Sidedoor Season 4, Episode 3:
Space Jocks & Moon Rocks

[MUSIC]

Lizzie Peabody: This is Sidedoor, a podcast from the Smithsonian, with support from PRX. I'm Lizzie Peabody.

[MUSIC]

Emily Martin: You haven't touched it yet.

Lizzie Peabody: I'm, I'm letting the anticipation build, Emily.

[LAUGHTER]

Emily Martin: It's time, Lizzie, I think, for you to touch a piece of the moon.

Lizzie Peabody: I'm at the Smithsonian's National Air and Space Museum (NASM) with planetary geologist, Emily Martin. The museum has just closed. Families of tourists are clearing out of the cavernous flight hall, and I'm getting ready to do something I have definitely never done before: touch the moon.

Lizzie Peabody: Okay I'm going to do it.

Emily Martin: Are you ready?

Lizzie Peabody: Yes.

Emily Martin: Okay. She's going in for it with her right hand. She's going to touch it. She's going for it. What's it feel like?

Lizzie Peabody: Wow. It's so smooth.

Emily Martin: It's very smooth.

Lizzie Peabody: It is smooth. But it's also, small! It looks like an arrowhead; a sleek, black, triangular sliver of moon. Not at all like the space potato I'd imagined.

Emily Martin: Did you expect, like, a piece of granite? Like a big chunk of rock?

Lizzie Peabody: I expected it to be more like a pumice stone. I expected it to be like kind of sharp and gravely and grainy. And I expected it to be bigger. At least like a brick-sized piece of rock.

Emily Martin: Rocks are heavy. Heavy things take fuel to get to space and to get home from space. So, they were pretty limited on how many rocks they could bring home.

Lizzie Peabody: This slice of moon rock was cut from a bigger chunk of rock that looked a lot rockier, but the hands of millions of people touching it each year has smoothed it so much, it feels silky under my finger. The rock is displayed in the main flight hall of the museum, and honestly, it would be easy to miss if you didn't know what you were looking for. You have to slide your hand under a thick shelf of glass to touch it, kind of like at the ticket box office. This so to keep people from dancing on it, or licking it. Not that, not that's something anyone would think about doing.

Emily Martin: Don't lick it. Please don't lick it.

Lizzie Peabody: I did not really want to lick it. I just wanted to know if I could lick it.

Emily Martin: Well, I feel like you'd be really hard pressed to come up with some kind of geometry where your face could get close enough to get your tongue on there.

Lizzie Peabody: And Emily says the moon rock has a bunch of security sensors around it, because…

Emily Martin: It's a federal crime to own a piece of the moon.

Lizzie Peabody: Really?

Emily Martin: If you have a meteorite from the moon… fair game. But a rock brought home from the Apollo missions… federal crime. Hundreds of billions of dollars in today's money was spent getting people to the moon. So, these rocks belong to everybody, which is why this is here so that everybody can touch it and sort of share in that. But that's also why it's very small because those samples are really scientifically valuable and really hard to replace. Well, impossible to replace right now.

Lizzie Peabody: It's definitely different than I expected, but there is something really other-worldly about putting your finger on something that existed for the majority of its life, orbiting us, in space. And now, it's been here since, what the 70s?

Emily Martin: Sure. So, this rock was put here in the 70s when the museum opened in 1976. So, it was brought home from Apollo 17, which was, um, in 1972. So, we're not necessarily celebrating the 50th anniversary of this particular rock this year, but we are celebrating the 50th anniversary of humans bringing rocks home from the moon.

[SFX]

Lizzie Peabody: The 50th anniversary of humans bringing rocks home from the moon; it's easy to tell that Emily is a geologist. Most people would say, it's the 50th anniversary of putting men on the moon. And "Hey, look at that cool rock" may not have been the first thing Neil Armstrong thought about as he stepped out of the lunar lander on July 20, 1969, but he and Buzz Aldrin actually spent a good portion of their time on the moon collecting rocks.

[SFX]

Lizzie Peabody: So, this time on Sidedoor, I sit down with our friends at AirSpace, the podcast from the Smithsonian's National Air and Space Museum, to talk about the part of the moon landing that you may not have heard about: what astronauts did once they got there. Because there's a lot we didn't know about the moon just 50 years ago, from space germs to moon dirt. And while getting astronauts to the moon is one thing, convincing them to care about rocks was trickier than you might think.

[MUSIC]

Lizzie Peabody: Emily Martin is not just a great moon-tour guide. She's also a planetary geologist, and one of the hosts of AirSpace, the National Air and Space Museum's podcast. And I got to sit down with her and fellow-host, Nick Partridge, to talk about their most recent episode called, "Walking on the Moon." It's part one of a two-part series on lunar science: what we didn't know about the moon, when we sent people there in 1969, and what we still don't know today.

Lizzie Peabody: So, a lot of people are talking about Apollo 11 and it's because this year is the 50th anniversary of that lunar landing. Um, and before I listened to your episode, here's what I knew about Apollo 11. We put a man on the moon and we did it to beat the Russians. And once Neil Armstrong stepped out of the lunar lander, we essentially had won the space race. I did not know that there was science going on up there. Of course, now that I think about it, it makes sense because if you're going to go to the trouble and the expense to send humans to the moon, you want them to find something out. It would be, that's like finally meeting Santa Claus, taking a selfie and then just going home without asking any questions first. Right?

[LAUGHTER]

Nick Partridge: Valid. That's valid.

[LAUGHTER]

Nick Partridge: Yes.

Emily Martin: I love that analogy.

Nick Partridge: So, it was unthinkable in that way. But, it's not uncommon for science to follow geopolitical goals and exploration in the name of exploration.

Lizzie Peabody: Here’s a clip from the show that really sets up that geopolitical motivation.

Nick Partridge: I'm gonna paraphrase Mike Collins, who was a command module pilot on Apollo 11 and first director of the museum. You may have heard us mention him before. He said that the elegance of Kennedy's challenge was it’s simplicity.

President John F. Kennedy’s Previous Recording: We choose to go to the moon in this decade and do the other things. Not because they are easy, but because they are hard. Because that goal will serve to organize and measure the best of our energies and skills because that challenge is one that we’re willing to accept, one that we are unwilling to postpone and one we intend to win and the others too.

[APPLAUSE]

Nick Partridge: Where? Moon. What? Land. When? End of decade. So, it was a very clear mandate.

Dr. Farouk El-Baz: Our mandate said, “Get a man to the moon and bring him safely to the Earth.” It did not say, “Bring back some dirt.”

[MUSIC]

Lizzie Peabody: I love that quote. Okay, so who is this guy?

Nick Partridge: Farouk El-Baz, Dr. Farouk El-Baz…

Emily Martin: Dr. Farouk El-Baz.

Nick Partridge: …was the founder of the Center for Earth and Planetary Studies.

Emily Martin: Correct.

Nick Partridge: …which is the science unit within the Smithsonian's National Air and Space Museum.

Emily Martin That is also true.

Nick Partridge: And previous to that, he was a geologist on the Apollo program.

Emily Martin: Yes. He really helped kind of revolutionize this field of photo geology, essentially doing geology from photographs that you take from some kind of satellite or airplane or whatever the case may be.

Lizzie Peabody: …which was really the only way to do geology on a planetary body.

Emily Martin: Exactly.

Lizzie Peabody: Before Apollo 11.

Emily Martin: Right. And so, he had spent so much time studying the moon that he became a really valuable asset to NASA and the Apollo program. It wasn't just the science, it was also the cartography because you need to be able to navigate yourself on the surface of the moon. When the astronauts land, they have to be able to say where they are, where they're located on the surface of the moon. How do you know where you are?

Lizzie Peabody: Ohhh.

Emily Martin: That was a really critical part of what studying the moon before Apollo was about, once we had the directive to go put people on the moon. And he's just a cool human.

Lizzie Peabody: Yeah. What's he like?

Nick Partridge: He's funny.

Emily Martin: He's not a stuffed shirt. He's got a really big personality. He's really fun.

Nick Partridge: Well, I started my Instagram account just to post a picture of me with Dr. El-Baz.

Lizzie Peabody: So, so, what was Dr. El-Baz's role in the Apollo mission?

Nick Partridge: The popular understanding of a lot of the work that he did was about training the astronauts. And these are test pilots. So, the idea that you should make room for a geology class, uh, was not automatically a priority for all of the astronauts and his, colorful way of expressing, uh, ideas may have helped get through to these, uh, honestly, fighter jocks.

Lizzie Peabody: So, there's this great part of the episode where Dr. El-Baz talks about the difficulty of getting astronauts to care about geology. You'll also hear the voice of Matt Shindell, fellow AirSpace host, and curator of space history at the museum. Here's that clip.

Emily Martin: So, training astronauts to care about lunar science really meant that scientists had their work cut out for them because they were training a bunch of test pilots to care about rocks. And Dr. El-Baz described what it was like training these early astronauts.

Dr. Farouk El-Baz: The first one that I talked to just told me straight out in my face that I don't want to touch a geologist with a 10-foot pole. They didn't give a damn about geology. And so, I knew, (laughs) so I knew that I had to talk their language. I had to convey things to them to become better at their flying machine.

Matt Shindell: Farouk El-Baz and the other scientists really had to fight NASA to schedule time with the astronauts for study. The entire program was rushing. It was sprinting to try to get to the moon as quickly as possible. And any time spent on geology and the other sciences was, you know, it was a struggle to secure it.

Nick Partridge: Dr. El-Baz said, everything changed when he was approached by astronaut Stu Roosa, uh, and asked whether he was the guy that taught Ken Mattingly everything he knew about lunar geology.

Emily Martin: Gary Sinise in the movie.

Nick Partridge: Right.

Emily Martin: Ken Mattingly, maybe best known as the astronaut who didn't fly with Apollo 13. But he did eventually fly to the moon on Apollo 16.

Matt Shindell: Right.

Nick Partridge: So, Dr. El-Baz said that he could help Roosa be just as smart. And Roosa said this in response, “Hell no. I want you to make me smarter than Ken! My name is Stu Roosa and I’m going to be the Apollo 14 command module pilot. And I want you to start my training henceforth. At that moment, I thought, oh my God, that they, they got it. They are going to begin to compete because there are very competitive people exceedingly competitive with each other. And from now on, we don’t have to push them. They will push for science time and training time.”

Matt Shindell: So famously and the, uh, Mercury and Gemini programs, those astronauts were incredibly competitive.

Nick Partridge: Hmm, mm.

Matt Shindell: Not, not just in flying and, and not just in their rankings within the astronaut program, but around Kennedy Space Center, they were racing cars with each other. They were trying to out drink each other. They were just basically competing with each other in every way they could possibly imagine.

[MUSIC]

Lizzie Peabody: So, did it work?

Emily Martin: Yeah, I think it worked. Because you can hear, if you get really nerdy about Apollo, you can go listen to pretty much all the tape ever that they ever took of the astronauts on the surface of the moon. But if you actually listen to them talking about what it's like walking on the moon, what they're seeing and observing because their voice is being recorded, those are in fact their field notes.

Lizzie Peabody: I hadn't thought about that, that you cannot be taking notes, while wearing a spacesuit. So, your notes are all vocal notes.

Emily Martin: Yeah. And they have to commit some energy into kind of saying, “Oh, that's a crack on the surface. Well, is it a crack? Is it a fault? Is it a trough? Is it, is it pointing up? Is it sticking down?” I mean those are the kinds of observations that are really important to make. So, kind of arming the astronauts with sort of your standard geologic field toolkit, um, is really important. So, that when you hand this information back to the geologists on earth, they could actually say something about the context of each sample that was returned.

[MUSIC]

Lizzie Peabody: So, we did it. We got our astronauts, armed with some knowledge of geology to the moon! They collected rocks, but that’s not all. More on that, after the break.

[MUSIC]

Lizzie Peabody: We’re back. This week we’re talking with Emily Martin and Nick Partridge, two of the hosts of the AirSpace podcast from the Smithsonian’s National Air and Space Museum. This year is the 50th anniversary of the Apollo 11 mission, but there’s more to that mission than the words we all know so well.

Moon Landing Recording: “That’s one small step for man, one giant leap for mankind.”

Lizzie Peabody: Today we’re talking about what happened after that small step, which was a lot of rock collecting, and some science experiments. In 1969, there was still a lot we didn’t know about the Earth’s largest satellite. Here’s Nick and Emily, on the Airspace podcast, talking about exactly what we didn’t know.

Nick Partridge: What were the fundamental questions that they were hoping to answer? What were they exploring? What, if you were a lunar geologist in 1961, did you hope people didn't ask you in bars because you didn't know the answer?

Emily Martin: I think your question kind of gets at this really great quote from Carl Sagan because nobody had ever been to the moon. So, how do you know what kinds of questions you should ask?

Carl Sagan: Astronomers worry about two very large questions. How does the universe work and where did it come from?

Nick Partridge: So, where did the moon come from? What did we think then?

Emily Martin: That's, I mean, that's, that's…

Nick Partridge: That's the question.

Emily Martin: That's the question, right? And there's the three different places it could have come from are the places that planetary bodies come from. One, they formed out of the original massive gas and dust and junk that everything in the solar system formed out of.

[LAUGHTER]

Nick Partridge: Junk.

Emily Martin: And the moon formed, as we say, in situ around the Earth and that the Earth and the moon just formed a separate bodies in their own little gravity bits.

Nick Partridge: Proto planetary medium.

Matt Shindell: Yeah.

Emily Martin: Sure. You could call it that.

Matt Shindell: Sure.

Emily Martin: The other place could be that, um, the moon was a captured object. So, Mars has two moons, Phobos and Deimos. They are asteroids. They're very potato-ey shaped. They were captured by Mars.

Matt Shindell: Hmm.

Emily Martin: And then the third is, um, some kind of catastrophic event.

Nick Partridge: Meaning what?

Emily Martin: Meaning some kind of large impact event where something really big, maybe the size of Mars, hit the Earth and all of that debris that got created eventually formed the moon.

Nick Partridge: Came out of the dust. Captured out of space.

Emily Martin: Sure.

Nick Partridge: Giant impact.

Emily Martin: Yeah.

Nick Partridge: Question. If fighter pilots are the jocks of the aviation world, were we just going to send jocks for rocks? And then, what did we hope to learn from them when they came home?

[MUSIC]

Lizzie Peabody: What about the Apollo 11 mission got us closer to figuring out how the moon was formed?

Emily Martin: Bottom line, if you have a sample of one thing and a sample of another thing and they have similar compositions, they may not be all that different. Or, they may not have come from all that different of a origin.

Lizzie Peabody: So, if you have a sample of a moon rock…

Emily Martin: Right.

Lizzie Peabody: And a sample of an Earth rock.

Emily Martin: Right.

Lizzie Peabody: You can compare them.

Emily Martin: You can compare them. Exactly. And if they're wildly different than maybe they're not related to one another.

Lizzie Peabody: Hmm.

Emily Martin: Um, if they're pretty similar than maybe they are. Um, and the short answer was they're pretty similar. So, somehow, their origin story is tied.

Lizzie Peabody: So, the moon rocks brought us valuable clues about the origin of the moon. But there were other questions to be answered! Like what would happen to Neil Armstrong's foot when he stepped off the lander? And what about those moon germs? In this next clip, the AirSpace crew tackles all of that. And a few science experiments to boot! Here's Emily.

Emily Martin: One of my favorite thought experiments about what people were concerned about when the Apollo astronauts landed was that they didn't know what the nature of the lunar regolith or the soil or dusty stuff at the top of the surface moon.

Nick Partridge: Moon dirt!

Emily Martin: Moon dirt! They didn't know what that was going to be like. And they were actually kind of worried. There was a couple of holdouts. People were really concerned that when Apollo landed and especially when the astronauts got out, that there was so much of this fluffy moon dirt that rather than sort of like stepping down off of the lander and being able to walk on the surface, they would just sort of *schllp* into the lightening sand in the fire swamp.

Nick Partridge: Sink down immediately.

Matt Shindell: And that's why the landers feet are actually larger than they really need to be. They were trying to be very cautious and that's also why the first step that Neil Armstrong takes when he gets off that ladder is not onto the lunar soil, but onto the foot pad.

Emily Martin: That sort of shaped like a big dinner plate.

Matt Shindell: Yeah.

Nick Partridge: So, doesn't he, doesn't he describe like how far down the foot pad?

Emily Martin: He does. If you listen past his famous first words, when he stepped out onto the surface of the moon, he actually starts getting into a description of that sort of lunar dirt.

Moon Landing Recording: "One giant leap for mankind. And the, the surface is fine and powdery. I can, I can pick it up loosely with my toe. It does adhere in fine layers, like a powdered charcoal to the sole and sides of my boots. I only go in a small fraction of an inch, maybe an eighth of an inch, but I can see the footprints of my boots and the treads in the fine, sandy particles."

Nick Partridge: Besides checking to see whether or not we were all going to sink into the moon dirt, what other science experiments were done on the lunar surface?

Emily Martin: There was a passive seismic experiment. You know, we use seismometers here on Earth to help us detect earthquakes. Um, but they also tell us about things like the structure of the interior of our Earth. Like we have a metal iron metal core in the center of our Earth, and we have this liquid outer core, which is why we have magnetic field, which protects us from all the sun's stuff.

[LAUGHTER]

Emily Martin: However, we don't know that about the interior of the moon because that was, that's still a really hard thing to do. So, they put seismometers on the surface of the moon, hoping that they could start to get a sense of how the interior of the moon was structured.

Nick Partridge: And did they?

Emily Martin: Yeah, actually they did. Um, they were able to find out that the moon has a core. That's not, I mean, we take that for granted here on Earth, but that's not a trivial conclusion.

Nick Partridge: Not a foregone conclusion.

Matt Shindell: No.

Nick Partridge: There's no magnetic field or anything.

Emily Martin: You can’t just slice it open.

Nick Partridge: Right. And you can’t see evidence of a core from here.

Emily Martin: Right. Exactly.

Nick Partridge: Right.

Emily Martin: And then, the last one I really want to talk about is one that still kind of, we still use it today. Um, they put essentially giant mirrors on the surface of the moon and from Earth, we shoot lasers.

Nick Partridge: **“**Pew, Pew, Pew, Pew. Zap!”

Emily Martin: The lasers reflect back to us and we can actually measure how far away the moon is very precisely from Earth. What's really cool about that, as we found out, that the moon is moving away from us.

Nick Partridge: Oh no!

Emily Martin: Oh no!

Nick Partridge: It doesn’t like us.

Matt Shindell: Very slowly.

Emily Martin: Right. It is very slowly, but so, that’s not all the experiments that they put on the surface of the moon. They did a lot more stuff there. But in addition to doing all of that, they brought back a bunch of rocks in boxes. Box of rocks.

Nick Partridge: Here's a bonus. We got you a box of rocks.

Emily Martin: Yeah.

[LAUGHTER]

Emily Martin: Hey, for geologists, that's a win!

Nick Partridge: So, what did Neil and Buzz bring back? If we had never gone back on subsequent Apollo missions, what lunar material would we have from their four hands on the moon? What’d they grab?

Matt Shindell: They grabbed about 44 pounds worth of rocks, 20 kilograms in scientific speak.

Nick Partridge: Hmm, mmm.

Emily Martin: But to put that into context, Neil Armstrong was out on the surface of the moon for about two and a half hours.

Nick Partridge: Hmm, mmm.

Emily Martin: Buzz Aldrin was on the surface of the moon for two hours. So, in four and a half hours of human work hours, they deployed at least, if not more, than five scientific experiments

Matt Shindell: Hmm, mmm.

Emily Martin: and collected 44 pounds of rocks.

Matt Shindell: And took a ton of great photography.

Emily Martin: And took an enormous number of photos. Here's some tape of Buzz and Neil hard at work.

Moon Landing Recording with Neil Armstrong and Buzz Aldrin: “But here and there where I plug with the contingency sample collector, I run into a very hard surface, but it appears to be very cohesive material of the same sort. I’ll try to get a rock in here. Just a couple.”

Matt Shindell: In exchange for all those moon rocks. We left 413,000 pounds of hardware on the moon.

Emily Martin: That's a lot. That's a lot!

Nick Partridge: That is a lot. What else did we find out that was wrong? What were the theories, before we went to the moon, that didn’t pan out? Not made of cheese?

Emily Martin: There was a really big concern that astronauts were going to bring home some kind of foreign contaminant of a biological nature… space germs, if you will. There is an airstream trailer that was retrofitted to be a quarantine for astronauts when they came home to make sure that they didn't bring home any kind of additional airborne space germ or something.

Matt Shindell: Yeah.

Nick Partridge: Which is why when you see the photo of Nixon congratulating the crew of Apollo 11, they're all crowded around the window of an airstream trailer and he's standing outside kind of leaning over them, awkwardly… water-gate-ingly.

Matt Shindell: Nixon style.

Emily Martin: Dr. El-Baz really fought hard. Um, of course the Apollo missions were paid for from the federal budget, from taxpayer dollars. And he felt like it was really important that we

had an opportunity to kind of connect with those missions in a really special way. And having a piece of the moon that we could actually touch, was something that he felt really strongly about.

Dr. El-Baz: “If we tell you with pictures and we tell you all kinds of things, it will not last with you. But if you touch it, it will remain with you, forever. So, I thought, God *Bleep*, we should have a piece of the moon for all visitors at the National Air and Space Museum to touch.”

Emily Martin: And we have it here and it’s great. And every time I walk by it, I stand in line.

Nick Partridge: You want to talk about moon germs?

[LAUGHTER]

Nick Partridge: How many millions of people a year touch that rock?

Matt Shindell: That’s the germiest rock ever.

[MUSIC]

Lizzie Peabody: Yeah. I feel like I need to go wash my hands now.

Nick Partridge: You should, but we all should, like, all the time.

[LAUGHTER]

Lizzie Peabody: Okay. So, earlier in the episode, you asked a question that we didn't quite come back to, which was how, how was the moon formed? Do we know? What is the answer?

Emily Martin: There is and there isn’t an answer. The short answer is we're pretty sure the moon formed because of a large impact with a Mars sized object with the Earth. But the details of how that all worked out, that's really still where the science is happening still.

[MUSIC]

Lizzie Peabody: Thanks so much to Emily Martin and Nick Partridge for joining me in the studio to talk lunar science.

[MUSIC]

Lizzie Peabody: And that science that Emily mentioned, the science on the lunar horizon is the subject of part two of AirSpace’s series, out July 11th. You can find a link to it in our episode description, or by searching for “Airspace.” That’s all one word, wherever you get your podcasts. AirSpace is produced by the Smithsonian’s National Air and Space Museum, just around the corner from us here at Sidedoor.

[MUSIC]

Lizzie Peabody: You've been listening to Sidedoor, a podcast from the Smithsonian with support from PRX. If you want to see photos of me, and the moon rock, you can find them in our newsletter. We'll also include a link to that photo of Nick and Dr. El-Baz. Subscribe at si.edu/Sidedoor. That's si.edu/Sidedoor.

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Lizzie Peabody: Sidedoor is made possible with help from listeners like you. Your generous support helps make all the amazing work you hear about at the Smithsonian possible.

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Lizzie Peabody: Our podcast team is Justin O'Neill, Jason Orfanon, Michelle Harven, Caitlin Shaffer, Jess Sadeq and Lara Koch. Episode artwork is by Greg Fisk. Extra support comes from John Barth and Genevieve Sponsler. Our show is mixed by Tarek Fouda. Our theme song and other episode music are by Breakmaster Cylinder.

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Lizzie Peabody: If you want to sponsor our show, please email sponsorship at prx.org. I'm your host, Lizzie Peabody. Thanks for listening!

[MUSIC]

Lizzie Peabody: All right. Now I have a quick list of questions that Justin wanted me to ask you.

Nick Partridge: Hmm, mm.

Lizzie Peabody: Does the moon have volcanoes?

Emily Martin: Yes.

Lizzie Peabody: Does the moon have lava?

Emily Martin: Yes.

Lizzie Peabody: Does the moon have water?

Emily Martin: Technically, ice.

Lizzie Peabody: Does the moon have cheese?

Emily Martin: Unfortunately, no cheese.

Nick Partridge: Only when astronauts are there and only if they bring it.

Emily Martin: Yeah.

Lizzie Peabody: If the moon did have cheese, what type of cheese would it be?

Emily Martin: Jarlsberg

Nick Partridge: Sharp Cheddar.

Lizzie Peabody: Gouda.

Emily Martin: Gouda. All right.

Nick Partridge: All right. Yeah, yeah, yeah.

Emily Martin: I'll give it to you.

[MUSIC]