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Hey guys! How do you get things to stick in space?

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Since the Apollo missions, we've been using Velcro.

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But it has its limitations. You need two sides for it to stick and loose fibers can create debris.

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Can we improve upon it?

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We're going to talk about exactly that in this episode of Crazy Engineering.

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(Music)

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Here on Earth, if you want to attach two things together

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you've got a lot of different options, but in outer space none of these things work well.

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This is Aaron. He's one of our experts in robotics and adhesives.

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Aaron, how do we solve this problem?

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So, we've been inspired by geckos. Geckos are nature's most amazing climbers.

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They go from the floor to the ceiling in 2 seconds and they can stick to almost anything.

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Interesting. So how does a gecko's foot work? Is it super sticky?

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Actually no. Geckos are not sticky to the touch. They have lots of tiny hairs, millions of them

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that stick using van der Waals forces. What are van der Waals forces?

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van der Waals force! The position of the electrons inside an atom or molecule,

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create a polarity, an electric field with a positive and negative pole.

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This induces a matching polarity in other atoms or molecules close by.

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The result is a temporary, adhesive force between them. We call this the van der Waals force!

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Ok that's interesting. So how do actually mimic a gecko's foot?

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So, we make synthetic gecko adhesives. This is our design. This is 2-thousand times the real scale.

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These hairs are actually much smaller than the hair on your head.

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And you can turn the stickiness on and off depending on how you load it.

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So if you just come into contact, this is the not sticky state.

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You don't have high real area of contact. Not much van der Waals forces - doesn't stick.

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You apply a sheer load, all of a sudden high real area of contact, lots of van der Waals forces. You stick.

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This is how the gecko does it, by weighing its feet.

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This is the real material. You can touch it. It's not sticky at all.

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No, it's not sticky at all. It feels rubbery but it's not sticky at all.

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Okay, so you have to sheer it. How do you accomplish that? Do you use a motor? Do you use springs?

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Can you show us some examples? Yeah, you can use lots of different mechanisms.

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So this solar panel, it's a spare from a communications satellite. Here's our gecko gripper

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We squeeze together touch the surface, now we've got it.

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And to release you just squeeze and it comes right off. This is a space station panel.

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This is what the astronauts have inside. You can see these Velcro on it where they've had to mount stuff

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in the past. This doesn't need a mating side, so you just stick it to the panel. Now it's on there.

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You want to move it later -- you don't have to reposition your Velcro.

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So, this technology obviously works great on the surface of Earth. How do you know if it works in space?

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We have to test it. So, we flew aboard NASA's zero gravity aircraft. It's nicknamed the vomit comet.

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You get about 20 seconds or so of free fall and we were able to grapple and manipulate

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a ten-kilogram object and a hundred-kilogram object. It was actually one of our operators wearing a target.

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What applications in space do we need it for? We can grab satellites to repair them, service them.

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We can also grab space garbage and try to clear it out of the way. We're interested here in making robots

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that could crawl around on the outside of say the Space Station. Do repair, do inspection.

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Aaron, this is all awesome stuff. What else we got going around here? Yeah, we got the gecko adhesives

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for smooth surfaces, but we actually have other grippers for rocks that use claws. And we have electrostatic

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grippers, which is like rubbing a balloon on your head and we put them on miniature robots

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that can climb up all kinds of surfaces.

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Hey, that was all awesome stuff.

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Hopefully we'll some of that technology soon up in space.