

The Pop Ups. Stay seated. Three, two, one, ignition. Get ready for an adventure of magnificent proportion.

The Pop Ups. (Singing.) I don't know what you've been told, but we're in a golden age - so many discoveries that are jumping off the page. Wow in the world. Wow in the world. Wow in the world. Wow in the world. Wow in the world. Wow in the world. Wow in the world. Wow in the world.

The Pop Ups. With Guy and Mindy. We're on our way, Houston.

(Crosstalk).

Mindy Thomas. Excuse me. Is this thing on? I don't think it's on. B-B-B-Bagels, b-b-b-bagels.

Astronauts. It's on.

Mindy. Oh, it is on. It's on. Can everyone hear me? Can everyone hear me?

Astronauts. Yes.

Mindy. Thank you.

Astronauts. We can hear you.

Mindy. Thank you. Thank you. Now, astronauts, please take your seats. Sit down. Please take your - sit down.

Astronauts. There's no chairs.

Mindy. Sit down, all the way down.

Astronauts. Or gravity.

Mindy. OK, OK, then you can float if you need to, all right? Just, I need everyone's attention. OK, thank you. Thank you. Now, you may all be wondering why I brought you here today to the International Space Station. Well, it's been brought to my attention that you have been leaving your space junk all over outer space. And now it's time to clean it up.

Astronauts. Oh, yeah, right. It's not even mine.

(CROSSTALK).

Mindy. No, I don't care whose junk it is. It's a mess up here, and it's dangerous. And if we don't clean it up, someone is going to get hurt.

(CROSSTALK).

Astronauts. Yeah, right. It's heavy.

Mindy. Astronauts, I'm only going to say this once. Clean up your outer space right this minute or no freeze-dried ice cream for dessert.

Astronauts. (Gasping). Come on.

Mindy. And I don't want to hear any whining. (Unintelligible).

(Soundbite of pop).

Guy Raz. Hey, Mindy. Who are you yelling at in here? I could hear you all the way from my house.

Mindy. Oh, hey, Guy Raz. I'm just imagining what I would say to the astronauts on the International Space Station if I had the chance. And it is not going well. Here, pop the top of my head and see for yourself.

Guy. I still feel weird about doing this, Mindy.

Mindy. Here, I'll do it for you. Just...

(Soundbite of door creaking open).

Astronauts. Get out of here.

Mindy. Whoa, quick, close it back up before they get out.

Guy. Oh my.

Mindy. See what I mean?

Guy. Yeah, wow, those astronauts are really mad. What's going on?

Mindy. I know I just asked them to clean up all their scrap metal and junk that's floating around in space. It's a mess up there.

Guy. You mean, all those bits of old satellites and empty rocket parts and pieces of metal just floating around Earth?

Mindy. Yeah. It's just this giant junk jumble that's been growing since 1957, which, by the way, is the same year that humans first launched a rocket into space. And that was the rocket that carried the world's first space satellite called Sputnik - still the best name ever.

Guy. Oh, yeah, that was launched by Russia.

Mindy. You are a little baby Einstein, Guy Raz. Anywho, ever since then, we humans have been launching more and more and more and more and more rockets and satellites up into space.

Guy. Mindy, did you happen to investigate just how much junk is even up there?

Mindy. Sure did. So the last time I counted...

Guy. You did not count it, Mindy.

Mindy. OK, so the last time someone else counted - NASA - they found more than five hundred thousand pieces of space junk, all the size of a marble or larger, just orbiting or circling around the Earth.

Guy. Wow.

Mindy. And now there are so many pieces of metal floating up there and orbiting around our planet that it's actually making things dangerous.

Guy. Dangerous, as in, some of this junk can actually crash into other junk?

(Soundbite of dramatic music.)

Mindy. Yep. And, in fact, this junk is flying around so fast that it's pretty surprising that there aren't even more accidents and crashes.

Guy. Yeah, I see your point. And I imagine that this can cause real problems for satellites, like the ones we use to help forecast our weather or the ones that take pictures of Earth.

(Soundbite of camera shooting.)

Mindy. Yeah. And it could also be dangerous for the human astronauts aboard the International Space Station.

Guy. Yikes. And I'd imagine that crashes caused by the space junk would probably create even more space junk that would go on to destroy more objects in space, like a chain reaction of junk and disaster.

Mindy. You know it, Guy Raz. In fact, there's even a name for this crazy catastrophic chain reaction.

Guy. Really?

Mindy. Yep. It's known as the Kessler Syndrome, and it's named after the NASA scientist Donald J. Kessler who first came up with the idea all the way back in 1978.

Guy. The Kessler Syndrome, a catastrophic chain reaction of junk and disaster. That sounds like - hey, that sounds like you, Mindy.

Mindy. What? I can't believe you noticed, Guy Raz. Hey, have you ever wondered what it might feel like to fly through all that space junk?

(Soundbite of soaring music.)

Guy. Come to think of it, not really.

Mindy. Well, then you're in luck, my friend, because I have purchased not one, but two space-debris-proof, rubber space flying suits. And I got one just your size.

Guy. What?

Mindy. Then I lost it. So I had to go back to the store, and they only had toddler sizes left.

Guy. No.

Mindy. So I had to get one of those for you.

Guy. No.

Mindy. It's going to be a tight squeeze.

Guy. No.

Mindy. But it will be worth it.

Guy. No.

Mindy. Here, put this on. Come on, you can do hard things. Just suck in everything you've got. There you go, little buddy.

Guy. This thing...

Mindy. Now, just try not to exhale while I jump into my suit.

Guy. ...Is a little tight.

Mindy. All set. Ready to go?

Guy. You promise this is going to protect us?

Mindy. No, I can't promise you that. But what's a few bumps and bruises, Guy Raz, when you are in the pursuit of science?

Guy. Yeah, fair enough. OK.

Mindy. So listen carefully because here's how it's going to work. So first, my carrier pigeon Reggie is going to fly us up to the upper reaches of the stratosphere. Then, we're going to have to use these rocket launchers on our rubber space suits to get us into low-Earth orbit. OK?

Guy. OK, Mindy.

Mindy. Reggie, slap on your space goggles, you cuckoo old bird. We're ready for takeoff. Guy Raz, let's say the magic words.

Guy and Mindy. Here we go.

(Soundbite of soaring music).

Mindy. OK, now this is the part where Reggie says sayonara. Flip on your rocket boosters, Guy Raz.

Guy. OK, I'm assuming it's this red button here.

Mindy. Yep, that's the one.

Guy. (Screaming).

Mindy. (Laughing). This is so awesome. Can you believe it? We're flying through space, Guy Raz!

Guy. Mindy, I think we're traveling at seventeen thousand miles an hour.

Mindy. That sounds about right. Wow, rocket straight ahead, pull the plugs, watch your head.

Guy. Just missed it. But, wow, this is nuts. There's so much junk up here.

Mindy. I know, right? I told you. Whoa, watch out, you're going to deflect some loose screws.

Guy. I think they're going to hit us.

Mindy. Brace for impact.

(Sound of metal clunking).

Guy. Mindy, I think I get the point. Can we rocket back to Earth now?

Mindy. Sorry, I can't hear you, Guy Raz. I'm already halfway back to Earth.

Guy. Oh, brother, rocket boosters on, back to Earth. What? Oh, no.

Mindy. Oh, hey, Guy Raz. Where did you come from?

Guy. (Screaming).

Mindy. Man, that was wild.

Guy. You were right, Mindy. It's a veritable junkyard up there in space.

Mindy. So now do you see why I wanted to get the astronauts to help clean it up?

Guy. Yeah, but it's going to be virtually impossible for the astronauts to do it alone. I mean, they're going to need some help.

Mindy. You better believe it, Guy Raz.

Guy. So then, why don't we just invent, like, a giant space net for them?

Mindy. Well, scientists have actually thought of that. But it wouldn't work because it would be so hard to capture all of that junk and keep it from floating out of the net.

Guy. And, of course, I guess a vacuum cleaner wouldn't work because it needs the air pressure here on Earth to suck things in.

Mindy. Yep. And in space, there isn't enough air pressure to get the vacuum cleaner to suck stuff up.

(Soundbite of vacuum cleaning).

Guy. So what can we do? I mean, how can we solve this problem of space junk?

Mindy. Well, the good news, Guy Raz, is that some super inventive scientists and engineers are already on the case.

Guy. Phew, that's a relief. So what's their solution?

Mindy. Oh, geckos.

Guy. Geckos.

Mindy. Well, not whole geckos, just their feet.

Guy. Now, I did buy my car insurance from a gecko, but I'm not sure he'd survive in outer space.

Mindy. Wait, did you really buy your car insurance from a gecko?

Guy. You were the one to recommend him to me. I mean, you said he'd give me a discount.

Mindy. I didn't think it would actually work. Anywho, back to the gecko feet.

Guy. I'm with you, I think.

Mindy. So you know how when you chase a gecko up a wall or a sliding glass door?

Guy. No, I've never tried that.

Mindy. Well, I've tried it. And let me tell you, it's not as easy as it looks.

Guy. OK.

Mindy. They scale up super smooth walls like nobody's beeswax and then laugh at you as they hang upside down by the tips of their toes.

Guy. Right. And they're able to do this because they have super-special sticky toes, right?

Mindy. Well, this is where it gets interesting. So if you were to look at the bottoms of their toes under a microscope, you'd notice that they're actually covered in teeny, tiny microscopic hairs called setae.

Guy. Interesting - but how are hairy gecko toes going to help clean up all that space junk in low-Earth orbit?

Mindy. Well, the story begins with an engineering professor at Stanford University in California named Mark Cutkosky. And he came up with this crazy idea, which he published in the journal Science Robotics.

Guy. What was the idea?

Mindy. The idea was that by using something called biomimicry...

Guy. Biomimicry - that means using animals and plants as the inspiration for new technology, for inventing cool new things.

Mindy. Exactly. So in this case, that animal would be the gecko.

Guy. And the gecko's sticky feet.

Mindy. You're picking up what I'm putting down, Guy Raz. So Professor Cutkosky and his team designed a robot that is actually a giant gripper.

(Soundbite of machine moving.)

Guy. Like a big robot hand?

Mindy. Yeah, kind of, and the bottom of it is covered in thousands of tiny bristles to mimic or copy the setae hairs on the gecko's feet.

Guy. Wow.

Mindy. And what's really crazy is that each tiny bristle is ten times thinner than a human hair.

Guy. But how do these tiny hairs on the gecko feet and the robot help to create a sticky effect?

Mindy. Well, on both the gecko and the robot, the hairs, or bristles, work together to create a special kind of sticky electric force.

Guy. Wait a minute. Are you referring to the Van der Waals force?

Mindy. I knew this would excite you.

Guy. So there are atoms or teeny, tiny little balls of material which, to be clear, we cannot see with our own eyes. And they're on the hairs of the robot hand and the gecko. And those atoms stick to the other atoms on the space junk.

Mindy. Phew, that is a complicated phenomenon. But when it works, it can create a really tight, sticky bond between two things.

Guy. Kind of like a friendship.

Mindy. Yeah, just like you and me.

Guy. I get it!

Mindy. Yeah, and the tiny bristles are put on little pads that are attached to the robot, so it's kind of like a little robot hand or foot that the astronauts can hold onto and control.

Guy. Wow. And so that's how it's able to grab onto the space junk?

Mindy. You got it, just like a gecko can stick and unstick its feet to walk up a wall.

Guy. And this way, the robot can grab the space trash, move it and then, I guess, let it go.

Mindy. Pretty cool, huh?

Guy. Yeah, I'll say.

Mindy. And Professor Cutkosky and his team are designing this robot to be able to stick to and capture the biggest and most dangerous space junk up there.

Guy. But, I mean, how big and strong will these robots be? Because, I mean, space junk can be huge. Some space junk is the size of trucks just floating around up there. I mean, it's pretty heavy garbage.

Mindy. Well, that's the thing. Because there's so little gravity in space, really heavy things, like broken satellites or spacecrafts or space minivans aren't actually heavy at all. It's a little bit like when you float in water and you feel a lot lighter.

Guy. Yeah. So the astronauts that you were scolding in your imagination actually might be able to clean up some of this junk.

Mindy. That's what I was trying to tell them. These astronauts would be able to take hand-held robots with sticky pads and stick them to pieces of space trash, move it and then unstick it.

Guy. Yeah, but where would they put it, Mindy? I mean, it's not like there are dumpsters floating around in space.

Mindy. Oh, this is crazy. So they would push the space trash back towards the Earth, which means that, as it came back flying towards the Earth, the

speed would create so much heat that the junk would naturally burn up before it even reached our planet.

Guy. Wow.

Mindy. Or they could even take some of it and put it inside a special spaceship to be recycled.

Guy. So by cleaning up this giant garbage pile floating around in space, we would actually be making space a little bit safer.

Mindy. Yep.

Guy. So about those astronauts in your head who are trying to get out of cleaning up their space junk...

Mindy. Oh, yeah, so you want to break the news to them?

Guy. I don't know if my insurance covers climbing into your imagination, Mindy.

Mindy. It does if you bring your gecko insurance salesman.

Guy. OK, here we go.

Mindy. Easy does it.

(Soundbite of door creaking open).

Guy. Do I just climb inside?

Mindy. Take your shoes off first. Got it - you got it. Just climb right inside. Yup.

Guy. I'm in here. Now what, Mindy?

Mindy. OK, now take the podium, and show them who's boss.

Guy. Astronauts, hello.

Astronauts. Who's this guy?

Guy. You're going to have to clean up your space junk.

Astronauts. I'm not doing it. No. (Booing). I'm an adult.

(CROSSTALK).

Mindy. Now tell them the good news.

Guy. But thanks to the common reptile known as the gecko, cleaning up outer space is about to get a lot more fun.