Lesson: “How can you go faster down a slide?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! In the hills of San Francisco, not far from where I live, there's a tiny patch of grass high on a hill. About 40 years ago, a group of people worked together to create a playground on this small spot of land. They didn't want it to be an ordinary park, they wanted it to be something special. But it was a very small patch of land on a steep hill. What could they build there? The neighborhood held a contest and asked everyone to submit their ideas for this new park. The winner of the contest was a 14-year-old girl named Kim Clark. What did Kim want to build on this hilly spot? She wanted a slide downhill. Everyone agreed this was a great idea and so they built two amazing slides. These are not your everyday playground slides. These slides are steep and slippery. Watch my friend Eva going down one. Woo! Woah! It's awesome. If you ever have a chance and you're in San Francisco, you've got to try these slides. I think they're some of the best slides in the world. Going down a slide has to be one of the most fun things on any playground. Think about some of the many slides you've gone down before. You might not have, like, a rating system for them, but I'll bet you if you think about it, you can think of the biggest, the scariest, the awesomest slide you've ever been on. Some slides are just better than others. But what is it about a slide that makes one better than another? As you're going to see today, it has to do with the unseen forces, the pushes and pulls, that are all around you. Slides are a great example of where, by learning to notice these forces, you can figure out how to do

extraordinary things. The extraordinary thing you'll figure out today is how you can go down a slide the fastest. As you know from your own experience, the most important thing that makes you go fast down a slide is how steep it is, how slanted. Steeper slides always cause you to go faster. That's because gravity pulls you down a slide and the steeper the slide is, the less slide there is to get in the way of the gravity. Think about what the steepest slide of all would be. It would be a slide that slanted so much that it goes straight down to the ground. There is a slide like this in Brazil called “Insano,” which is a great name for it. It's so steep that when you go down it, you're not really sliding so much as you're just plain falling straight to the ground. I think this slide wins the category hands-down for the world's scariest slide. It's a water slide. And you should know that it does level off at the bottom, so that it's at least safe, but still really scary. And what would the world's most boring slide be? Well, I guess it would be a slide with almost no steepness at all, something that's barely slanted, right? But let's not forget, your goal today is to figure out how you can go fastest down your slide, the nearest one, whether at school or a nearby park. And you can't easily change the steepness of your slide. So, what else is involved? What could you change in order to go faster down your side?

EXPLORATION VIDEO 2

What affects how fast you can go down a slide? Well, the other thing you probably thought of is the slide itself, what it's made of. We're talking about a property of the slide's material. So, slides like this that are made of polished metal, they're smooth and slick—and then, on the other hand, would be a material that's a bit more rough, like this old, rusty slide. Ugh, this makes me cringe just to see. It doesn't look too bad, but if you get up close, if you ran a finger over it, you could feel the roughness, little jagged bumps. Scientists have figured out that every material has some of these little jagged bumps, even if the material looks and feels pretty smooth. Like, this

diagram shows a smooth wooden block on top of what looks like a smooth surface. But scientists know that up close on a very small level—that's what we see in the circle here—there are actually little jagged bumps. What makes one material more rough than another is just how many of these bumps there are and/or how big the bumps are. Like, this diagram helps us imagine what a pretty smooth material would look like. You see some bumps, but not as many compared to, say, this material on the bottom, which has bigger, more jagged bumps. This is the difference between a smooth, polished metal slide and a rusty one. When you rub something against a material, like you're wearing your jeans and you slide down a rusty slide, if we imagine it in close up here, each jagged bump pushes back against you as you try to move across it. The more or larger these bumps, the more you're slowed down. Maybe it'll even stop you altogether. So there's a pushing force between two materials when they rub together. Scientists call this push the *friction force*. It means that going down a slide is a lot like a tug-of-war. Gravity pulls you down the slide, and gravity almost always wins. But the material that the slide is made of pushes back against you. That's the friction force. The tug-of-war is a fight between friction and gravity. If the friction force is great enough, if it's equally matched against gravity, that would mean you'd get stuck on the slide. Now, seeing all this, you realize it's not just the slide's material that matters, but the material you're wearing too. Some clothes are more smooth or slippery than others, like jeans. Jeans aren't exactly rough, but they probably aren't as smooth as polished metal. So what if you had jeans that were coated in smooth metal bottle caps and then you went down a slide? Would you go faster down a slide? It seems like an interesting idea. So the trick is, going fastest down a slide, you need to find materials that have the least jagged bumps, materials that won't create as strong of a friction force that fights against the pull of gravity. In today's activity, you're going to test out different materials to see which ones will help you go fastest down a slide. Now maybe you thought about: what about making the slide

wet? That would certainly make it very slippery. I'm going to show you a slide in Ohio called the “Slip N Fly,” and I think you'll see why getting your playground slide wet, though fun, might be a dangerous idea unless you have a nice deep pool like this where you can safely land at the bottom. Watch. Yeah, so, it looks awesome, but nothing wet or greasy on your slides. You have to figure out something that's solid that would work well.

ACTIVITY INTRODUCTION VIDEO 1

How could you figure out which solid materials cause the least friction and which ones cause the most friction? Your teacher has a few different materials for you to test out today. It's totally up to you to figure out how to test them. I'll give you this little bit of guidance. If we use an actual slide to test these materials, there's going to be a lot of students all lining up and waiting. So, instead of using an actual slide, we can make a model of a slide by propping up a piece of cardboard against a stack of books. Scientists often make models when doing an experiment for the same reason that you're going to make a model of a slide: because sometimes it's easier to test a model than it is to test the real thing. I would also recommend turning each of your materials into a little slider that you can use on your model slide. We can think of a slider as a model of a person going down the slide, like this. Now, there are some tips on how to make a slider on the handout you'll get, so that's my only guidance to you. Work in a small group to set up a model of a slide and to make your sliders. Once you and your group have all that set up, your group should spend like five or 10 minutes trying out some different ideas. There are a lot of things you can experiment with, like how steep you make the slide. Or you could experiment with how many pennies you put on each slider as weights. Or how many sliders you test at one time. These are all different possibilities you can experiment with. Try out a few different methods. Here's what you need to get started. You're going to need a “Try This” worksheet and

pencil, a piece of stiff cardboard to use as your slide, some tape, some pennies for weights, a stack of books or blocks that can be used to prop up the top of the slide, and a few different materials to test, like: sandpaper, Styrofoam, smooth plastic, cardboard, paper, and metal. Go ahead and prepare your sliders and your slide, and then spend five or 10 minutes trying out some different ideas, just as practice. When you're done with that, you can all get back together as a class and talk about what you noticed and what ideas you came up with.

ACTIVITY INTRODUCTION VIDEO 2

Now that you built your model and sliders and you had some time to discuss your different ideas as a class, it's time to figure out for sure exactly which materials create the least friction as they slide down a slide. Before you start, I thought I'd show you a couple of different methods that we came up with here at Mystery Science in case you decide you want to try one of our methods. First, we experimented with some different weights. We had one penny, two pennies, and five pennies. Now, I'm not sure what you found, but we found that two pennies worked well. That gave the sliders enough weight for the pull of gravity to make them move. We also made sure that each slider had the same number of pennies so that that way it would be a fair test. We thought it might not be a fair test if some sliders had more weight than other sliders. So then, we figured out how steep our slide had to be to make all of our sliders start sliding. We lined all the sliders up behind a ruler, and then what we decided to do was let them loose all at the same time, kind of like letting runners line up at a marathon—you know, on your mark, get set, go. Just like that. And the idea here is that the first one to reach the bottom must have the least friction. So, we watched to see which slider ran off the end of the slide first. Notice I'm not going to give it away here. I don't want to spoil it for you. I'm not going to show you what happened. So, this was one method we came up with. Now, this is not the only way to do a test. We tried

another method that worked well too, and here it is: we put the sliders on the slide when it was flat, and then we lifted the end of the slide one inch at a time. When it was lifted one inch, none of them moved. So we lifted it another inch, still nothing. Inch by inch, we lifted it until we saw, oh, which slider started to move. And so we made a note of how high up this slide was and what the slider was made of. So, those are the two methods that we tried, but you guys might have come up with something totally different that worked just as well. The truth is, there's no single right way to do this. We could come up with a couple of other ways that would have worked too. So, now that you as a class have talked about the different ideas you came up with and you heard our ideas too, go ahead and decide on one way, one method that you'll use. Your teacher will hand out the “Design a Test” sheet now. Work with your group to make decisions, perform your test, and fill in the sheet as you go. Good luck!