Lesson: “How is your body similar to a car?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! Have you ever thought about this? We use the word energy in some totally different situations. Like, on the one hand, we talk about energy and our body. Think about when you're running around. People might tell you, “You seem hyper. You have lots of energy.” Or think about when you're sick, for example. When you're really sick, it's the worst feeling. That feeling where you just don't even feel like moving. You just lie there, barely wanting to do anything. We say, “Ugh, I feel like I have no energy.” So that's energy in our body on the one hand, but we also talk about energy when we think about things that aren't even alive, like computers and smartphones and cars. We all say these things need energy in order to work. Could it really be the same thing? After all, we get our energy from what, food? But cars, they get their energy from gasoline, or, if they're electric cars, then from batteries. Could it really be that the stuff that's in food, whatever this thing is that we call energy, is really the same thing as the stuff in gasoline and batteries? What do you think?

EXPLORATION VIDEO 2

We've all heard that we get energy from eating food. To make that a little more real, consider this guy. This is former Olympic swimmer Michael Phelps. He's won more gold medals than anyone in history. Athletes who compete in sporting events know that they need a lot of energy. Well, what do you think Michael here eats for breakfast? He eats three fried egg sandwiches with cheese, lettuce, tomato, fried onions, and mayonnaise. That's a pretty big meal. But that's not it. He also eats French toast and pancakes and grits. Oh, plus an omelet. All for breakfast. That's a ton of food. But all of that food has energy stored inside, which Michael Phelps's body uses in order to move his body and swim as fast as he does. Still, is this energy that's stored in our food the same energy stored in gasoline, the energy used to power cars? I mean, people can't run on gasoline. But think about what happens when a car runs out of gasoline. Sometimes people have to get out of the car and push it to make it move. That would be a car running on people. And since people run on food, technically then this is a car powered by the energy stored in food. Still, that seems a stretch. Could a car be powered directly by food? It is possible. A car can't digest food the way our stomach does, but believe it or not, this truck has a special engine that runs on french fries. The drivers collect the oil that the french fries cooked in and pour it into the gas tank. The truck's exhaust even smells like french fries. Now, here's a bus that runs on beans, soybeans specifically. They grind up the beans until a liquid oil comes out, and that gets turned into fuel. Someone has even created a race car that runs on chocolate. So, just like people use the stored energy in food to move, cars can use the energy in food to move, too. And it's not just cars either. For example, some toy rockets are actually powered by sugar. You've probably heard that sugar is one of the foods that has a lot of energy stored in it. Now keep in mind, that doesn't mean it's healthy for you. But check this out; this is a video of someone using sugar as energy for a rocket. First, he melts the sugar in a pot until it's golden brown. Then, he pours the melted sugar into the rocket, just like this. When he lights the fuse, the rocket blasts off into the sky. Wow, that gives you a real sense of just how much energy is stored in sugar. All of this is just to show you, energy isn't just some cute expression that we use—it's a real thing. Energy may not be something you can see or hold, it's not an object, but it is real. Inside a battery, inside of food, inside of gasoline, there is something stored up, which, when it gets released, makes things start moving. That thing or ability to make something start moving, that's what energy is. Batteries, food, and gasoline are just a few of the things that contain energy stored inside of them. But there are even other things that can store energy. We've talked about real cars, but consider something like this, a wind-up toy car. Where does a wind-up toy car get its energy from?

EXPLORATION VIDEO 3

Wind-up toys are a classic toy of childhood. I'm sure you've played with one before. You know you have to wind it up to make it move, but have you ever thought about what's going on inside a wind-up toy? Well, have a look at this one. As you open up this wind-up toy, you immediately see there's no battery inside of there. So where does it get its energy from? How does it move? This thing right here. This piece of metal here that's all coiled up is a type of spring. When you twist the knob, you're winding the spring tighter and tighter. You see that? A spring is something that can store energy, just like a battery, or just like gasoline. The coiled spring inside of a wind-up toy car might not be something you've seen before. The more classic-looking spring, like this one, is one you might be more used to seeing. But it's the same kind of spring, like if you've ever used a pogo stick. As you press down on the spring, it stores energy, then releases it again, causing you to bounce back up. Where else can you find energy being stored and released? That's something we'll keep coming back to throughout this unit. You're going to get to explore and play around with energy. You'll even get to use what you learned about energy to design fun and useful things, starting today. Let's consider one other way that energy can be stored: in these, rubber bands. If energy is the ability to make something start moving, then rubber bands are definitely something that can store energy. One of my favorite things to do—and with this, you have to be careful—is to use a slingshot. It's basically a huge rubber band that you pull back and then try to launch something. Like in this case, launching apples at targets. You can see when you pull way back on the rubber band, the apple can fly all the way across the field. Now, I hope it goes without saying, but never use a slingshot indoors. Now you can even use rubber bands to make rubber-band-powered racing cars, where the more you wind them up, the farther and faster they go. There are so many creative ways of using rubber bands to make something move, like even this toy airplane. Now, why is it that the more your stretch a rubber band, the faster you seem to make an object go? Why do you think that is?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to build a new amusement park ride for the company Acme Amusements. The ride is called The Twist-O-Matic, and it works by twisting rubber bands, which store energy. When the rubber bands are released, they use all that stored energy to spin the riders around and around and around. Now, the real, full-sized amusement park ride hasn't been built yet. So today, you'll be testing a model, a smaller version of The Twist-O-Matic. Your goal is to figure out how to make the most exciting ride. We'll show you how to get started, step by step.

ACTIVITY STEP 1

Find a partner. If you're working alone, that's okay too. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Get your supplies. Each person will make their own Twist-O-Matic. If you're working alone, you'll want to make two.

ACTIVITY STEP 3

Fold your Twist-O-Matic in half along the thick, dark gray line, like this. Now, when you do this, be sure to press down with your fingernail to make a good crease. Then fold it in half again on the thin line, and make a good crease there, too. Okay, it'll look like this when you're done.

ACTIVITY STEP 4

It's helpful to color one side of the Twist-O-Matic to make it easier to see as the ride spins. You don't want to spend too long on this step, so we'll just color the riders' outfits. Use one different solid color on each rider so that you can tell them apart from one another. You can use any two colors you want. This should only take you about a minute, so I'll set a timer in case that's helpful. Okay, it's been a minute. Go to the next step.

ACTIVITY STEP 5

All right, now what you're going to do is find the back of the Twist-O-Matic. Then, cut along the two dotted lines until you get to those stop signs you see there. You see how this creates this flap of paper? You'll fold that flap up, like this, and match up the pictures. You'll make the fold a nice crease with your fingernail. Then, flip the whole thing over, like this. Fold the flap back down. Match up that picture again, and make another crease on both folds using your fingernail. So, it should look like this when you're done.

ACTIVITY STEP 6

All right, go ahead and get these supplies. You'll use them to set up two Twist-O-Matic models. Also, you should decide which of you will be Clipper and which of you will be Ruler.

ACTIVITY STEP 7

The Twist-O-Matic uses rubber bands to store energy, so we need to turn the rubber bands into strips. Clipper: cut the thin rubber band, like this. Ruler: cut the thick rubber band, like this.

ACTIVITY STEP 8

You'll be comparing two Twist-O-Matics, one that uses a thin rubber band and one that uses a thick rubber band. To make sure that we have a fair test, we need both rubber bands to be the exact same length. So, Clipper: line up the tops of the rubber bands, like this. Hold them down near the bottom. Ruler: if they're different lengths, cut the longer one so that they're both the same.

ACTIVITY STEP 9

Now let's add the rubber bands to your Twist-O-Matics. Have the riders facing you, like this. Then, Ruler: hold one end of a rubber band on the short middle line, like this. Then, Clipper: Close the binder clip over the rubber band to hold it in place. Okay, repeat these steps for the other Twist-O-Matic and rubber band.

ACTIVITY STEP 10

Now let's attach your Twist-O-Matic to a support beam. Ruler: put the end of the rubber band in the middle of the ruler, like this. Clipper: put the binder clip over it. Make sure the rubber band is still in the middle after you clip it. Repeat these steps with the other Twist-O-Matic. They should look like this when you're done. And here's a tip. If your ruler is a wavy shape, like this, look for a flat part in the middle where you could place the rubber band.

ACTIVITY STEP 11

The Twist-O-Matic need to hang in the air to spin. So, Ruler: place one of the rulers on the edge of a table, like this, so that the ride hangs in the air. Let about half the ruler hang off the table. Clipper: put a heavy book on top so that it stays in place. Then repeat this for the other Twist-O-Matic. You'll want to put these right next to each other.

ACTIVITY STEP 12

For your riders' safety, check that both of your Twist-O-Matic rides are balanced. If they lean to one side, you may need to adjust the rubber band and clip like this, so that they're clipped on the center lines.

ACTIVITY STEP 13

Okay, before you start testing, let's talk about the difference between a turn and a spin. For a turn, start with the riders facing you. Turn it clockwise until you see them again. That's one turn. Now a spin, release the ride after winding it up. And watch for the riders to pass in front of you. Every time you see the riders that's one spin. If the ride's going really fast, just watch for the color of their outfits. If it only goes around halfway that does not count as a spin. Okay, so now that you know this, go to the next step.

ACTIVITY STEP 14

Get your Twist-O-Matic Challenge sheet. Each person needs one worksheet.

ACTIVITY STEP 15

For your first challenge, the engineer from ACME Amusements tells you that the Twist-O-Matic must spin exactly five times on its own. Work with your partner. Fill in your answers for Challenge number one on your worksheet.

ACTIVITY STEP 16

The supply manager for Acme Amusements comes to you with some bad news. It turns out that the thick rubber bands cost a lot of money, so the Twist-O-Matic ride cannot use thick rubber bands. Work with your partner; fill in your answers for Challenge number two on your worksheet.

ACTIVITY STEP 17

Challenge three: how will you make your real ride go? Where will the stored energy come from? Draw your ideas.

ACTIVITY STEP 18

Discuss some ideas for Challenge number three. Then, put your Twist-O-Matics away and watch the final video.

WRAP-UP VIDEO

The Twist-O-Matic might not seem like any kind of ride in real life, especially not one made from rubber bands. But there are actually amusement park rides that make use of elastic bands, like this, called the Slingshot ride. And even though there's no spinning involved, what's happening in terms of energy is very similar. When you either pull back on a rubber band or when you twist a rubber band, like you did in the activity, the energy from your body gets stored in the rubber band. Or, to be more exact, the energy from your arm muscles is getting stored in the rubber band. That's energy that came from the food you ate. When the rubber band is released, the stored energy gets released, too, which is why your Twist-O-Matic would spin. But why did the thick rubber band spin faster than the thin rubber band even though you gave them the same number of turns? We're hoping you noticed that the thick rubber band was a little harder to turn. Because you had to use more energy to turn it, that means more energy got stored in that rubber band, which is also why, when you released the rides, the thick rubber band spun around a lot faster compared to the thin rubber band. In other words, the more energy you put in, the more energy you get out. The more energy stored in something, the more energy it can release. If you did want the thin rubber band to go as fast as the thick one, then you had to store more energy in the thin one by turning it around more times. Again, because you added more energy, it released more energy. It spun around faster. Notice how there's a connection between energy and speed. The more energy you store in something, the faster it goes when that energy is released. Or, to put it another way, if you want something to go really fast, you're going to need a lot of energy. And that makes sense with other things you've probably noticed before. For example, the faster a car goes, the more gasoline it uses. The faster an Olympic athlete wants to move, the more food they need to eat. What if we had used an even thicker rubber band in the Twist-O-Matic, not one this thick, but one more like this? Well, let's have a look. Let's spin it up. It takes a lot of effort to spin this one. Whoa, you see this? Look at how much that thick one spins! If you liked using rubber bands as a way of exploring the connection between energy and speed, definitely check out some of the other activities you can try, which we've linked in the Extensions. Have fun, and stay curious!