AirSpace Season 1, Episode 18

Good Vibrations

Matt:

Hey Mister, you want to buy a paper?

Nick:

Welcome to this episode of AirSpace. We're your hosts.

Matt:

I'm Matt.

Emily:

I'm Emily.

Nick:

And I'm Nick. Breaking news from Mars, soon to be breaking news from Mars. What's happening on Mars?

Emily:

What was that?

Matt:

Bomb bomb.

Nick:

That is a sound effect for a technology that has been outdated for generations now.

Matt:

And then I kind of got out of control.

Nick:

But is somehow still relevant as a newsy sound effect.

Emily:

On November 26, the InSight mission is going to land on the surface of Mars and start doing all kinds of fun experiments to try and learn more about the interior of Mars.

Matt:

That's right. Shortly after Thanksgiving, we're going to have another Lander on Mars.

Nick:

And this mission is focused on what's deep below the surface.

Matt:

Giving us a better understanding of the interior of Mars and this could tell us more about how planets work and how our own planet might change over time.

Nick:

Something to talk about around the family table that isn't politics or-

Emily:

Religion.

Nick:

When you going to get married? Why don't we have grandkids yet? All of that and more coming up on this episode of AirSpace, the podcast from the Smithsonian National Air and Space Museum with help from PRX. So InSight stands for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport. Would you believe that they named it that before they realized it spelled InSight?

Matt:

No, I wouldn't.

Emily:

No, I've seen people actually work on the acronyms for their missions and they play with uppercase and lowercase letters. So when there's a lowercase letter, you know that it's part of a word that starts with the uppercase letter right before it. So in the case of InSight, it's capital I, little N because you know it's interior. So they get really creative with how they put these acronyms together.

Nick:

It's like naming a band, you have to name your spacecraft and then you know what kind of mission you've got.

Matt:

Oh, I see, that's how it works.

Nick:

Yeah, you've seen the famous photo of all the NASA scientists at the blackboard that's three stories tall and they've got ladders?

Matt:

Yeah.

Nick:

That's just the acronym part. So on a scale of one to let's put something on another planet, how cool is InSight? Does it qualify?

Matt:

I'd say measuring and studying what's going on below the surface of Mars is qualifying. It's worth mentioning that we have sent other Landers and rovers to Mars for decades and this InSight mission is another Lander, meaning it's going to land and then stay still.

Emily:

When InSight is successful at accomplishing its science goals, it's going to be a really great proof of concept for what we can do on other bodies and there's always talk about putting Landers on places in the outer solar system that I study.

Matt:

And this is sort of the third in a series of Landers that have been sent to Mars. The first was Mars Polar Lander, which unfortunately didn't land on Mars successfully and then Phoenix, which was successful back in 2008 and now we have InSight. It's the same basic body design, but with different instruments than those other two Landers.

Emily:

Right, and so InSight's kind of built on the same skeleton that the Phoenix Lander was built on. Two completely different missions, testing totally different hypotheses, but it's all kind of in the same infrastructure, which makes InSight sort of, well, we did it already, but look at this cool stuff that we're going to do in a totally different way.

Matt:

The landing site is named Elysium Planitia, which is a very beautiful sounding place, right? You'd go to a resort with that name. But in fact, it is an incredibly flat, boring surface on Mars when you compare it to some of the other places you might land, some of the volcanic areas or something like that but they're really not interested in going to a beautiful spot on Mars. They're interested in studying what's underneath the surface.

Nick:

The principal investigator of the InSight mission, whose job it is to be really enthusiastic about this part of Mars, called it Vanilla. Said that if it was a salad, it would be romaine and kale with no dressing.

Emily:

Which I think is a great way of saying it because, of course, kale has a lot of nutritional value. It's good, but you might not enjoy eating it.

Nick:

NASA feeding us our vegetables. So what do we hope to learn from InSight's landing on this steadiest, most predictable place on the surface of Mars?

Matt:

We're going to put a seismometer on the surface and study martian earthquakes.

Nick:

Earthquakes?

Emily:

Marsquakes.

Nick:

Marsquakes, band name.

Emily:

I always envision the seismometer as sort of the schematic you see in sort of an intro geology textbook, where it's kind of a weight on a spring, which is not exactly what it is, but it's this thing that's really easy to move so anytime there's an earthquake or a moonquake, it oscillates. It kind of goes back and forth.

Nick:

Are marsquakes pulses? Is that like a heartbeat?

Emily:

It depends on which seismic wave you're talking about. There's two different kinds of waves when an earthquake happens, P waves and S waves. One of the seismic waves kind of oscillates up and down, it kind of makes an S shape. And one of them sort of, kind of makes these pushes, like if you've ever lined a slinky on the ground and you've just sort of pushed it and you can watch that wave sort of propagate.

Nick:

We had half a slinky when I was younger, we straightened it though.

Emily:

So that's kind of like a pulse, right? The pulse idea is also interesting because it's kind of telling you about, if you think about a human, the pulse is driven by your heart. And that's kind of what we think of as part of our core and so it's sort of telling us about the interior of the planet. These waves tell you something about the property of the material in which they're moving through when there's an earthquake or a moonquake or a marsquake and it also tells you something about the structure. So for example, we know that the earth has a liquid outer core and a metallic inner core because P waves can travel through liquids and S waves can't so you can actually see P waves going through and you can actually see, Oh, it's moving through these different materials so the waves change. And then you have an S wave that's like, bam, done, I'm out. Reflects back.

Matt:

And this is in a way also just like the space program, that discovery was kind of a legacy of cold war technology because during the Cold War, we, the Americans put seismometers all over this planet, partly so that we could detect if people were testing nuclear weapons and one of the things we discovered, having that huge network of seismometers, was in fact that there is this solid, liquid, core dynamic going on that gives us our magnetic field.

Emily:

We don't think that Mars has a liquid outer core because it doesn't have a magnetic field anymore.

Matt:

Right, and on Earth, it's that turning of the solid core inside of the molten liquid core that actually is a dynamo that generates the magnetic field.

Emily:

Right, and so Mars used to have that. Planets are cooling all the time so we think that that liquid outer core has become solid now because it's cooled off.

Nick:

And that's why there's no more magnetic field perhaps?

Emily:

That's why there's no more magnetic field.

Nick:

Which I know is bad news for us.

Emily:

Well, it would be bad news for us if we lived on Mars.

Matt:

Right.

Nick:

Which we hope to do.

Matt:

Our planet has a plate tectonic system that keeps our planet pretty dynamic. We don't really have to worry about it cooling in the lifetime of our species.

Emily:

I'm particularly excited about InSights drive to understand the interior of Mars. Interiors of planets are really interesting because how they're cooling off, how fast they're cooling off, it tells us more about our Earth. I mean, our Earth is also still cooling off and being able to get into that subsurface tells us about why Mars doesn't have plate tectonics. Why doesn't it look more like Earth? Why isn't it doing all these kinds of things? It's going to put a seismometer on Mars. With InSight being a successful mission it's the kind of questions we can start asking of other planets.

Nick:

Is that building a Martian infrastructure so that we know more about the planet that we're dealing with for eventual human missions?

Emily:

I think absolutely. I think one of the cool things about the InSight mission is if another mission goes and can go plant another seismometer on Mars, we're all of a sudden starting to build this seismic network, which is going to be an important part of future infrastructure for Mars.

Matt:

Yeah and that actually has been the plan since the 1990s. The Pathfinder mission, which landed on Mars in the nineties, was the first discovery mission and in fact, it was supposed to be one of many Pathfinders that would land on Mars and collect data at multiple points on the surface of the planet because scientists thought, we could learn a lot more about Mars if we were studying it from multiple places simultaneously on the surface.

Nick:

We've made light about where it's landing and the fact that it doesn't rove around, but one truly extraordinary thing that InSight plans to do is to send its heat probes up to 16 feet under the surface.

Emily:

That is so unbelievably deep. I don't know of any other mission that has managed to get that far down. How far down were the Apollo astronauts coring on the moon?

Nick:

A matter of a handful of feet.

Emily:

Right, because they had to do it manually.

Matt:

Right, not very far.

Nick:

They were doing it by hand and that was really difficult.

Emily:

Yeah, I mean, that's extraordinary. That's extraordinary.

Nick:

That's further than any mission has burrowed into any asteroid moon or planet.

Emily:

Yeah, 16 feet is really deep.

Matt:

That's deeper than I've ever dug any hole.

Nick:

I would hope.

Matt:

I don't know how it's going to have enough torque to do that without breaking the-

Nick:

We just all watched Armageddon. We know how that works.

Matt:

A.J. you're going to break that drill.

Nick:

I know what the machine can do.

Matt:

Just back off Harry, back off.

Emily:

I don't know how you would get out of that hole.

Nick:

So there are three classes of NASA missions, right? Where does InSight fit in?

Matt:

There are three main classes of missions, Discovery, New Frontiers and Flagship. They're sort of like three tiers. Discovery is the first tier, they're the least expensive and the lowest stakes missions.

Emily:

Discovery missions tend to be in the $500 to $600 million range.

Nick:

That doesn't include the rocket.

Emily:

That does not include the rocket.

Nick:

Always important. That's how they get you.

Emily:

That's how they get you.

Matt:

You might be wondering how do you keep those costs low? I mean, in some of the bigger missions with the bigger budgets, they're developing new technologies. With Discovery missions, you're supposed to keep technological development to a minimum and use mainly off the shelf technology.

Nick:

Which is why InSight has the same bones as two of its Mars siblings.

Emily:

Right, the Phoenix Lander.

Matt:

Exactly, and it's probably using commercially developed camera elements and other technologies to keep costs low.

Nick:

No power windows.

Matt:

No windshield wipers.

Emily:

But that's one of my favorite things about the Discovery mission. Because the cost cap minus their cost of the launch vehicle, because the cost cap is in that $500 to $600 million range. People are forced to get really, really, really creative about how they put together and propose these missions.

Nick:

The other two classes of missions are New Frontiers and Flagship missions, right? And Flagship is your most expensive, your really big ones?

Emily:

Oh, it's the big ones.

Nick:

Like landing an SUV Rover on Mars.

Emily:

Right or the Cassini mission, which is near and dear to my heart. That was a Flagship mission. The Europa mission, which I'm pretty excited about, the one going to Jupiter's moon, Europa. That's also a Flagship mission. But there's that medium class, the New Frontiers mission, as you get more and more expensive, usually those missions are pretty well directed by the community and pretty well directed by NASA. Discovery missions have so much more freedom, I mean, they're restricted because you're restricted by money, always.

Nick:

But you can really set your sights anywhere in the solar system.

Matt:

They're kind of like the grassroots missions of NASA, I think. They're the ones that come up from the postdocs and the people early in their careers trying to get started.

Nick:

So it's the college radio class mission.

Emily:

Yeah, I mean, it still takes a village and it still takes a pretty big village, but some of these Discovery missions are incredibly successful so the Messenger mission, you should look up that acronym, it's pretty spectacular.

Nick:

Really?

Emily:

Oh yeah. That's a whole acronym. There's lots of uppercase and lowercase letters in there. The Messenger mission went to Mercury. When I first heard about the Messenger mission, I was like, well, that's cool, Mercury is a really interesting planet. It's really stinking hot on the surface and it's pretty small and it has an enormous core and so Messenger, I was like, okay, that's cool. Well, I didn't realize when we sent the Messenger mission to Mercury, we'd seen 40% of the surface and I'm like, that's not very far away. And we don't know what the surface looks like. And then the Dawn mission was another Discovery class mission. It's the only mission ever to have orbited two separate planetary bodies and it just, R.I.P., lost communications a couple of weeks ago, that was a Discovery mission and it was going on for years.

Matt:

Well, and another Discovery mission that also just retired, was the Kepler space telescope, which discovered thousands [crosstalk 00:13:13] planets.

Nick:

Kepler was a Discovery mission?

Matt:

Yes it was.

Nick:

It discovered four or 5,000 planets.

Matt:

Exactly, and it used off the shelf CCD commercial technology to do it.

Nick:

I ask you how many planets has curiosity discovered? So InSight lands on November 26th, you still have time to put together plans for a house party. What time should you have all of your guests in position with drinks in their hand, facing the TV for this momentous historic event?

Matt:

Well, I'm going to tell my guests to arrive around 2:00 PM so that they can load up on pizza and Cheetos and leftover Thanksgiving turkey by the time the landing happens, which will be at 3:00 PM here on the East coast and around noon on the West coast.

Nick:

You don't want to miss the red planet red carpet.

Matt:

No, not at all.

Nick:

To see what all the fashionable rovers are wearing this year.

Matt:

I hear they're doing interesting things with solar panels.

Nick:

That's it for this episode of AirSpace. This December marks the 50th anniversary of Apollo eight and the famous Christmas Eve broadcast. So next episode, we will be talking about the spiritual side of space flight. AirSpace is produced by Katie Moyer, Jocelyn Frank and Lizzie Peabody. Mix by Tarek Fouda. Special thanks to Genevieve Sponsler, John Barth and Jason Orfanon. If you and all your friends get together to watch the InSight landing, shoot us a photo on our Instagram, which is AirSpace podcast and hashtag it AirSpace InSight. This episode was supported by PRX and the Alfred P. Sloan foundation, enhancing public understanding of science, technology and economic performance. More information at sloan.org.

Speaker 5:

From PRX.