AP Computer Science total, and less than 6000 of them were women. So the statistics still haven’t really improved.

If we look at the next slide, Slide 8. Why should we care? Well I think for me there’re a lot of reasons why we should care. One is definitely economic. By 2020, it’s estimated -- this was a White House estimate -- but there will be about 1.4 million computer science related jobs available in the United States. But less than half a million computer science graduates in order to fill them.

If you go to the next slide [Slide 9] there are additional reasons too. So yes better job security is great. Good pay, of course, is also really great. Having varied viewpoints is great. But there are also very specific reasons on such things as medication and engineering.

If we go to the next slide [Slide 10], there are also additional topics such as more generally thinking, improving critical thinking skills, making up a more well-informed citizenry, and also general problem solving skills. All these
things can be improved by researching and understanding and learning in STEM fields.

So we are on Slide 11 now.

Jessica Kenney: Okay.

Kim Arcand: So upward trends that we are seeing some things happen which is great. Carnegie Mellon University, for example, announced recently that 40% of incoming computer science majors are now women, and that is a great number to see.

And there are other programs as well going on at the University of California Berkeley and elsewhere where they are seeing similar trends just by -- mostly by re-working the undergraduate computer science program.

We are going to go Slide 12 now and make the transition over to astronomy.


And you will see there is a bar chart showing the respective percentages of men versus women in the field. And what happens is as you kind of go up the ladder, the amount of women decreases.

So if we go to the next slide, Slide 14, we’ll see that as of 2013 there are about 95 female full professors in astronomy in the United States versus about 543 [males].
Now there is plenty of good and sort of neutral news, I guess you would say. In the last decade, universities have been, on average, recruiting and retaining women in Assistant Professor positions at higher rates.

But also in the last decade there is evidence that the currently highest ranked institutions have been slower to recruit, promote, and retain women than the mid to lower rank institutions.

Also it has been noted that some departments have become more polarized in their recruitment and retention of women with increasing numbers at the extreme numbers at the high and low fractions. So there is still a lot of work to do.

On the next slide, Slide 15, for minority women the statistics are even lower. The New York Times reported that women make up about 14% of physics professors in the U.S. And Dr. Chanda Prescod-Weinstein wrote that in 2015 there are only 78 black American women with PhDs in physics.

If we go to the next slide, [Slide 16], we are going to jump a little bit over to NASA. [Slide 17] So in 2013, Business Insider reported that about 37% of the new hires at NASA are women, which is decent.

On the next slide, Slide 18, you will see that we have a quote from then NASA Deputy Administrator, Lori Garver, who wrote how important it was to have role models and mentors.

She noted that “I was in college when Sally flew and frankly I don’t think I really paid attention to the Space Shuttle program until Ride’s first flight. She had a great influence on me. She shaped my life in this program. So role models do, in fact, matter. We have all in a way been touched by Sally.”
And I think this is the really key important point to go over. How important it is to, you know, see what you can be. That quote. If we look at the next slide, on Slide 19, you’ll see that over – more than 560 people have been trained as astronauts worldwide, and about, on the next slide [Slide 20], you’ll see that 75 astronauts have been female.

And on Slide 21 there is a list of all of them, all of the women. Some really good news, in the current class of astronauts, it’s 50/50 and there are – have been about 20 African American astronauts in the U.S., 5 of them have been women.

But some good news, on January 5th, NASA announced January 5, 2016 NASA announced that Jeanette Epps is becoming the first African American space station crew member when she launches on her first space flight mission in May 2018 as a flight engineer.

Kim Arcand: Okay so onto Slide 22. My own role in science. Well if we look at Slide 23. I’m not an astronaut. Though I did want to be one when I was really young. On the next slide, [Slide 24], you will just see that my story is a bit circuitous, I guess, or at least not straight.

I started out in molecular biology but I was kind of lost in the field and I really did not have any mentors. I went into computer science where I did find two amazing mentors and I ended up working for NASA’s Chandra X-Ray Observatory where I was able to do data visualization, image and meaning research and science communications.

And I had a wonderful mentor there that I have been very happy with. But for me, having a mentor has been really important in my career. So all these
stories that I’ve mentioned so far, they are partly my story. They’re also the stories of countless others.

And unfortunately, success in STEM fields is still not a given for many especially women and people of color. Far too often there are these hurdles and obstacles - some seen, some unseen, some recognized, some unrecognized - in order to reach those key milestones.

For those who mostly fall outside of the traditional perception and background of what a scientist, technologist, engineer, or mathematician should be, and where they should come from.

There is a great quote from the Hidden Figures book that really spoke to me a lot. It was that “these women’s pasts set the stage for mine. Immersing myself in their stories helped me understand my own.”

So you will see on the next slide, Slide 25, with that idea in mind, we created a resource for women in science at http://chandra.si.edu/women.

And in it, we have these hand drawn illustrations highlighting some of the women that we have been particularly inspired by.

So these are some of the women that have inspired us and we have short stories about them on our new web site that we just launched in time for Women’s History Month.

On Slide 35 you will see that there is actually a collection of posters with some information on them. And a little introductory poster that is not shown. But essentially, the idea is to help girls see what they can be.

And if you are a museum or a library or a science center and you want to display these posters during Women’s History Month or beyond or before please get in touch with me. We actually have about 30 sets that we can send out for distribution through the Museum Alliance.

So if anybody is interested in having a copy to put up on their walls let me know. They are pretty small. They are 11x17 size. We do them small purposely for various kinds of spaces.

Also if you are interested in doing these types of programs to help girls see what they can be. On the next slide, [Slide 36], is a program that’s called, Recoloring the Universe.

And this talks about essentially takes kids both, girls and boys, through a simple online program where they can actually work with real NASA data on various topics, from exploded stars to star forming regions, and learn basic coding to actually color images of the universe.

It’s for the beginner. We tested this. We worked with Google to create it and we tested it very heavily among young female populations to really good success.
And you will see on slides, let’s see, [Slide 37], [Slide 38] and [Slide 39], a little bit more about the program. [Slide 40] We had some great feedback on it that we are happy to share if anybody wants more information or tips on how to run it.

It is a self-contained program so all the materials are in videos. So even if a facilitator doesn’t have an extensive knowledge of astronomy or computer science it can run by itself.

So we have had good success with that. We also created another program that you can see on Slide 41, “how to build a galaxy.” [Slide 42] And for this program essentially we use some 3D data that the Chandra X-ray Observatory had gotten, and also other NASA observatories to help us create 3D models.

[Slide 43] [Slide 44] And the activity takes students through basic 3D modeling and uses CAD [computer-aided design] software to help them create their own 3D objects and they then 3D print them.

[Slide 45] And what we have just started researching with this project is that sometimes with girls their spatial reasoning skills can be slightly delayed due to cultural biases. And working with these types of 3D prints can actually help them catch up a bit.

We have just, just started this program and started getting the research on it. So there is nothing definitive to say yet, but we are hoping that will help sort of show that it is easy to catch up with spatial reasoning skills.

[Slide 46] So I am going to wrap it up there because I think I have gone on long enough. But any questions?
(Ann): Kim I have one. It is Ann in OPO [Office of Public Outreach] at (STScI) Who did the fabulous illustrations for those posters?

Kim Arcand: Yes so we have this amazing designer on our staff, (Kristen Divona). And she had done a couple of them just for fun, and when I saw them I fell in love and said we have got to do something with them.

So they come from her and she is credited on the posters too and they are just beautiful.

(Ann): Thank you.

Jessica Kenney: Thank you (Ann) for your question. Any other questions for Kim?

Man: Hi Kim, again great presentation. I literally just got an email asking for the posters. You said you had how many?

Kim Arcand: I have about 30, 35 sets to give away.

Man: Okay.

Kim Arcand: Yes.

Man: First come, first serve I guess right?

Kim Arcand: It will be first come, first serve yes. We are doing a big batch print now but if anyone needs them more immediately we only have about 35 sets on hand.
If people are waiting to do programs a little later we are doing a big batch printer with a government printing office that will probably take about three or so weeks to come in. So we will have more.

Man: And I know you were going fast on purpose but I am really interested in the 3D printing tinker CAD. How much testing have you done with that with students and what kind of impact do you see it having?

Kim Arcand: So, so far we have piloted the first part of the test and the first part of the activity pretty well. And we have gotten the bugs out through the actual activity itself.

We have just started collecting data on how mixed gender populations are responding to it. And so far by doing a very, very simple pre and post-test on spatial reasoning skills we are seeing an uptick in both gender skills.

So the next step -- that was kind of like the pilot to see if this was something we should keep pursuing? But now that we have got a little bit of data to work with, we are going to keep pushing on seeing what happens when girls are doing this in single gender populations? What happens if they have more pre and post-tests? That sort of things.

So we are just beginning but I have to say I am very, very excited about where this could go.

Man: Thanks, and one last question. The code program and the TinkerCAD are they both browser based. So then schools with Chrome books can also do it?
Kim Arcand: Yes exactly. We tested them on Chromebooks and they have worked great. We did have a couple of schools that weren’t allowing video usage of YouTube. So for a couple of the activities you have to toggle your screen. The activities were created so that the video plays like in the activity itself. But if your school restricts YouTube, then you have to toggle between a browser and a YouTube window. But it is a pretty simple toggle to do.

Man: Great thanks.

Woman: Hi this is Adrienne Provenzano from the Solar System Ambassadors. And I just want to comment what I think is great about the posters is that it shows not just portraits of the women but it shows them with their gear or their tech. And I think that is really great that you put that in a group together that way.

Kim Arcand: Thanks. Yes that was very intentional and we were hoping -- again that quote, you can’t be what you can’t see. I have always felt it was really on point and was really inspiring to us. So that definitely drove us. And then I am so happy to hear you appreciate that. That is great.

Woman: Great, thank you.

Jessica Kenney: We will take one more question and then we will move on to our next speaker.

Any more questions?

Woman: How exactly do we get the posters please?

Kim Arcand: If you send me an email I can get right back to you.
Woman: Okay and which slide was your email on? Sorry I didn’t get the slides until after this presentation.

Jessica Kenney: It is on Slide 3.

Woman: Slide 3 okay thank you. Sorry I will mute myself again. Thanks.

Kim Arcand: Sure no problem.

Woman: Thanks.

Jessica Kenney: Well if there are no more questions thank you Kim so much for all that you have shared today. We really appreciate that. We are going to start on Slide – Slide 47 for all those that are following us via PowerPoint or our pdf files.

I have the honor of now introducing a close friend of mine and someone who I was inspired who I saw when I was an undergraduate finishing my masters – finishing my undergraduate degree and then moving on into my Master’s Degree.

So our next speaker is Dr. Jedidah Isler. She is currently a National Science Foundation in Astronomy and Astrophysics postdoctoral fellow at Vanderbilt University where she studies the physics of particle depth emanating from super massive black holes at the center of massive galaxies called blazars.

She was recognized as a TED Fellow in 2015 and a National Geographic Emerging Explorer in 2016 for her innovative research and efforts to inspire a new generation of STEM mentors from underrepresented backgrounds.
Most recently she has been named TED Senior Fellow to continue to develop and host a monthly Web series she founded called, Vanguard: Conversations with Women of Color in STEM. Jedidah thank you for being with us today.

Jedidah Isler: Thank you so much Jessica, what a warm welcome. I really appreciate it. And I am super excited to be here, and just want to express my pleasure of being with such a distinguished panel in this really special conversation.

Apologies if you hear sniffles or artifacts. I have been sort of struggling with sickness this week so I am excited I just may not sound like it.

So I wanted to just really quickly - I don’t have a PowerPoint presentation. I mostly wanted to highlight a specific resource and in service to that I wanted to talk a little bit about who I am.

How I got to where I am and what I do. I think all those things are important for the resource that I will share at the end which Jessica has mentioned. Namely, Vanguard STEM.

So I am an astrophysicist by training. I have loved space and science and astronomy since I was very little. And in fact I have loved it before I even knew it was a thing you could do. I thought the sky was really beautiful and it made me feel calm and connected so I would go out and look at it all the time.

And so it was really a very early thing in my life that I came to love. And really what took me over the edge from, I guess, aficionado to someone in pursuit of a STEM degree in astrophysics in particular, was really seeing people who I identified with, so Kim, I am 100% on board with seeing examples of people that I can identify with. That certainly worked for me.
And so the first half of what I do is I am an astrophysicist. So I do study blazars. I love them. They are my personal favorite things in the universe. I am really interested in understanding how jets work. There are these particle streams that are shooting things out super fast.

And I have to give a shout out to Julie McEnry, who is also on the line and also a panelist. She is a Project Scientist at Fermi and I use that instrument. And she has adeptly managed and overseen it, and it is central to our understanding of blazars. So hey, Julie. I really appreciate your oversight there.

But yes I study blazars. That is the things I do in my day job. But the other thing that I do that is equally important to me is I consider myself a very strong STEM advocate and do that by necessity.

I am very passionate about making STEM more accessible to a broader and more representative portion of our population. Specifically I have an eye towards communities that are traditionally marginalized and excluded from such spaces.

So going back to that role models principle. They are important not just in developing interest in recruiting, getting people interested, but also retention of talent. It’s not just, as you say, seeing them but it is also tracking and mimicking what they are doing.

For me that was people like Mae Jemison who was on your list of astronauts. Also Cady Coleman now that I have gotten to meet her. Hi Cady.

Cady Coleman: Hello.
Jedidah Isler: And seeing these women really just doing their thing and doing it well. So Mae Jemison was my first role model. She’s also the first black woman in space. And also Beth Brown who is a black woman astrophysicist who I learned about when I was in college.

Those were the women that proved to me that my interests were just fine and that they were not at odds with my identity. That I could be both a black woman and an astrophysicist or a scientist at the same time. I didn’t have to give up one for the other. That was crucial to my development.

And my first role model was my mother who convinced me that it was possible to do this. She did not doubt it. She didn’t know how to do it, but she didn’t doubt that I could, and that was really important.

So I bring up role models not only to underscore what Kim said but also because that concept of having someone there to lead and guide you, whether they are doing in sort of a here-done way or just by being who they are, is essential to the engagement and advocacy work that I do. So that is a core component.

Now the lens that I bring to do this advocacy work is an intersectional lens. That is a theoretical framework, that was developed by Kimberle Crenshaw in the early 1990s.

The idea of intersectionality is that people with overlapping identities are likely to face overlapping discrimination unique to that overlapping identity, that is not necessarily experienced in the same way as every un-overlapping identity.
So for example, I am a black woman. That means that my experience is colored by being both black and a woman. And that those two things can’t really be pulled apart and that it creates some interesting and new experiences.

We’re talking about “Hidden Figures” this month, and so that is a really good example of this kind of differential lived experience right? So Katherine Johnson, as played beautifully by Taraji Henson, had the moment where she was working in the office within the space task force office. And they had marked the coffee not for – it basically said, there was one that said “colored only” right?

That is something that she faced at the intersection of being a black person and being a woman. And so those kinds of experiences are key. So talking about women in STEM we have to keep in mind that women are not a mono-[identity].

That there are differential lived experiences and differential impacts that are having overlapping identities. Not just race and gender. It could be sexual orientation or gender identity. It could be any number of identities that play into the experience one has.

And so unless we are finding space and creating space for the voice of marginalized women in this conversation, then we lose that lens to what is happening. And as Kim said, not just in terms of habit, but also in terms of creativity, in terms of impact, in terms of interventions actually in the STEM sphere.

So the work that I do centers intersectionality that has -- as I said it is a theoretical framework. It’s been born out in the sociological research since the 90s. And it is not just shown there.
We have seen research Joan Williams at UC Hastings has done a lot of work looking at what women in STEM, and actually separating, and specifically analyzing women from different backgrounds.

And so one of her studies that she talked about was how in an interview of 600 women in STEM, of which 60 were women of color in STEM, she asked how many people had ever been confused with the help staff, the janitorial staff.

And in this population of 600 women, all 60 women of color in STEM had reported being mistaken, at least once, with the janitorial staff. And no white women had reported that same effect.

So it is clear that we have got to be talking about these different experiences as we’re trying to get to the same goal that is increasing the number and persistence of women broadly defined in this STEM enterprise.

Definitely born out of my own personal experience as a budding astronomer: I was very interested in doing service work for my professional organization, the American Astronomical Society.

And I looked for committees and I had to determine if I wanted to be in the committee for the status of women in astronomy or the committee for the status of minorities in astronomy.

Before I could even give service I had to prioritize a part of my identity which is almost impossible. So these things matter. The one thing that matters - interventions we use matter. So I was really happy to see such a diverse group
of women represented in those beautiful posters; let me put my name on the list too, Kim.

So really that is the framework that I come from in terms of trying to understand it. And the reason why, I think, really highlighting Hidden Figures as a tool for this is because it has been a galvanizing force for many, many young women of color.

Black women, women that come from under resourced communities have just found it to be incredibly valuable. From a young woman saying, “I am Katherine Johnson. I can do what Katherine Johnson does. I love NASA like Katherine Johnson.”

I think this is a particular moment to really give voice and insight to the experience of women of color in STEM.

So the main initiative that I have been working on for just over a year, I suspect now. It is called Vanguard: Conversations with Women of Color in STEM which is Vanguard STEM for short.

And the idea is to try to ease the tension and discomfort that come from constantly being asked to reduce an irreducible quality like identity. And to make space specifically for intersectional identities, and specifically, in particular, women of color in STEM.

So what VanguardSTEM is is an online platform designed to cultivate an empowered community of women of color who are positioned to advocate for ourselves, our scientific, technological, engineering and mathematical identities and interests.
We do this by providing a space for women of color in STEM to create and curate original published work. We have had a number of women who contributed pieces, written pieces now, but we have got a couple more interested in doing some multimedia things that are from their perspective.

We did a huge series last summer about burnout regarding Dr. Shine Change expert at studying burnout [http://vanguardstem.com/dealing-with-burnout-in-and-out-of-the-stem-space/], and we spent time thinking about what burnout was, and what its actually physiological manifestations are, and then how to combat it. That was one of our most watched shows because it resonated, the sense of constantly being put upon.

We also had a number of people come and write -- contribute original work to the web site based on that show. So they are very interested in highlighting and bringing those works to the floor.

And we also host a monthly live online show that discusses issues that are very important to this community, but really broadly, because our audience is predominantly women of color in STEM, but it is not only women of color in STEM. The idea is to highlight these voices. But we are an inclusive space and we don’t exclude anyone.

So the monthly shows generally feature a rotating panel of people. We’ve had anywhere from one to six guests at a time. I host it and we talk about a theme every month. So our biggest panel was six people. That was a lot to handle but we had six people and we talked about building support networks.

We had six women who had known each other for almost 20 years from the time they met in a college program, a college conference for organic
chemistry and biomedical engineering all the way through to their varied and sundried life paths.

And they told us about how they maintain their relationships. How they determine who would be in what they call the BOD, their Board of Directors. And what the value of those relationships were over time.

At the same time we have, as I said, conversations about burnout. We talked about dealing with racial trauma. And all kinds of different issues that are resonant to these communities.

Generally what happens is the show happens live and then we have – and the people that are engaging with us are on social media. We are a completely social media and internet driven enterprise and so all of our material is at our web site which is http://vanguardstem.com, which is in the materials have been shared with you. And we maintain a presence on Twitter, Facebook, Instagram, Snapchat, all those preferred platforms.

The idea is that there is both an avenue out so that people are – so that participants are hearing new information that they may not have had, any sort of factually based and not just opinions. But also they would be able to give us back things that they’re hearing, that they’re feeling so that we can build community.

So fundamentally, the goal is to create a robust virtual community. And we did that on purpose. We wanted it virtual because often what happens is women of color will be one of the few or only women of color or people of color in their department.
And so what we were trying to do is point out that while you may be alone at your home institution, there is a whole community of people that surround you, that you can get to virtually. So many of our emerging scholars are so connected in the digital space.

So those are the two interventions that we have to make the program work. We are mostly focused on the tension and culture change that is to walk alongside these young scholars. That is why we bring in this ever-rotating panel of women of color in STEM.

We also have features that we do every week that we call Women Crush Wednesday in STEM where we just pick someone and highlight them and we talk about their research. We talk about the work that they do. And then we ask them why we think this community is important.

Even though we are focused a lot on tension, and culture, and community building, these role models really help with recruitment. Because young people see it and realize that they can do it.

One of the surprising realizations that we have had dealing with Vanguard STEM is how young our audience goes. We had positioned it to go from roughly junior high school up through professionals.

That is where we thought people would get to it. But there is a surprising number of really engaged parents who have daughters who are very interested, specifically in astronomy and astrophysics, I think because they see me running it, that have reached out.

And I have talked to young women as young as eight or five about astronomy which is always a wonderful conversation. It has been resonant farther than
we even thought it to be, just a small initiative that we started, that I started individually, now we have a small team around.

So just to point again back to “Hidden Figures” because I really, really love that we are doing that. It is part of the theme here. The specific video resource that linked to is our interview with Margot Lee Shetterly, who is the author of “Hidden Figures” and really the catalyst, I guess I’d say, behind this whole sort of phenomena that is happening around the movie.

What is compelling about her story is that her dad worked with Katherine Johnson. She went to church with Katherine Johnson. These are just people around her neighborhood.

And so she took this concept of normal genius, what is just around her, and amplified the stories and that has really changed, I would say, the conversations around women of color and black women in particular in STEM.

So I think Vanguard STEM can certainly be helpful in the sort of museums, informal education space and community because of its sort of ease of access, because it is giving a sense of community that is just a community that you plug into.

And having been a board member of the Museum of Science and Technology at Syracuse, I am very familiar with the often very wide disconnect between museums and families of color outside of school.

So I know this is a space that is ripe for growth and I think, like I said, can really be used to highlight and draw attention to STEM practitioners from diverse backgrounds.
And certainly use “Hidden Figures” as a framework, building on that momentum. So I certainly encourage you to watch that – share that episode with Margot Shetterly because it was really interesting seeing where this all came from. [https://youtu.be/eDqqgx-sdmo]

We are experimenting with watch parties where we have groups get together and watch the show collectively and give us feedback as a group. We have had a couple of small liberal arts colleges join us in that way and we have really enjoyed that.

The next show is actually this coming Tuesday at 7 Eastern. All that information is on our social media account and it is – the theme is Speaking Truth and STEM to Power. And it actually features Dr. Chanda Prescod-Weinstein who you mentioned previously Kim. So we are very excited to have her.

So ultimately the goal of VanguardSTEM is to bring awareness, advocacy and advancement for women of color in STEM and along the way help create a more just enterprise. I am happy to entertain any questions you have. And thanks for your time.

Jessica Kenney: Thank you Jedidah. Any questions?

Woman: I had a question. You mentioned you have had young women, very young, much younger than you were expecting come across you. Partially true maybe their parents are looking for resources to support that.

Have you guys gone out into schools at all intentionally? I think you – if you said that I am sorry I missed it.
Jedidah Isler: No we haven’t gone to schools in particular. What we have been trying to do is get – two answers. We have not gone to schools yet because we have been trying to focus in on the individuals. And so that – it inhibits us in a way, because if you go to schools and many more people see us.

But at the same time we really want to get people who are – they have motivation to do it themselves. Which is why the young women were so surprising to us because – the very young girls, I guess, were surprising to us because what was happening was they were expressing interest to their parents and their parents were being their sort of messenger to bring this thing out to the world.

So it is not out of the realm of possibility. It just hasn’t been a focus for us given our small team. But what we do try to do is engage with schools and groups not just formal education but also informal education through social media and get them to spread the word in that way.

Woman: Thank you.

Jessica Kenney: Jedidah you spoke a lot in the beginning about intersectionality. Can you point our audience to a few resources where they can read a little bit more or watch a little bit more about intersectionality?

Jedidah Isler: Absolutely, absolutely. So the work is based, as I said, on research done by Kimberle Crenshaw. I will send some more of those around that – actually that’s a good point.

[https://informal.jpl.nasa.gov/museum/Conversations/women-stem-uol]. She wrote a – her seminal paper was written in 1990 and I will just send a link to that.
And then also she has just given a TED talk so if you just search intersectionality and Crenshaw it will pop up. And she sort of gives an overview of that in the context with her larger work with advocating for women and girls of color just broadly.

So her work is not necessarily focusing on STEM. I am trying to take her run and apply it to this space given that a lot of the experiences are the same.

So those are the two that I would focus most formally on. Then going a step further trying to bridge the gap between intersectionality and STEM. A group of astronomers in 2015 put together a conference called, Inclusive Astronomy, which was also based on their framework.

So you can read a lot of the work that we did there and some of the recommendations that came out of it. So what I will do is I will just update my – I will send you those three links so that you have them. Okay thank you.

Jessica Kenney: Any other – we have a few more minutes for questions. We can take maybe one or two more questions that we have for Jedidah.

Cady Coleman: Hey it is Cady Coleman. Jedidah first of all, hello. And if you guys haven’t met her in person I mean you realize that they are just a force of nature. As soon as I saw your name I was just so excited to be hearing from you today.

And I am listening to the list of things that you are putting in action. It is just really impressive to me and I commend you for it, and it is inspirational. I have got a hard question, or I think it is a hard question.
And that is that everybody on this call cares about STEM. We care about women in STEM and we care about people who can’t – who aren’t being seen.

And yet I am always realizing that basically as much as I would like to, I can never fully really feel or understand what it’s like to be a woman of color in a STEM field.

And I wonder if you can share just some ways that people like me who care and want to, how do we know more? How do we learn more? How can we – I mean because sometimes when you are trying to help people when you know they are looking at you like “you have no idea what it’s like to live in my shoes.”

You know it is just harder. So do you have any constructive things that we can think about?

Jedidah Isler: Yes so Cady you know my love for you is strong and I was trying not to say that but you know it is. It is strong. So thank you so much for your kind words. I feel, honestly, the same way about you. You are such a role model and an incredible human being.

Right so it is a tough question in a sense that, you know, it allows us to get down into brass tax, so thank you for asking it. And part of the reason why I built VanguardSTEM and there are other initiatives like this popping up is because the request is not necessarily to be able to walk in my shoes or in the shoes of, let’s say, a woman of color in STEM. That is not the request.

The request is more to give space around those different experiences right? So, for example, a lot of the research just for women and STEM, women
really in business and any arena has shown that often times women will say something in a group and it will go unnoticed.

And then say a man or someone in a leadership position would say the same thing, and all of a sudden everyone heard that thing, right? That same experience is amplified when you are a woman of color in STEM.

So for example, to say “okay I walked into this room and I was made to feel unwelcome in these ways.” If that is dismissed as “well, I think you are just being too sensitive.” Or “I know that person. That is definitely not what they meant.” That is an unhelpful thing to say.

Rather, to go in and be like “you know what? I don’t know what that means. I have not experienced that but how can I help you feel more comfortable in this space?”

It is much more a coming alongside than it is trying to actually stand in the same shoes. Does that make sense?

Cady Coleman: It sure does and that is helpful. Thank you.

Jessica Kenney: Great conversation. Is there anything you wanted to add Jedidah?

Jedidah Isler: No. But ultimately I think that the easiest and most succinct way to see it is that it is much more standing alongside, amplifying, than it is needing to necessarily have gone through it.

Jessica Kenney: Thank you so much Jedidah and thank you all for those questions. As we have to move forward but this is some great conversation. Thank you Cady for asking that question.
We will go now to our next speaker. We will start on Slide 48. It is a huge honor, first and foremost, to be on this call facilitating it. But to be able to introduce people that have been my role models. And Cady I have never met you but it is a superb honor to be able to introduce you right now at this moment.

Cady Coleman is an American chemist and former United States Air Force Officer. And a former NASA astronaut. She is a veteran of two space shuttle missions. She was a part of the International Space Station on May 23, 2011 as a crew member of the Expedition 27 after logging 159 days in space.

She retired from the Air Force in 2009 and from NASA in 2016. I will turn it over to you Katie. Welcome.

Cady Coleman: Well thank you very much. And boy, just an amazing discussion to be having at 3:30 in the afternoon on February 2nd, and the way Kim has arranged it. I mean I am in my home in Shelburne, Massachusetts. My cat is sitting on the kitchen table, which he knows he is not supposed to do but we are both kind of cozy.

And I just think it is amazing that we can gather everybody in one place like this.

I have a bunch of slides here and the first one I just wanted to go through really quickly. Almost just to – since I had you and you think so much about education I just wanted to share just a sense of the science that we are doing up there on the space station.
But mostly I wanted to talk about the idea of being hidden and having a different perspective and what all of us, I think, can bring or are already bringing to the equation.

I really love this movie “Hidden Figures.” I have actually seen it four times now. I wanted to see it partly as my job, even though I was retiring at the time, but I care a lot about these things, and I wanted to understand the situation.

I will tell you I see different things every time that I see it.

And now I am finding that I am applying it in all sorts of different contexts. One of them I will share really quickly is just last week I gathered – someone else gathered us, actually -- two visionary women gathered us which was about a dozen really high executives, women executives, at Hewlett Packard Enterprises.

And we gathered together for about a day and a half to talk about women in STEM and women in tech and how there weren’t enough and especially at their level and what could be done about it.

And when we could have spent the evening chatting and drinking wine and all those things. Everyone chose to watch a screening of Hidden Figures that someone in the group actually was -- basically had access.

And it was really – it has been interesting to watch this with all these different groups of people with – I watched it with the AeroAstro department at MIT. I watched it in the African American Museum in Washington, D.C. with some of the stars. And also sitting next to Al Drew is another astronaut he is still active.
But there is one scene in the movie and those of you that have seen it. There is one scene in the movie where it is not Katherin Johnson but – I am sorry I am nervous and I forgot her name. But the woman who is the engineer, Mary, the engineer. And so…

Woman: Mary Jackson.

Cady Coleman: Yes Mary Jackson, I am so sorry. Anyways, Mary walks in the very first time she sees a spacecraft hanging up above her and she just has this look on her face. And I looked over at Al and I said, did you feel that way? He goes oh I did.

I mean it’s just – it’s the way you first feel when you see a spacecraft. And it’s the same for all of us, that we have the same awe in having our job.

So looking at slides real quick we’ll just run through the first one since I know I have got some interesting ones to look at I think. [Slide 48] is just the space station. [Slide 49] is me with a suit. It’s actually a tribute to my nephew who’s an Irish dancer. The spacesuit and I are both doing our share of Irish dancing in that photo.

But in that spacewalk club that is a club that is a hard one to be in, and I have that picture because I am very proud of seeing it. I am the smallest person certainly to be on the spacewalk team, so to speak, for the space station.

[Slide 50] I didn’t get to actually do a spacewalk but being a person who had their suit up there ready to go, and would have gone out if we’d needed to, is something I am very proud of.
But I really had to sort of just cheerfully, cheerfully, cheerfully fight hard to be in that club. And the number of times that people asked me “do you fit in the spacesuit?” I’m like “absolutely.” They go “well, we don’t have small ones anymore.”

And I say, “well, when you look at this chest do you think that this chest fits in a small spacesuit? Look again.” Anyways I can’t hear you guys laughing. I hope you’re laughing.

But anyways, you know it is one of these things where you have to just cheerfully show up and somehow have a little courage inside you that you know you’re supposed to be there.

And I think what we are here for is the – you shouldn’t have to have that kind of courage. You should actually just get to bring your abilities to the table and be part of the solution and have people recognize that you are.

And so that’s one of the things that I think about is having to try really hard to be on those teams. And I will say that NASA is considered the best place to work in the country or in the federal government.

At the same time, when it comes down to assigning people to a mission or picking people, whether it is astronauts or mission controllers. The mission is so important and safety is so important, that I think people feel compelled to pick the very, very best person that they can think of. The one that they know they can defend no matter what happens that this was the best person to send.

And so often it is a person who looks like just them. And so you just have to have your facts on paper together that you belong on that team.
Looking at Slide 51 there. (Scott) juggling a bunch of oranges and my point was really just that there is – it is a wild place to do science and we quickly go through science.

Slide 52 is me using tools which I learned to use basically in my late 40s. Going to the space station happened the day after my 50th birthday. But it turns out that using tools is something that is actually just not that hard.

First of all, there are instructions. And second, when you look at it and you get people to explain it to you then it makes sense and you can fix things. Even me.

Looking at Slide 53 of so many experiments we do, we get to see what do liquids really want to do? And by taking away gravity we have a lens, a different kind of lens, on the behavior of materials and the behavior of science.

And so looking at Slide 54 you see what could be just liquid in a container, but you can see it is climbing wildly up the wall. So up there we really do get to see what do liquids really want to do.

Slide 55 is that same answer for combustion. On the left, a normal candle flame, and on the right one in a zero gravity where - or very little gravity, where we see that the lighter gases are not going to rise. And so it creates a situation where measurements can be made in just over – measurements that are made here on the ground in less than a second, can be made over 30 or 40 seconds.
Slide 56 and then [Slide 57] you see the ugly Earth crystal and then a beautiful space crystal. And so it’s basically a laboratory up there that allows us to do science experiments that we just can’t do down here on the ground.

I do find that in many of the things that we do up on the space station it’s a multitasking environment by definition. We start something and go do something else.

Time is so absolutely precious and crew time and so precious that we really try to get so much done by going around and multitasking, and there is always a number of things to keep in mind.

And I find that women are pretty effective in this environment. Take a look up on orbit at Dr. Peggy Whitson who’s up there right now. She is renowned and amazing. The ground actually, in some ways, shudders when Peggy goes to space because it is hard for the ground to keep up with her.

And one of the cutest signs that I saw. They always make sort of funny signs for when we get back. There is one that had Superman, and he’s wearing kind of a strange outfit on the bottom and it says, Superman wears Peggy Whitson pajamas.

So looking at Slide 58 some of the medical things that we do. A lot of osteoporosis research. Slide 59 shows that as well, and that is really, really effective research because it happens to us so quickly up there.

And Slide 60 is growing plants and 61 is Steve Swanson with the first lettuce crop grown up on the space station. And all the things that I just showed you, combustion, liquids, all those things. This is one big, giant test bed for that journey to Mars.
And understanding how to recycle water. How to recycle air. How to grow plants in places where it’s hard to do that. How to have food to last more than three years?

These are all space exploration problems for Mars but they are also problems for Earth. And in order to solve these problems we need diverse teams. There is no question in my mind that diverse teams are better.

So now just – I have kind of an interesting, at least I think it is interesting, perspective exercise. And that is look at Slide 62 where you see the space station looking out at the Earth.

And so you get a sense of how close we are to the Earth, really, about 250 miles up. And we’ve got a window, actually a cupola, a series of windows almost like a widow’s walk, like something you expect to see on the top of a building where you are surrounded by glass. We have that kind of window on our space station.

So now look at Slide 63 which is the hurricane. So you see what it looks like to look down. And now look at 64. That is our cupola. That is our windows or our “sitting in the glassed-in place looking out.”

And whenever I’m there I think that I must be sort of up high and looking out. But now go to Slide 65. So in order to see the Earth, well that cupola, that glassed-in place can’t be actually up and looking out. It must be down.

So now look at Slide 66. So really that is up. We are upside down looking at the Earth. So think about that and now look at Slide 66. And now look at Slide – sorry look at Slide 67 and 68.
And so those are sort of mirror images of each other. You know in 67 we are looking down at the Earth, which is, kind of in my mind, what we are always doing because we must be looking down if we are having such a view.

But really our situation is Slide 68 where we are looking out that window but up at the Earth because we are upside down. I don’t know if that makes sense to people.

But now look at – so now I have got a series of pairs like that. Slide 69 and 70 are looking at the East Coast. Long Island, New York City on the left side, the Hudson River going straight up. That’s that sort of snaky white thing. It is wintertime so it is easier to see these things. And on the far right is Boston and Cape Cod.

A friend of mine likes to say – we were up in space together. He was from Massachusetts with a very thick accent, (Al Sacco) from STS-73. And the first time we saw Massachusetts together he looks down and he goes, “oh my gosh, it looks just like the map.”

And now look at 70 where it is upside down. So it is just a different way of looking at things. And now look at 71 and 72. You can think about Cape Code in Slide 71 like we always see it or think about coming from up north and going south and you, yourself, being sort of upside down.

So we are always and now look at 73 and 74, Cape Cod in a different light and a different viewing. And so I am trying to get you to see that it just depends how you look at things.
And in Slide 75 you see Tracy Caldwell. It is a beautiful picture. Sometimes people think it’s me but it’s Tracy. She took it herself of herself. And it’s a really wonderful picture of a human and her perspective to the Earth.

So now look at Slide – I know it’s been a long winded point here – but now look at Slide 76. And I think you see Paolo on the left, Paolo Nespoli, and [Dmitri Kondratyev] right above him, and you see me with my big hair. And then you see sort of a mess on top of us.

But now look at Slide 77. Well now we see those guys who were on top of us. We have a way of looking at things - we are so used to things being right side up that we just don’t see things that are upside down.

I mean do you see how in Slide 77 it’s kind of hard to see me and Paolo? We’re just sort of like things. But the people on the bottom are people.

Now look at Slide 78 and 79. Here in 78 you see on the bottom, Tracy Caldwell. She is a chemist, PhD chemist. Amy Wilson is an aeronautical engineer, the queen of the robotic arm, and an amazing person and friend. But we don’t really see the people above them.

And now, if you turn it around you see Dottie Metcalf who is on [Slide 79]. Dottie Metcalf is on the right there. She is a teacher turned astronaut, and now retired, and a mom. And Naoko Yamazaki from Japan. One of the first woman astronauts from Japan.

And now look at Slide 80. So my point is that we are just used to looking at people a certain way. And in some ways when you look at 80 that’s Eileen Collins and myself and then Steve Hawley, Michel Tognini, and Jeff Ashby.
And the number of times that Jeff and I would fly somewhere in the same airplane and we would get out and they would assume that he was the astronaut and I was the flight test engineer.

When we’re both astronauts, first of all, and I was very much the senior person. That kind of looking at people and especially underestimating, I would say, women and people of color, in some ways it’s nice because you only have to come out when you want to, because people don’t really quite realize who you are. But I do just think in looking at these pictures and if you sort of scroll through and you see some of our crews.

I think you can see that there are lots of different people in the pictures and we really have to look closely to really, really see them. And I will have you look for – I am almost done here -- but I’ll have you look at Slide 82 and 83 and those are my two space station crews.

And if you can see it close enough in the middle of Slide 82 I am back to back with Dmitri Kondratyev, and now you can see him again and you can see me again in Slide 83. And I think you will notice that (Dima) is a pretty serious looking guy.

And I make the joke, and it’s not to make fun of (Dima). But this is a slide of our whole crew really excited about going to space. And if I could see all of you some of you would be laughing because clearly (Dima) does not look very excited at all.

And yet this is actually a photograph of (Dima), Dmitri Kondratyev, very excited about going to space. But this is the way that he shows it.
And so I think that one of the things that we can do as people who are interested in STEM is to realize that our perspective is valuable and that we see things that other people don’t see. And sometimes our job is to point them out to people.

That our job - that we really see life through a different lens than other people because we have been aware of these situations. And I liked all the data that Kim brought to us about what the situation really is.

And so I think that that’s really our job is to bring the situation to light and help people see it.

Look at Slide 85 and 86. I actually took these right of the TV screen the other night when someone was showing this at a screening. And it is a picture that really sticks out to me when you see Katherine Johnson in a sea of white shirts. And in both pictures - it is just a little closer in Number 86 - and it really struck me because if you go to Slide 87 you see my picture with my space station crew and the shuttle crew that visited us and that was the Kelly Brothers. And it was also – the Kelly brothers, one was a systems commander and one was the shuttle commander.

And so we have about nine of us there in that picture with President Obama. And I am wearing a bright green shirt actually because they had said we were all going to wear flight jackets and black pants and white shirts and ties to everything that we did in Washington that weekend. So that is how I came prepared to dress.

And then we all met down at the desk at the hotel to go to the White House. (Mark) looked at (Scott) and said, “you didn’t tell her.” Which was that the
wardrobe had changed. And basically throwing on this shirt over a pair of black pants was the best I could do in 20 minutes.

And so I use this picture, Number 87, almost always when I talk because I just – sort of naturally stick out in a visual way in the picture. And I use it to tell people that when I was in third grade no one knew that I was going to be in this picture. And that is why every one of them needs to be ready and it is our job to get every one of them ready because we just don’t know who is going to be special. Because the fact is everybody is special in their own way.

So looking at [Slide 88] that is a picture of my son very young and his curiosity, and I think that this is exactly – I mean we have girls that really think that they could discover things when they are this age. And then there are things that happen.

Jessica Kenney: Cady we have a few more minutes and then we will have to go to questions.

Cady Coleman: Okay did you say just one more minute? Because I think we are about finished here. So what I would say is that as STEM [educators] we have the possibility to provide that lens. And these last two pictures are just about the future and the fact that we have got places to go that are very exciting.

And you know I will give you an example. I have been very passionate about “Hidden Figures” and I feel very strongly about it. And in my Facebook blog I wrote that I thought it was a movie that could change the world if we let it.

And then I just recently got asked to review another movie just last week. It is coming out tomorrow and it is called, the Space Between Us. And it is interesting. It is basically a baby that gets born on Mars. Don’t dwell on how.
But it’s a kid that grows up there in secret. He is 16. I have a 16 year old. And he wants to come to Earth. And Mars is actually his home but he wants to find out what piece of Earth is really that part of him.

And he likes a girl that he has met over the Internet, so to speak. I mean it is really a charming, wonderful movie. But what I ended up talking about in my review and in the interviews that I have done for it, that I think surprised the producers was that in this movie there are five major characters.

Three of them are women and all three of them are basically really smart, technical, resourceful, determined people that you want to have on your team.

And so when people walk out of this movie, especially kids, they are going to walk out thinking that it is normal to live on Mars, and that when they solve problems in teams, the girls are going to be a really big part of that because they are really smart and good.

And so I am pretty fascinated these days with the power of the popular media and its ability to change what our kids think about. And with that I will stop for questions.

Jessica Kenney: Thank you so much Cady for what you shared and I really appreciated your perspective of pointing out the things. Because as scientists we do have a certain perspective and being able to point those things out to others as kind of our duty. I thought that was a really powerful perspective that you brought to the table.

Is there any questions that we have for Cady?

Kay Ferrari: I have a comment. This is Kay.
Man: Chicago, Dundee, actually, I wanted to follow up on points she just made at the end, the role models are key for women in science and technology. And folks like you have blazed trails for that.

I had the privilege last week of seeing Dr. May Jemison speak at Northwestern and she happened to be talking there about the Martin Luther King Week celebration. But she also covered a lot of the role model things.

One key point she mentioned is that the kids have this natural instinct to begin with, but the adults have become gatekeepers to keep women and minorities out of these positions.

Cady Coleman: I think that is a great comment and something we all need to look at and realize that we can affect the gatekeepers. And I will just share really quickly at this woman’s gathering that we had for Hewlett Packard.

Susan Helms was there as well and we never get to hear each other talk. It turns out we both have basically exactly the same story which is that seeing Sally Ride in person changed that our lives.

And that we suddenly saw someone that we could relate to and thought wow, maybe I can do that. And so I think it really reinforces that role model point.

And was there someone who started another question.

Jessica Kenney: I think it was Kay.
Kay Ferrari: Hi yes it is Kay. I have a comment on that. And it is about what we noticed about 20 years ago when we were bringing girls into JPL to get them interested in careers in science.

And we found that if we had all of our speakers [as] women who had got – were inspired when they were quite young and carried on through, that there was a certain population of the audience that we had of girls that would kind of shut down or turn off.

So we decided to mix it up a little bit and we got some women in who were now in careers in science but had not started out in careers in science. And then we started seeing the girls that would normally shut down start to perk up because they realized it wasn’t too late. And that made all the difference in the programs that we had

Cady Coleman: That is valuable insight. I appreciate you sharing it. I want to make sure that we get to talk – to hear from (Julie) because I love – I was caught at her very first slide from Dublin to NASA getting to where I didn’t expect to be.

Jessica Kenney: Yes we will move on. Thank you so much for all the questions and thank you Cady so much for your perspective and being with us here today. Julie - I have the pleasure to introduce Dr. Julie [McEnery].

She is a Project Scientist for the Fermi Gamma-ray Space Telescope and is an astrophysicist in the astrophysics science division of NASA Goddard Space Flight Center.

She is the adjunct professor of physics at the University of Maryland, Co-Director of the Joint Space-Science Institute, Chair of the Division of
Astrophysics and a fellow of the American Physical Society. (Julie) we will turn it over to you.

(Julie): [Slide 93] Thank you very much. I am somewhat in awe of all the inspiring women who have spoken before me. My comments here in some sense are going to be a little bit less broad than many of the other speakers.

In the sense that I have been doing a lot more learning about the role of outreach and the degree to which it has changed my own thinking about questions of diversity and inclusion. And not really as much direct working in the area.

So what I thought I would do with my time slot is describe my story. How I – what I thought I wanted to be. How I got to where I am now. And how my thinking has changed through my career.

As the title suggests, I am Irish. So like most Irish people I have a substantial fraction of my life not living in Ireland. In places I have spent more than a year are Ireland, the U.S., the U.K., Australia, the United Arab Emirates and Hong Kong. So I have been a lot of places and worked with lots of different kinds of people.

On the first slide there are three figures. They represent the current…

Jessica Kenney: And we are on Slide 93 I am sorry.

(Julie): Sorry, Slide 93. They represent the current status of three experiments that I am currently involved in and got involved with their predecessors when I was a graduate student and postdoc.
So you have Fermi on the top left. It is a satellite experiment. HAWC [High-Altitude Water Cherenkov] on the top right. It is a partnership between the U.S. and Mexico right at the foot of the Sierra Negra volcano. And you can tell it is a volcano because you see the lava flow stop just before our experiment.

One of the questions that we got in our first review at NSF [National Science Foundation] is did we think we could put out the fire if our volcano erupted again. And the answer is no.

And then on the bottom is Veritas. It is another third Gamma-ray telescope that is a partnership between the U.S. and Ireland.

So I did my PhD in Dublin following an undergrad in the U.K. Jedidah and I have something in common. We have both worked on looking at these objects, blazars, which are active galaxies. Galaxies that contain a supermassive black hole with jets of particles moving close to the speed of light.

A blazar is when those jets are pointed directly at us and they are very special. Because when you are looking down the barrel of something that is moving at close to the speed of light, the intensity of the radiation is much greater. The rapidity of the variations is much higher. So you get to view a really extraordinary place in the universe.

[Slide 94] On the left hand side is the telescope itself. It was in Tucson, Arizona. I was fortunate in that I got a fellowship from the Smithsonian Institution that allowed me to spend four to six months a year in Arizona.
So I spent winters in Southern Arizona and summers in Ireland, which if you are familiar with weather patterns you will realize that that is the right thing to do.

After I finished in my PhD, I had a choice of jobs, a choice of two. Either to work in the U.S. in an experimental Los Alamos National Lab or one in Japan. I chose the U.S. position and I worked in an experiment that was repurposing an alternative energy experiment and turning it into a large Gamma-ray telescope.

And then maybe I should say a word about why I have been so driven by high energy astrophysics. When you view the sky with your eyes you see stars, you see the moon. If you know where to look you can see planets. If you are in a dark enough place you can see the Milky Way.

But if you can fly above the Earth’s atmosphere and you see the sky with Gamma-ray eyes it is drastically different. We don’t see stars. The single point sources of Gamma-rays are these blazars – so you are seeing the product of jets and particles moving at close to speed of light.

The Milky Way itself which is fairly dim in optical wavelengths is blazingly bright in Gamma-rays. Over 85% of the Gamma-rays that we see come from our Milky Way Galaxy.

So it is really a completely different way of looking at the universe. And I think it is a way of getting at some of the most exciting astrophysical objects.

[Slide 95] So in any case, when I was a postdoc at Los Alamos I– this was the first time that I lived full time in the U.S. We also learned to do scuba diving at high altitudes which is extremely interesting.
My science interests changed to move from studying active galaxies to looking at Gamma-ray bursts. It is the largest explosions in the universe.

My way of working also changed. When I was a grad student I had a perception that I really liked doing science. I would be happy if I could just be left to myself to pursue my own scientific interests.

And I felt I would be as comfortable working with myself as I would be in groups. And what I realized when I was a little bit older as a post-doc that in fact for me personally working in groups is absolutely essential. That I thrive in a group. I am much stronger in a group.

I think that a well-structured group is much more than the sum of its parts. And when working, it is as important to make sure the group is working well as it is to contribute significantly yourself.

I also – my technical interests changed. I discovered that I was good with computers, good at setting up computer systems. I realized that I liked to write drivers to use computer hardware in new and innovative ways.

And I started to get involved in questions of big data. So there was a significant transition both in my science interests, in my method of working, and in my technical interest during this period of being a post-doc.

I fell into – sorry I am moving to Slide 96. I fell into working at NASA kind of accidentally. I thought I was looking for faculty position and in the course of looking for a faculty position I realized that junior faculty didn’t seem all that happy.
And that I would really prefer to try and find another post-doctoral level position so that I could get involved in a new area of science in a position that allowed me to devote all of my energy to that.

And I expressed the sentiment in a group of people, most of whom I didn’t know, and the next day I got a call from somebody at Goddard saying we hear you might be interested in coming and I did so that is how I arrived.

I started working at GLAST and here – so Fermi is the renamed version of this Gamma-ray Large Area Space Telescope. So at this point I am making a transition from hands on working on an experiment that you see and feel and touch, to one that is treated very carefully in a clean room on the ground.

You spend years working on your experiment and then you put it on top of a huge amount of explosives and hope that it fairs well in the journey into space.

It has been a very large partnership. So this is where I learned how to work with engineers. The science team is a combination of people who have an astrophysics and a particle physics background.

And one of the things that I have learned there is that groups of people who are different and have different approaches work much better together. Because you don’t – nobody starts with the assumption that you know what the solution is going to be because you have always done it.

Because the standard “this is the way we have always done it” is different for different people. And I think that that has been a huge strength for GLAST.
After a few years there they found a way to make me a civil servant even thought I was not a U.S. citizen and I didn’t have a green card. I became the Deputy Project Scientist and later the Project Scientist.

Which meant that my work expanded from sort of being in the trenches purely doing the science to having oversight of a relatively large budget, which supports university groups across the country.

I had oversight of our flight operations team. I worked with science writers and graphics artists to promote the mission. And we have a science group and a science port center that is co-located with me.

What you see in the images on the bottom left is a group of us in General Dynamics facility about a year and a half before the launch of our instrument. This is the instrument is kind of nestled to the right of the six people, seven people hunched there.

The photo above is several months later when the spacecraft is in the faring of the rocket. The image on the top right is our picture of the Gamma-ray sky. This is the deepest, sharpest image that we have ever got at the highest photon energies.

The point sources as I have mentioned, those little dots that you might think are stars are actually galaxies. The stripe across the center is the Milky Way and there is lots and lots of new and exciting discoveries. It has been really a trip over the last eight years.

The Science cover is - I was very proud that one of my students, her paper – a paper she led was selected for the cover of Science. While I can’t directly take any credit for being directly involved in that, I am happy to bask in the
reflected glory. I am extremely proud of (Sylvia) for the work that she did while she was here.

She is now spent the last year and a half working with LIGO. And on the bottom right just to put in a random science result, is an image showing our discovery of anti-matter produced in thunderstorms.

So here instead of using our spacecraft to look out at the universe we are observing the highest energy photons that are being produced by thunderstorms on Earth.

And we discovered that not only do we see Gamma-rays, particles of light but we also see electrons and positrons. The electrons and positrons are produced in the thunderstorm. They travel along the Earth’s magnetic field lines impacting Fermi hitting what is known as the conjugate point bouncing back again.

So this is the same phenomenon that keeps radiation trapped in the radiation belt. So what happens in Fermi is that we see two peaks. And that is what you see in the pink on the left hand side of that plot.

And when we look at the energy spectra we realized that we weren’t seeing Gamma-rays. We weren’t seeing particles of light. What we were seeing is positrons that were annihilating in our detectors to produce the emission signature that we were seeing.

I find it really quite remarkable that a spacecraft above Egypt is irradiated by particles that are produced by a thunderstorm in Tanzania.
Moving on to Slide 97. Every group – everything that I have done has really been a function of the people that I work with. And I am not showing here all of the people on Fermi. This is most of the people who work with me on Fermi at Goddard Space Flight Center.

We are a somewhat unusual group. The science team is majority female. Our flight operations team is majority African American. We don’t quite know how either of those two things happened.

Myself and my deputy have worried significantly that we have got some sort of bias because it doesn’t seem statistically reasonable that either of those two things should have happened.

Our hypothesis is that we are in a particularly good place for attracting very, very strong candidates from those two groups so that is what is driving those changes.

And then finally moving onto my last slide is onto the future. I don’t want to stay doing the same things all the time. And I want to stay active as a scientist. So we have started to think as a group what we might want to do next.

And there is three fun things that you get to think about when you are doing this. Firstly, you start off with a grand list of what are all the science topics that we think are interesting in the light of what we have discovered over the past 5 to 10 years?

And that is what we put in those three bubbles. Dividing them by the kinds of measurements that can help us make a better understanding in each of those science areas.
I have also started a little foray into detector development in the lab. So this is really quite different from anything that I have done before. We are looking at developing new readout for solid state technology. It is a very steep learning curve but it is really a lot of fun.

And on the bottom left is a schematic of a mission concept that uses those detector developments that allow us to address the science that we have in the top three bullets.

If you would ask me, when I started as a grad student would I be a project scientist? I would have said no because I wouldn’t have even known what one was.

If you had asked me when I was a grad student would I ever be satisfied and happy with a job that wasn’t focusing purely on doing science and doing science research and I would have said no.

And I would have been wrong. I think it is very important to be flexible and allow your career ideas change as you learn more. That is what you are good at and what you enjoy doing.

I hope to continue changing on into the future. And while I am not – regrettably not as proactive or at least have not been as proactive as some of the other speakers on the call in promoting outreach towards women and minorities.

It is certainly something that I feel I should and would like to be doing more of and plan to. Thank you.
Jessica Kenney: Thank you so much (Julie) for what you have shared with us today. Do we have any questions for (Julie)?

Man: Hi (Julie) this is (Jeff Nee) with the Museum Alliance. I really, really think that is not true especially with your group and your leadership. I really appreciate how you set an example for your whole team.

And I just had a question specifically about that and this is for the whole panel as a whole. In terms of mentorship for girls. We have been talking about role models a lot.

But like for your student who published that paper on the cover of Science, do you have any specific tips or tricks or trade secrets that you have to share with the rest of us on how we can all be better mentors for girls in STEM?

(Julie): I can’t really. I seem to do okay, but I am not quite sure why. Something that I encouraged in my group is that we work collectively. And I encourage my students to not – I always have an open door. People can come in and talk to me.

But I really like to see my students actively collaborate with other people in the group and with other people in other groups outside Goddard. So at least my approach for working with students is to help to foster their own connections.

And to help to foster their own ability to start new scientific collaborations and to help them figure out how to get to the end of them. To distinguish between what is important and what is not.
Jessica Kenney: Okay we are kind of wrapping up. Do we have any other questions that we have for our panelists today?

Cady Coleman: No I just wanted to – this is Cady. I just wanted to thank (Julie). You know it is interesting I think the self-reflection about what you are good at. What you are not. I mean I do some of that as well.

It is not something I find commonly talked about at work even in a field like mine where we’d better be digging to figure out what we can bring to the team. But also, you know, looking at doing different things as you go on.

It takes courage and I know it is encouraging to me to hear someone say, you know, I am looking at this and I wouldn’t have thought I would have liked it but now I am really interested in this and you are going and trying it even though you are not sure you are going to be good at it, which I am sure you will be.

And so I just think that that courage is really contagious and I appreciate that you expressed it.

Jedidah Isler: Agree. I wanted to chime in and just say (Julie) that part of the reason why I started working with Fermi is because of your work and your workshops and such.

So part of the reason you’re good at it, and maybe you don’t know, is because you are so reflective about it. So that is something that breaks down to you.

The other thing I wanted to point to was your question about sort of overrepresentation given the numbers over the field. There has been some
research that shows that once you have a strong – I am going to use a critical mass word but that is not the research I am talking about.

That you do bring –other people gravitate towards that. So generally, if you have a very strong advisor that is a women who is good at mentoring. She will have more women in her group because it is sort of like a magnetic pull.

So it is not completely random. It is something that happens as you start to build that cluster. And so the question about mentorship. For VanguardSTEM the way that we try to think about is we try to think of it as dynamic mentoring.

So we don’t necessarily team people up permanently. This is the person you go to to get your questions answered. What we try to do is create a space where people can ask their question freely and then the best people can answer that question.

So for example, we had a young woman who is studying for her GRE. She is just having a really hard time with it. And she needed help. And so we reposted her question on our social media and several people came with specific resources.

Oh I did this book. Have you tried this? Look at this? Consider this. And so we feel like it is dynamic mentoring. So it is more empowering the right people to comment at the right time when someone needs help.

Rather than doing like a formalized this is now your paired person and this is who you go to for everything which is actually more aligned with the research.
(Julie): Thanks Jedidah for the comments.

Jessica Kenney: Kim or Cady do you want to give any more feedback?

Kim Arcand: Just to the point of mentorship. The one suggestion I have is that I am a huge fan of both formal and informal mentorship programs. And one thing I always find whether it is a group mentorship or individual starting with personality assessments.

That might sound a little strange or a bit hooey. But that sort of starting with the self-reflection both on the mentors and the mentees in whatever shape the group takes. It is really helpful for setting a tone and also giving that sort of self-direction. So one slightly strange perhaps but specific feedback.

Jessica Kenney: Thank you.

Woman: I have a question. My name is Yvonne and I represent San Diego region. And what I have come across is that just in general the majority of the public don’t realize opportunities and advancements that basic organizations have to offer.

And I have been kind of inspired to start a non-profit to like push that. So I don’t know if there might be any resources maybe any of you could let us know about or anything.

Woman: Sorry I missed your – you said what kind of resources were you looking for?

Woman: I am interested in starting a non-profit to push for more awareness in space education. And I just didn’t know if there was any resources or anyone that
would like to -- because I am very interested in setting up more space events, workshops and mentorships.

And I feel starting a non-profit would allow me to be more into the public. And maybe partnering up with local businesses and such. And that is what the Solar System Ambassador program has kind of inspired me to do that. Because I realize there is not enough awareness in general in the space industry.

Cady Coleman: This is Cady. You know I will say when you say that I go “wow, I don’t know that sounds kind of hard. I don’t know if I would want to do that.” Which sounds pretty not courageous right?

But that is my first reaction. And my first – I am sort of one who likes – I like help and I like company. And I think that there are some organizations that already have a lot of structure or maybe like the AAAS [American Association for the Advancement of Science] or I don’t know that organization as well as probably all of you do.

But that there are organizations with some structure. And yet here you are saying, I would like to make something happen. I would be a little more inclined as opposed to starting a new non-profit, to see what you could do within the structure. You know an organization that could basically, just provide a lot of the things that you don’t want to have to invent on your own.

So you can just demonstrate some concepts. Maybe they grow into something that you have refined some and then you are going off on your own. So basically advocating using the resources of a larger organization before you start alone. But other folks should weigh in.
Woman: Okay thank you.

Jedidah Isler: I agree Cady. That is what I was going to say that it might be good to connect with organizations that are doing things like that. So I think right now the Space Foundation it is certainly not the only one but it has two words that you were talking about so it came to mind.

But yes getting a sense of what is out there so that it will be easier for you to signal boost that. It is probably the best way for you to get the most sort of bang for your buck fastest.

And not that speed is the metric but I am just saying I agree with Cady that there are some things that people can do for you that you can signal boost that is just as important.

Because in some ways if you become the beacon in your community, in your group, in your world, then you are bringing information to people – excuse me who wouldn’t have had otherwise.

Cady Coleman: Even in their ability to help publicize it. Like (Julie) mentioned that you know, she just said, “I am looking for this kind of job” and the next day someone called.

I mean by being part of - doing stuff with another organization where basically, I think, a lot of times, they have ideas but no one to implement them. And so now you are saying, hey I have ideas and I would like to implement.

I just want - I want you to send it out in your newsletter and when it looks interesting things when things are happening. They have a bigger umbrella to
brag about it with you. And so I don’t know. I just think there is some advantage in there.

Jessica Kenney: I really hate to cut this conversation short. There have been a lot of great questions. A lot of good conversations. We do have to come to a close. I wanted to thank Kim and Jedidah and Cady and Julie so much for your time to spend with us today on the Universe of Learning science briefing.

I just wanted to point you guys again to Slide 2 which has some additional resources. And on the last slide, Slide 99, to ensure that we meet the needs of education community, which is you guys.

The NASA Universe of Learning is committed to informing regular evaluations to determine the effectiveness of professional learning opportunities like the science briefings.

If you prefer not to participation in the evaluations you can opt out by contacting Kay. Again thank you guys so much for your time to joining us today and we will go ahead and end the call. Thank you.

(Julie): Thank you.

Kay Ferrari: Thank you very much everyone. This is Kay again. I want to let people know that a week from today on February 9th we will be having an Earth science telecon and it will be about testing new approaches for mapping snow water equivalent. So please join us at that time and thank you all for joining us this afternoon.

Woman: Thanks a lot.
Woman: Thank you.

Man: Thanks everyone for joining us and remember that you can always email questions for the speakers later after the fact. And thanks for everyone who’s listening to the recording. Okay have a great day.