Episode Book

EPISODE #5717

What It Takes to Land on the Moon Again

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SYNOPSIS

Humans orbited the Moon again in 2026 for the first time since Apollo — but nobody has walked on it since 1972. NASA's Artemis IV, targeted for early 2028, is supposed to change that, and the preparation required is a different category of problem entirely. This episode breaks down what a landing actually demands: rendezvous and docking between Orion and a lander in lunar orbit, human-rating two competing landers (SpaceX's Starship HLS and Blue Origin's Blue Moon), surface operations at the lunar South Pole, and the physical training astronauts are going through right now. It also covers the architecture shuffle that turned Artemis III into a low-Earth-orbit rehearsal, the cancellation of Gateway, and why the lander — not the rocket — is the real critical path.

TRANSCRIPT



Corn

April eleventh, nineteen seventy-two. That's the last time a human being stood on the surface of another world. Gene Cernan, Harrison Schmitt, the Taurus-Littrow valley, and then nothing. Fifty-four years of nothing.



Herman

And Daniel's noticed something interesting about where we are right now, which is that the milestone people have been waiting for has already half-happened.



Corn

Right. Here's what Daniel sent in this week. He points out that humans were in lunar orbit again for the first time since Apollo, which is true, that already happened, Artemis II flew this year. But the last time anybody actually walked on the Moon was Apollo 17 in 1972, and NASA's plan to change that is Artemis IV, targeted for early 2028. So he's asking four things. What do we actually know about the current preparations for that mission. What other tentative plans are in the works for putting humans on the Moon. How much more preparation a landing requires specifically compared to the earlier Artemis missions that only brought people close to the Moon without touching down. And then the human side, what physical preparation the astronauts themselves are going through.



Herman

It's a good framing because it separates two things people mash together. Being near the Moon and being on it.



Corn

And the gap between those two is the whole episode.



Herman

It is. Artemis II was a flyby. It was Apollo 8 with better cameras. Artemis IV is a landing, and a landing is a completely different class of mission with a completely different set of failure modes.



Corn

So let's start with what actually happened this year, because the premise needs correcting.



Herman

Artemis II launched April first, twenty twenty-six, from Kennedy Space Center. Nine days, one hour, roughly. Splashdown April eleventh in the Pacific southwest of San Diego. Crew was Reid Wiseman as commander, Victor Glover as pilot, Christina Koch, and Jeremy Hansen from the Canadian Space Agency.



Corn

And they went further from Earth than any human beings in history.



Herman

Further than Apollo 13, which had held the record since 1970. Artemis II hit two hundred fifty-two thousand seven hundred fifty-six miles from Earth. Apollo 13's record was two hundred forty-eight thousand six hundred fifty-five. They broke it by about four thousand miles.



Corn

On a free-return trajectory.



Herman

That's the important part. They went around the far side, closest approach was about four thousand sixty-seven miles above the surface on April sixth, and then the spacecraft came home essentially on its own momentum. No big propulsion burn required to get back.



Corn

Which is Apollo 8. You point the thing at the Moon, you let gravity do the work, you come home.



Herman

So what did it prove? It proved Orion's life support works for a crewed deep-space duration. It proved the navigation, the manual handling qualities, the crew operations. It proved reentry at lunar-return velocity, which is around twenty-four thousand six hundred sixty-four miles per hour. That's the number that matters, because coming back from the Moon you're hitting the atmosphere at roughly eleven kilometers per second.



Corn

And what did it not prove?



Herman

Almost everything that makes a landing a landing. It didn't prove rendezvous and docking with another spacecraft. It didn't prove crew transfer between vehicles. It didn't prove descent to a surface, or ascent from one. It didn't prove a surface EVA. It didn't prove surface science operations. The flyby tested the capsule. The landing tests the entire architecture.



Corn

So walk me through the first thing that changes. Rendezvous and docking.



Herman

Right. Artemis IV launches four astronauts on SLS and Orion to lunar orbit. But Orion doesn't land. A lander has to already be there, or arrive separately, and Orion has to meet it, dock with it, the crew transfers over, two of them go down to the surface, spend about a week, come back up, redock with Orion, and then everybody comes home.



Corn

And Orion has never docked with a lander.



Herman

Orion has never docked with anything in lunar orbit. It docked with the ISS in low Earth orbit during Artemis I testing, but that's a different regime entirely. This is why Artemis III exists.



Corn

Which is the mission that got demoted.



Herman

And this is the architecture shuffle from February and March of this year, which is the thing that reframes everything. On February twenty-seventh, NASA announced that Artemis III is no longer a landing. It's now a crewed low-Earth-orbit demonstration mission, targeted for mid to late 2027. They call it a risk-reduction mission. Artemis IV becomes the first landing.



Corn

And the Gateway got cancelled.



Herman

Gateway got cancelled in March. Which is a big deal because for years the plan was a small station in lunar orbit that would serve as a staging point. That's gone. And they're standardizing the SLS configuration, abandoning the Exploration Upper Stage and the second mobile launcher, both of which had been slipping for years.



Corn

So what does Artemis III actually do?



Herman

It's the choreography rehearsal. Three separate launches. Blue Origin's lander test article goes up first, and it can loiter in orbit for up to thirty days. Then Orion and SLS with the crew, four astronauts, Randy Bresnik commanding, Luca Parmitano from ESA as pilot,



Herman (continued)

Frank Rubio and Andre Douglas as mission specialists. Then a third launch with a SpaceX Starship V3 test article.



Corn

And the crew docks with both.



Herman

Orion acts as the chaser. It docks along the side of Blue Moon first. The crew puts on the orange Orion crew survival suits, they ingress into the Blue Moon test article, because Blue Moon has a functioning life-support system and a real crew cabin. They spend time in there. Then they undock and go dock nose-to-nose with the Starship test article.



Corn

And they don't go inside Starship.



Herman

They don't. Starship's test article doesn't have operational life support. So they stay aboard Orion for that half. The point is to rehearse the choreography, the approach, the docking mechanics, the hatch interfaces, the procedures, with two different vehicles from two different companies.



Corn

Jeremy Parsons at NASA called it a highly choreographed dance. Which is either an honest description or the most polite way anyone has ever described a mission where the entire point is that we've never done this before.



Herman

It's one of the most complex things NASA has attempted, and they're attempting it specifically so that the landing mission doesn't have to do it for the first time.



Corn

Alright, so that's the docking problem. What's the second thing?



Herman

The lander itself. And this is the single biggest unproven element of the entire program. Neither Starship HLS nor Blue Moon has completed NASA's human-rating certification. Not close, in the sense that the certification process is still running.



Corn

And which one flies on Artemis IV is still open.



Herman

Still open. It depends on the Artemis III test results in 2027 and each company's readiness. Eric Berger at Ars Technica framed it as, NASA shuffled its rockets, but what about the landers. That's the real question. The rocket schedule can be reorganized on a whiteboard. The lander has to actually work.



Corn

This is the critical path.



Herman

It is the critical path. Everything else is downstream of it. You can move Artemis IV to early 2028 on paper, but if neither lander is human-rated by then, it doesn't matter what the paper says.



Corn

So that's the hardware question. Let me ask about the third difference, which is what actually happens on the surface.



Herman

Surface operations. Descent to a planetary surface and ascent from one. That's the thing nobody in the Artemis program has done yet, and nobody has done it since Apollo. And the lunar South Pole is not the Sea of Tranquility.



Corn

Explain that.



Herman

The South Pole has extreme lighting conditions. The Sun is very low on the horizon, so you get long shadows, and there are permanently shadowed regions where sunlight hasn't hit in billions of years. The thermal environment is brutal, swinging from very hot to extremely cold depending on whether you're in sun or shadow. And the terrain is largely unknown at the level of detail you'd want for picking a landing spot.



Corn

And NASA has identified candidate sites.



Herman

Nine candidate landing regions near the South Pole, each with multiple potential landing sites within them. They haven't picked one. That's still an open decision.



Corn

What about the suit?



Herman

The Axiom Space AxEMU. It's a different beast from the Apollo suits. The way Axiom describes it, it's essentially a one-person spacecraft. It has to protect against the thermal environment, the radiation, the dust, the vacuum. Artemis astronauts did not wear it for the flyby. It's being built, tested, and qualified in parallel with everything else.



Corn

And the surface science.



Herman

Field geology, sample collection and return, deployed instruments. NASA has completed an astronaut-deployed science instrument for the lunar surface, called LEMSA. And there's a whole category of supporting work that doesn't show up in the mission plan. Plume-surface interaction tests began in August, studying how lander exhaust interacts with lunar regolith. That matters because you're landing near other hardware, or near sites you want to preserve, and the exhaust plume kicks up dust at high velocity.



Corn

So that's three things. Docking, lander, surface ops. What else is on the technical prep list?



Herman

The mission hardware itself. Artemis IV uses Orion CM-005 and ESM-4, the European Service Module, which was delivered from Airbus in Bremen in December twenty twenty-five. And it's the final mission to launch with the Interim Cryogenic Propulsion Stage. After that, there's a new second stage coming.



Corn

And there's Starship work happening. Wind tunnel tests in July.



Herman

NASA and SpaceX wind tunnel tests in July. Human Lander Challenge 2027 opened in September for lunar communications concepts. Blue Origin has Blue Moon Pathfinder missions planned for 2027. There's a huge amount of parallel work that's all feeding into the same critical path.



Corn

Alright. So that's the technical architecture. Let me push on the comparison Daniel's asking about, because I think it's the sharpest part of his question. How much more preparation does a landing require than a flyby.



Herman

Not twice as much. Not three times as much. It's a different category of preparation.



Corn

Meaning what, concretely?



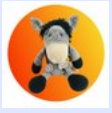
Herman

Meaning the flyby tested the capsule against the environment. The landing tests the capsule, a lander, a docking interface, a transfer procedure, an EVA suit, surface operations, ascent, and redocking, all against the environment, all at the same time. Each one of those is a new thing that could fail. With the flyby you had one vehicle and one set of procedures. With the landing you have two vehicles, four crew, two companies providing hardware, and a surface stay.



Corn

And the failure pattern multiply.



Herman

The failure pattern multiply, and the failure pattern are not independent. If the lander has a problem reaching orbit, the crew is stuck in Orion with no way down. If the suit fails on the surface, you can't extend the EVA. If the ascent engine doesn't light, you're not coming home. With the flyby, honestly, the biggest failure pattern was the heat shield, and everything else was a tested system.



Corn

Which brings us to the heat shield, and I want to talk about that because it's the thing that pushed Artemis II by two years.



Herman

Artemis I flew in 2022 and the heat shield charred in a way the engineers didn't expect. It didn't fail, but it lost more material than the models predicted, and it came off in a pattern that nobody could immediately explain.



Corn

And the review report was heavily redacted.



Herman

Heavily redacted, which drew criticism from former engineers and astronauts who argued that if the public is being asked to trust the program, the public should be able to see the analysis. That's a fair critique. Artemis III flies an upgraded heat shield. Artemis II flew with fixes applied.



Corn

So the schedule pressure is real.



Herman

The schedule pressure is intense. Artemis II slipped from 2024 to September 2025 to February 2026 to April 2026. That's four target dates. It slipped for heat shield concerns, life-support issues, hydrogen leaks, helium leaks, weather. Every one of those is a real engineering problem, not bureaucratic foot-dragging.



Corn

And the same pressure is now on Artemis IV.



Herman

It's on Artemis IV, and Artemis IV has more moving parts. Which is why I would take a bet against an early 2028 launch and a bet on late 2028. But I'd be happy to be wrong.



Corn

Let's talk budget, because that's the other thing under pressure.



Herman

The fiscal year 2026 budget proposed ending SLS and Orion after Artemis III, citing roughly four billion dollars per launch. That's the number that gets thrown around. Then the One Big Beautiful Bill Act in July of twenty twenty-five funded SLS and Orion through Artemis IV and V. So the program survived, but the argument isn't over.



Corn

And the argument is going to come back.



Herman

It'll come back every budget cycle. Because the fundamental question is whether the cost of flying SLS is justified when private launch is cheaper, and the answer NASA is giving right now is that SLS is the only vehicle currently certified to carry crew to lunar orbit. Which is true, and will remain true until Starship is certified for crew, at which point the argument becomes much harder to make.



Corn

So the hardware side is one story. Let's shift to the humans, because that's the second half of Daniel's question and honestly the part I find more interesting.



Herman

The human preparation side. This is where the research gets specific.



Corn

Start with the suits.



Herman

Axiom Space stated in June that suit testing is ongoing regularly at the Neutral Buoyancy Lab in Houston. The NBL is a giant pool. It's where astronauts have trained for spacewalks since the shuttle era, because neutral buoyancy in water approximates the sensation of weightlessness. You put an astronaut in a suit, you sink them in the pool, and they practice the EVA.



Corn

But lunar gravity isn't weightlessness.



Herman

No, and that's the limitation. The Moon is one-sixth Earth gravity. You can't simulate that in a pool. You can approximate the resistance and the movement range, and you can rehearse the procedures, but the actual physical sensation of walking on the lunar surface in a suit is something that has to be practiced in a different way, or learned on site.



Corn

Which is not ideal.



Herman

It's the best we've got. Or rather, it's the best anybody's got. The Apollo astronauts did the same thing. They trained in the pool, and then they got to the Moon and found out what it actually felt like.



Corn

What about the suit itself?



Herman

The pressure garment, the layer worn under the outer suit, is fully assembled and undergoing testing. The primary life-support system components are in hand and being integrated. The suit will fly to the ISS for checkout in 2027, and there will be hardware interface checkouts on at least one lander during Artemis III.



Corn

So they're testing the suit on a lander test article before they test it on the Moon.



Herman

That's the whole philosophy of Artemis III. Everything that can be rehearsed in low Earth orbit or in a pool gets rehearsed there first.



Corn

What about Orion training?



Herman

Orion mock-up training. The Artemis II crew did Post-Insertion and Deorbit Preparation training in January twenty twenty-five. That's the unglamorous procedural work, the stuff that builds muscle memory for launch, rendezvous procedures, and reentry. You run it again and again until the checklist is internal.



Corn

And the medical side. Daniel asked about physical preparation.



Herman

There's the ARCHeR payload, Artemis Research for Crew Health and Readiness. Crew wore movement and sleep monitors before, during, and after the flight. And there's AVATAR, A Virtual Astronaut Tissue Analog Response, which is a set of tissue analogs designed to mimic astronaut organs, and it was tested beyond the Van Allen belt for the first time.



Corn

Meaning they wanted to see what deep-space radiation does to human tissue analogs.



Herman

Because you can't put a human in the Van Allen belt and then take a biopsy. So you put a tissue analog there and see what happens, and use that to estimate the radiation dose and the biological effect.



Corn

After they got back?



Herman

Post-flight readaptation testing. Functional assessments, obstacle courses, a simulated spacewalk. All of it to evaluate how the crew readapted to Earth gravity. And NASA framed it explicitly as preparation for future lunar and Mars operations, which is telling.



Corn

Telling how?



Herman

Telling that they're already thinking beyond the Moon. The point of Artemis IV isn't to plant a flag and come home. The point is to establish a presence.



Corn

Let's zoom out. Where does that leave us on the program-level tensions?



Herman

Four big ones. Schedule, lander certification, heat shield, budget. And one more, which is public appetite.



Corn

The Moon joy thing.



Herman

Artemis II generated a cultural phenomenon. The crew photographed a solar eclipse from lunar vicinity. They took the first human-taken photos of the full Earth disk since Apollo. Glover became the first person of color to travel around the Moon. Koch became the first woman. Wiseman became the oldest person to do it. Hansen became the first non-American. And the public reaction was warm.



Corn

Because you'd think fifty-four years of absence would make people indifferent.



Herman

It didn't. There's something about the Earth seen from far away that still works on people. The photos hit.



Corn

Let me ask the harder question. Fifty-four years since Cernan and Schmitt left the surface. If Artemis IV launches in 2028, that's fifty-six years. Why now, and why not in 2005, or 2015, or any of the years when the technology was available?



Herman

Money and politics, mostly. The Apollo program ended because the geopolitical reason for it ended. Once the Soviet Union stopped being a competitor in crewed lunar flight, there was no constituency for spending the equivalent of a mid-sized federal agency on it.



Corn

And now?



Herman

Now there are three constituencies. One is China, which has its own crewed lunar ambitions. One is commercial, because SpaceX and Blue Origin have business models that include the Moon. And one is institutional, because NASA has spent twenty years building the architecture and the constituency inside Congress that funds it.



Corn

It's not pure science.



Herman

It's never been pure science. Apollo wasn't pure science. The question is whether the mix of motivations this time produces a durable program or a one-off stunt, and that depends more on Artemis V and VI than on Artemis IV.



Corn

Because Artemis V is targeted for late 2028.



Herman

Late 2028, at which point NASA expects to begin building the Moon base. And the stated goal is one lunar mission per year thereafter. That's the thing to watch. One mission per year means permanence. It means the Moon stops being a destination and becomes a place.



Corn

If they miss Artemis IV by a year, everything else shifts.



Herman

Everything else shifts, and there's a real risk that the window closes. The political coalition that funds this is not permanent. If Artemis IV slips to 2030, and Artemis V slips to 2032, the argument for cancelling becomes much easier.



Corn

The answer to Daniel's question about what preparations look like, in one line, is that the preparation is enormous and it's happening on six parallel tracks, and none of them is fully done.



Herman

Hardware, lander, suit, training, health, and program politics. All six have to land at the same time.



Corn

Let me push on the lander question once more, because it's the thing that could break everything.



Herman

The lander is the critical path. If Starship HLS isn't human-rated by early 2028, and Blue Moon isn't either, Artemis IV doesn't launch. There's no alternative scenario where you just sort of figure it out. Human-rating is a process with milestones, and it either happens or it doesn't.



Corn

What does human-rating actually require?



Herman

It's a certification that the vehicle meets NASA's standards for carrying crew. Structural margins, life support, abort capability, failure tolerance. For a lander you also need the ascent engine to be reliable, because if it doesn't fire, the crew doesn't come home.



Corn

That's a lot of engineering that hasn't been done yet.



Herman

A lot of engineering that hasn't been done, some of it by companies that have been moving fast and have a track record of schedule slips. Which is why I said I'd bet on late 2028.



Corn

Let's bring it in.



Hilbert

The thing nobody mentions is the O-rings.



Corn

Say that again.



Hilbert

You can build the most advanced spacecraft in history and lose it to a rubber ring that sat on a shelf too long. I've seen it happen. I once watched a pressure vessel fail a proof test because of a single O-ring that had been in storage past its shelf life. It looked fine. It passed visual inspection. It failed under load.



Herman

That's the Challenger problem, basically. The O-ring wasn't the design, it was the material.



Hilbert

The material, and the age of the material, and the temperature, and the fact that the certificate said it was good until a date that had passed four months before anyone installed it.



Corn

The AxEMU suit's pressure garment being fully assembled is exactly this kind of milestone.



Hilbert

It's the whole ballgame. If the suit leaks, nothing else matters. You can have the perfect lander and the perfect schedule and the perfect crew, and if the seals on the suit don't hold, nobody goes outside.



Herman

There's a distinction there that matters, between a proof test and a leak test.



Hilbert

A leak test tells you the vessel doesn't lose pressure at the rate you'd notice. A proof test tells you it survives one and a half times the pressure it will ever see in service, without permanent deformation, and then you inspect it. They're different tests for different failure pattern and they cost different amounts of money.



Corn

The stuff that has to hold is unglamorous.



Hilbert

All of it. The seals, the valves, the fittings, the torque on every one of them, and whether the man doing the torquing that day had a good night's sleep. You don't write the mission patch about the valve. But that's what flies.



Herman

There's a piece of that in the mission architecture, actually. The reason Artemis III does hardware interface checkouts on at least one lander is precisely so that somebody can put a wrench on the actual fitting, in the actual configuration, before the crew is on the Moon.



Hilbert

Good. That's the right instinct.



Corn

The practical lesson, if there is one, is that the most advanced mission in human history still comes down to whether a seal holds.



Hilbert

Every mission does. You just don't usually have to say it out loud.



Corn

Alright. I want to pull this back to Daniel's question, because there's one part of it we haven't fully answered, and it's the part he was most interested in. Will it actually happen in early 2028.



Herman

My honest answer is probably not early 2028, probably late 2028, and possibly 2029. The lander is the risk. Artemis II slipped four times, and Artemis IV has more moving parts.



Corn

We're on the verge of ending a fifty-six year gap, or we're not, and the difference between almost ready and ready is where missions live or die.



Herman

That's the whole thing. Almost ready is a schedule. Ready is a proof test that passed.



Corn

That's the one I want to leave with. Not a prediction, just the observation that the last time anybody did this, they had to actually do it, not plan it.



Herman

The hardware is being built. The crew is training. The seals, if Hilbert is right, are being tested. It might all work.



Corn

Thanks to Hilbert Flumingtop for producing, and to Daniel for the prompt. This has been My Weird Prompts, the human-AI collaboration podcast. If you enjoyed it, leave a review and subscribe, and visit my weird prompts dot com for the full archive.



Herman

See you tomorrow.