mystery science

Grades K-5
Mini-Lesson: “Why don't people fall out of roller coasters when they go upside down?”

VIDEO TRANSCRIPT

VIDEO 1

Hi, it's Doug! You're about to find out what it's like to ride Valravn, one of the tallest and fastest dive roller coasters in the world. See how the car just hangs there before going over the cliff? Are you getting a little nervous? Dive coasters like Valravn are special types of steel roller coasters that drop straight down in a free-fall, like this. Whoa, that's a huge drop! Someone named Ethan has a question about roller coasters. Let's give Ethan a call now.

[Video Call]

- Hi, Doug!

- Hi, Ethan!

- I have a question for you. Why don't people fall out of roller coasters when they go upside down?

- Oh, that's a great question.

And I know the perfect person to answer it. His name is Jay Flores and he's an engineer who knows a lot about this subject. In fact, Jay is going to be helping me answer questions regularly this year. Not only is he an engineer, but he has a lot of experience helping people better

understand how things work. And personally, I think he's really good at it. Let's find out what Jay has to say about this question.

- Hi, Doug. I'm really excited about this question. I love roller coasters. I actually got to ride Valravn recently, and it was so much fun. Especially when it spins upside down. Valravn actually goes upside down three times. It was so cool. It's amazing how rollercoaster tracks can twist in all sorts of different shapes. Like, check this one out. This is The Incredible Hulk Coaster at Islands of Adventure in Florida. It has two loops and two corkscrews. A corkscrew is when the rollercoaster twirls you around like this. And check this one out. If you're the kind of person that really likes loops and corkscrews, you would love the Steel Curtain. It flips you upside down an incredible nine times. Think about that for a second. When you tip something upside down, like a bowl of cereal or a cup of water, what happens to it? It all spills out, right? That's because of the force of gravity, something you've probably heard of. Gravity pulls everything down towards the earth, like all those Cheerios you just dumped all over the floor. So if you're going upside down nine times, like on the Steel Curtain, how do you not fall out? I mean, you're hanging upside down. Shouldn't gravity be pulling you out of the car? Before we go on, I'm curious. What do you think? Why don't people fall out of roller coasters when they go upside down?

VIDEO 2

You might have thought about the fact that roller coasters have special seat belts. And you're right, they do. Or maybe you've even noticed that a roller coaster itself is attached to the track so you won't fall off, either. Having seat belts and attaching the roller coaster cars to the track itself are important safety precautions that make extra sure no one gets injured when doing a loop. But what if I told you that even without a seat belt, you would probably still stay in the car when racing upside down? And not only that, what if I told you that the roller coaster train itself

probably wouldn't fall off the track, either, even if it wasn't attached? Would you believe me? Well, check out this real live car doing a loop. It's not attached to anything and it's not falling. How is this even possible? Doesn't the car have to be attached to the loop? Why doesn't it fall once it's at the top? There's an experiment you can try sometime on your own which can help you see the answer for yourself. Find a bucket with a handle and fill it with water. Now, this part, you might need an adult's help with, as the bucket will be heavy. Ask them to spin the bucket in a circle like this, just like the loop on a roller coaster. Spin it fast like this and no water falls out. But what happens if you spin it slower? Haha, you get really wet! All the water falls out. It's kind of like a jump rope. When you spin it really fast, it stays over your head. But when you spin it too slow, it falls. So speed clearly has something to do with it. If the roller coaster weren't going fast enough, it seems like the riders would fall out like the water did. But what is it about speed that keeps the water in the bucket? How is it possible that the water isn't getting pulled out of the bucket by gravity? As you start to spin the bucket in a loop, the water starts to move forward and gets squished up against the inside of the bucket. By the time you get the bucket over your head, the water is being squished against this side of the bucket, the very inside bottom of the bucket, which is opposite the direction from gravity. At the moment you've got the bucket right over the top of your head, it's not that gravity isn't pulling down on the water. Gravity is still there and pulling. But as you're spinning the bucket fast enough, the water is being squished to the inside of the bucket. And the strength of that squish is stronger than the pull of gravity. So the water stays in the bucket. The faster you spin the bucket, the stronger the squish is. But if you were to spin the bucket more slowly, once the bucket got above your head, the pull of gravity would win out and you would be a wet mess. If you've ever gone upside down on a roller coaster, you've probably felt as if you were getting squished against your seat. It's pretty awesome. So in summary, riders don't fall out of roller coasters when they go upside down

because riders get squished into their seats when a roller coaster spins in a loop. If you're squished into your seat, you don't fall out. But remember, even if that force is going to keep you in your seat, it's still really important to always wear your seat restraint when you're riding a roller coaster to be extra safe. That's all for this week's question. Thanks, Ethan, for asking it!