Lesson: “What can magnets do?”

VIDEO TRANSCRIPT

ACTIVITY INTRODUCTION VIDEO

Hi, it's Doug! All right, check this out. Look at this. See what I'm doing with this paper clip? I'm making it levitate. Woah. How am I doing this? A magnet is making it possible. Today's Mystery, we're asking: what can a magnet do? I'll keep this video short, because the most important thing is for you to actually go handle magnets yourself. See for yourself what they can do. We're going to start with the activity today. For this activity, your teacher has some magnets. Now, magnets come in all sorts of shapes, not just the classic horseshoe shape like you see on the left here. That's the kind you find in science kits. We're hoping your teacher was able to get some of these, the donut-shaped magnets, for the experiments you'll do today. So, your first job today is: we actually want you to just have fun playing with magnets. There's no special rules here. You're going to get two magnets from a teacher, and as you play with them, think about them. See if there's anything new you can learn or observe. Do some experiments. Like, you already know that a magnet sticks to certain things, it can pull on certain things, right? But will a magnet pull on anything? What kinds of materials does it pull on—just metal, any kind of metal? Can a magnet’s pull go right through something like an eraser? Can you figure out how to use a magnet to make something float or levitate like you saw me do? So, figure out experiments that will help you answer these questions. So, try your experiments, and then there's space here on the sheet where you could write down what you did and what happened. If you start

experimenting and you realize you need some inspiration, your teacher has a handout with some ideas on it; just ask for a copy. All right, so let's get started. Here are the supplies you're going to need to start experimenting. You need at least two magnets. You need the worksheet to write things down on. You need a pencil. You need some paper clips. You need a piece of thread, or string or light ribbon will work. A few three-by-five index cards, and your teacher will also have some things laying around made of different materials that you can test to see if they're magnetic. And don't forget, if there's anything in your desk or pockets, you can test that too. Have fun. When you're all done, come back and watch the next video. I'll show you some interesting things about magnets, which you might not be able to do in your classroom.

EXPLORATION VIDEO 1

I'm hoping that you had fun playing with those magnets. I'm playing with one right now here. They're so fun to play with! I can tell you, I'm an adult, and this does not get old to me. Magnets are so weird. What is it that's so unusual about them? Well, I think the biggest thing is that, it's because they can pull on things. They're a force but without touching on anything. That's what's weird. In fact, a magnet's force, as you saw, can go right through a solid object, like my hand here. Now think about that. Normally, in almost every other example in your life, if there's a pushing or pulling on something, it's because one object is touching the other object. They're in contact with one another. But magnets, they're weird. They don't need to touch something to pull on it. This is the property, this is the characteristic of magnets which is their most famous. Magnets can pull on certain things without touching them directly. And it's actually this fact about magnets which led to their discovery in the first place. Have you ever thought about that? Where do magnets come from? How did we find out about them? The ones you have were made in a

factory. But the very first magnets were actually found in nature. Nobody knows exactly when the first names were discovered. But let me tell you a good story about them passed on to us from the ancient Greeks, who lived here in Europe about 2,000 years ago. Now, in order to make sense of this story, you have to know that the ancient Greeks, well, they wore sandals a lot. And those sandals used nails to keep the top part of the shoe attached to the bottom. You can see some of those nails right here. And the story goes that an ancient Greek farmer went out into the hilly countryside to look for his sheep. But at one spot where there was this patch of bare rock, his shoes kept coming apart. He'd take two steps and the nails would fall out of his shoes. So he'd fix them, and he'd take another step, and the nails would fall out again. This had him really scratching his head. He's thinking, what is going on here? He sat down beside the rocky area and he tried to figure out what was happening. And that's when he noticed that the rocks themselves were pulling the nails out of his shoes. The name of this place was a region of ancient Greece called Magnesia. And the word used to describe something that came from Magnesia was *magnetes*. And so these strange, nail-pulling rocks—this is a real picture of one. You can see it's pulling on some paper clips. These rocks came to be called *magnetes rock*—or for short, *magnets*. That's the story of how the first magnets were discovered. And that's how they got their name. Now, this story brings up another really important characteristic of magnets, which is that they don't pull on just anything. They only pull on metal. And it's not all kinds of metal, either. They only pull on one kind of metal that you're familiar with. There are lots of different kinds of metals—there's copper, there's gold, there's silver. But magnets only pull on this kind: it's called *iron*. And they pull on steel as well, but that's because steel is a metal that is mostly made of iron. So of all these common metals, only iron and steel are magnetic. Magnets are only able to pull on iron or steel objects. The nails in that shepherd's shoes from the story, they were made of iron. And paper clips, they're made of iron too, which is why we included

them for your experiments. Now, through those experiments, hopefully you discovered some of the other secrets of magnets too, like this. Let me show you something. You know that this paper clip, it's not a magnet. It can be pulled on by a magnet, but it's not a magnet itself. But hopefully you saw, when it touches a magnet, now the paper clip acts like a magnet too. And so now the paper clip itself can pull on or attract other paper clips. You can just keep adding them like this. So that's another secret of magnets. When a piece of iron touches a magnet, the iron becomes a magnet itself. We have a word for this. We say that the iron has become *magnetized*. But here's something you might not have thought to experiment with. Does the iron stay that way once it touches a magnet? Like, if we were to pull these magnets here away from the paper clips now, will the paper clips stay magnets? Will they stay magnetized?

WRAP-UP VIDEO

Another fact you hopefully discovered through your experiments is that a magnet's force is stronger up close. But as you take an iron object and you pull it farther away, you notice that the magnet's force is weaker when you're farther away. So you can kind of just feel this by holding the paper clip close to the magnet and then pulling it away. But a more dramatic way that I can show you this is by using iron filings. That's this stuff. It's iron that's been broken down to be very fine, like a powder. And then I've got a magnet under a clear plastic container here. So what I'm going to do is I'm going to sprinkle the iron powder over the top of the magnet. And this way, we can see where the magnet's force is strongest and weakest. You can actually tell where the magnet is invisibly pulling on the little bits of iron. Isn't that cool? Iron powder lets us do some pretty crazy things that you couldn't otherwise see in class. Like, if you mix it with Silly Putty—you know this stuff? You ever played with Silly Putty? It's a stretchy, rubbery material

that's kind of like Play-Doh. On its own, Silly Putty is not magnetic at all. But when iron powder is added to it, well, guess what? You just made magnetic Silly Putty, Silly Putty that can be pulled toward a magnet. So there's a magnet up here at the top of the screen. Check it out. Isn't that crazy? The Silly Putty is now magnetic because of the iron powder in it. Looks so weird. Or, here's my personal favorite: this is iron powder mixed with oil. So, if you do this, then you've got a magnetic liquid. Woah, see this stuff? Really crazy and fun. You can pull on it. So those are some fun examples of things you can do with iron powder. Now, it's weird enough that magnets can pull on iron without touching it directly, but there's another great secret of magnets, which I hope you discovered through experimenting. And I've saved this one for last. And that's how magnets act around each other. In other words, what happens when you have two magnets and you bring them together? So, hopefully, during your experiments, you saw this for yourself. You tried stacking magnets on a pencil. You can stack them like this, and they pull each other. But now instead, if you take that top magnet off of there and you flip it over, what did you notice as you bring it down? Now the force is totally different. They're pushing on each other. You try to shove them together, you can really feel them pushing against each other. Woah. So, it's like they're hovering when they do this, almost as if like magic. See, magnets have two opposite sides. Depending on how you have them facing, they either pull each other or, if you flip it over, they push each other. Scientists call these two different sides of a magnet the magnet's *poles*, but we'll explore that another time. So, this kind of hovering could make for some really cool inventions. I'll bet you could come up with some. Now, I'll show you one example to get you thinking—and that's this train in Japan. Instead of having wheels the way an ordinary train does, this train has powerful magnets. And the track itself is a powerful magnet with the two magnets, the magnet of the train and the track, flipped so that the train hovers above the track. It doesn't hover very high. It might be kind of hard to tell from this photo. So let me show you the view

from inside the train where a passenger has set up some paper clips on the floor of the train. Now watch what happens as the train starts to move. Woah. Isn't that awesome? So, hopefully, all of this gets you thinking about some useful inventions that could be made using magnets.