Lesson: "What if there were no electricity?"

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! Wait. Don't touch that. You've heard that before. This is the thing we're all told from the time we can first walk. Don't touch that outlet. It's dangerous. Don't stick anything in that outlet. Well, OK, except for things that are supposed to be plugged into it. Even then, the first time a kid learns to plug something in properly, parents often feel nervous about it. It's true, there's danger with electricity. You could get really hurt if you messed with an outlet. You could get electrocuted. But the danger of electricity also makes it mysterious, doesn't it? Like, what's back there behind the outlet? Is there a blue ball of lightning buzzing around? Where does electricity come from? And what is electricity? Did someone invent it, or has it always been here? You see what I mean? There's so much mystery about electricity, so many interesting questions we can ask about it. Today, let's focus on trying to figure out what electricity is. In order to find out, we have to know more about what electricity does. There's no better way to appreciate what electricity can do than a power outage. Have you ever had that happen? Sometimes it happens when a storm knocks down an electrical power line. You might be at home or maybe you're out shopping, and suddenly, the lights are flickering and the power goes out. How is your life different when there's a power outage? Take a moment now, and think about what kinds of things you lose the ability to do. Think about all the things that stop working when the power goes out.

EXPLORATION VIDEO 2

Every once in a while, there can be a power outage that doesn't just affect a single neighborhood or a town, but instead an entire section of a country. Sometimes even more than one country. That's what happened in huge parts of the United States and Canada on August 14th, 2003. Take New York City, for example. Say you were standing here in Times Square with all its billboards and signs. Times Square in New York City might be the most lit-up place in the world, but at 4:10 p.m. that day, all those lights went out. And not just the billboard lights. I'm talking about every light in the city. Hallway lights, kitchen lights, office lights. By the time the sun set, most people's homes were pitch black. Even worse, think of all those skyscrapers. At the moment the power went out, if you were in an elevator, guess what? Elevators are powered by electricity. Someone would have to manually come open the elevator doors to let you out. Even if you weren't on an elevator when the power went out that day, soon you might have realized you had other problems. Say that your school or office was some distance from where you lived, and so normally you'd take the subway to get home. Subways—they're powered by electricity. Well, okay, you think maybe you can just take a taxi or ride a bus home. They're not powered by electricity. Yeah, but guess what is? Traffic signals. When the traffic signals stopped working, now everyone had to take turns stopping and letting each car go. That led to huge traffic jams on nearly every street in the city. Now the power outage wasn't all bad. It could have been worse. Since it was August when it happened, the weather was fairly nice. Imagine instead if it had been the middle of winter with no heat. The heaters in our homes rely on electricity. You'd get so cold. Now, no electricity does mean that refrigerators and freezers stopped working, too. They're powered by electricity. Many grocery stores and restaurants soon realized, if they had any ice cream in their freezers, it was going to melt. So they had to give away all their ice cream. That evening, you might have been stranded at work or school in total darkness, but at least the first night you got some free ice cream, plus views of the night sky in all its glory, thousands of stars that normally would be drowned out by bright city lights. That might have been the only good thing about the power outage. To say that electricity is really important in our lives today is to not say it strongly enough. Without electricity, our everyday life basically comes to a complete stop. In some ways, it's like the heart and blood of our society. Electricity keeps so many things going. It's a form of energy. In fact, instead of calling it electricity, really we could say electrical energy. Like any other form of energy, it allows things to be moved, like subways you see here, and elevators, and so on. But electrical energy does even more than that, doesn't it? It doesn't just make things move. Based on all the things you heard in this story, take a moment now to stop and think about what's special or unique about electricity as a form of energy. Besides making things move, what else can electrical energy do?

EXPLORATION VIDEO 3

So, the reason we have outlets all over our homes and schools is because electricity, or electrical energy, is such an amazing form of energy. Not only can it make things move, like subways and elevators, but it can also light things up and even be used to make things hot or cold. But plugging things into wall outlets, that's not the only way to power electrical devices. They can be powered by batteries, too. A battery is something that stores electrical energy, and most batteries, especially the smaller kind that you can find in stores, are a safer strength of electrical energy than what comes out of the outlet. It's one we could actually experiment with to learn more about. Now, here are a few things you might already know about batteries and about electrical energy, but I'll mention them here just in case it's new to you or if you need a reminder. One thing you might know is that just like the energy you can trace in a chain reaction machine, electrical energy always moves along a pathway. It goes from one point to another, but electrical energy is special. It has some of its own rules. One of those rules is that electrical energy won't move along just any pathway. It will only move along a pathway made out of certain materials. Copper is a good example. The electrical energy in your home or any battery-powered devices is usually flowing along wires made out of copper on the inside. Aluminum is another example. Wires can be made out of aluminum. The wires that hang on power lines are usually made out of aluminum. We say that copper and aluminum are electrical conductors, which just means they're a type of material that allows electrical energy to flow through them. There are metal wires in almost everything that runs on electrical energy, not just the things you plug in. Have you ever looked closely at a light bulb? You can see there on the inside, it's got two little wires. You can also see it in this type of light bulb called an LED. An LED even has the wires sticking out on either end. Whenever a light bulb is on, electrical energy is flowing through those wires. Here's one last rule that's special to electricity. Have you ever noticed this on a battery? Every battery has two different ends or two different sides, and on one side you can always find a little plus sign painted on. Sometimes, on the other side, you'll see a negative sign. You see that? Whenever you hook a wire up to a battery, you give it a path, and electrical energy always flows from the negative side of the battery to the positive side of the battery, but until you give it a path, the electrical energy stays inside the battery. So those are the rules. Electrical energy needs a path. The path has to be made out of material like copper or aluminum. And in a battery, the electrical energy flows along the path from negative to positive. Now, let's put some of this knowledge to use and investigate something. It's time for today's activity.

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to make a flashlight of your own design. All you need is a battery, an LED light, and some aluminum foil. Like any other light bulb, an LED only lights up when electrical energy flows through it. So, before you make your flashlight, you're going to have to do some experimenting to figure out how to make electrical energy flow through that LED. That means thinking about everything you've learned about electrical energy today, and then using that knowledge to figure out different things to try. Experimenting also means just tinkering, messing around with something to see what happens. You'll know when you've figured it out when the LED lights up. Now, here's something to note. While you're experimenting, you'll try lots of things that don't make the LED light up. This might surprise you, but finding out what doesn't work is often just as important as figuring out what does work. After all, once you figure out how to turn the LED on, you'll be making a switch to turn it off. If you get frustrated because you don't get the bulb to light on your first try, then I would ask you to just think about this person, Thomas Edison, the inventor of the electric light bulb. He claims to have tried thousands of ideas that didn't work before he came up with one idea that worked. After he was a success, a reporter asked him how it felt to fail thousands of times. Edison explained that he didn't see it as that he failed thousands of times, it was more like he learned thousands of ways that don't work. Sometimes, that's what it takes to solve a tough problem. So it's your turn to be an inventor. It may take you a few tries to get a flashlight that works. I don't think it will take thousands of tries. We'll help you get started, step by step.

ACTIVITY STEP 1

Find a partner, if you can. Each person will make a flashlight. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Get your first batch of supplies. Each person needs these things. You'll get more supplies later.

ACTIVITY STEP 3

Can you make the LED light up? Use your battery and try out different things. You know you want electricity to flow through the bulb, how do you think you can make that happen? Take two minutes to tinker with it and try. Now this can be tricky so it's OK if you don't figure it out. After two minutes, we'll help you out. Ready? Go. Two minutes is over. Go to the next slide.

ACTIVITY STEP 4

If you didn't figure out how to light up the LED yet, that's OK. Let's take a closer look at the battery. The batteries you're used to might look different from this one. Take a moment and find the positive side. Where do you think the negative side is? Draw a picture of the battery on your worksheet on question number one. Do the two sides of the battery look exactly the same? Pay close attention to the details. Label everything you think might be important.

ACTIVITY STEP 5

If you haven't made the LED light up, try this. Look at the wires coming out of the LED. One wire is longer than the other. Put the long wire of the LED on the positive side of the battery, like this. Put the short wire of the LED on the other side. Now it should light up. Try it out.

ACTIVITY STEP 6

Why do you think the bulb lights up? Talk with your partner. Then do questions two and three on your worksheet. Draw a picture that shows what you think is going on. In question three, write a reminder about which wire of the LED goes on which side.

ACTIVITY STEP 7

Do you know where the negative side of the battery is? Some parts are tricky. Like, is the ring around the center of the negative side positive, or is it negative? And what about the edge of the battery, is that positive or negative? Experiment and find out. Remember the LED will light up when you put the long wire on the positive part and the short wire on the negative part.

ACTIVITY STEP 8

Here's how we experimented and figured out that the ring of the battery is positive, and so is the edge.

ACTIVITY STEP 9

Get the rest of your supplies. This is all you need to make a paper flashlight.

ACTIVITY STEP 10

Write L+ on one side of the card and S- on the other, so that you remember that the long wire goes on the positive side of the battery and the short wire goes on the negative side. Then, slide the LED onto the card with the long wire on the L side, like this. Then tape it in place with a sticker, like this. If your sticker is too wide, cut it. Don't cover the entire wire with tape. Electrical energy won't travel through tape.

ACTIVITY STEP 11

Here's a challenge for you. Now that the LED is taped on, can you use aluminum foil and your battery to make the LED light up? Give it a try. If you get stuck, talk to your partner. This is a tricky problem. Sharing and discussing your ideas is a great way to come up with possible solutions. If you get really stuck, go to the next slide.

ACTIVITY STEP 12

Before we give you any hints, talk about what you've figured out. Discuss.

ACTIVITY STEP 13

Having problems? Here's our checklist for getting the LED to light up. You can check these off one by one and fix any problems. If your LED is working, then help someone else.

ACTIVITY STEP 14

Your light-up card works as a flashlight. It'll let you see in the dark. But you probably want more than that in a flashlight. So here's a challenge. Change your flashlight to make it easy to turn on and off. Check the Extensions if you get stuck. If you have time, think about other features you want to add. If you don't have time to work on other features now, write your ideas on your worksheet. Maybe you'll have time to work on them later. There's one more video, so when you're done, make sure you advance the slide and watch the final video.

WRAP-UP VIDEO

So, you've done some experimenting with electricity today, and hopefully, now you have a better sense of what electricity is. As you've learned today, we often use this word, electricity. But electricity is a form of energy. Saying electricity is really the same thing as saying electrical energy. Electricity is a form of energy that has special importance to us because of all the things it can do. Like any form of energy, it has the ability to make things move. But not only can it make things move, we also use it to make things light up, or to make things get hot, or even to cool things down. Without electrical energy, as happens during a power outage, our lives as we know it come to a complete stop. Like the energy we saw in chain reaction machines, electrical energy moves along a pathway. But with electricity, that pathway has to be made of special materials, like copper or aluminum. These are usually in the form of wires. Behind every electrical outlet and every switch in your home are copper wires. Whenever you plug something in, you're connecting the wires in the wall to the wires in whatever you're plugging in, allowing electrical energy to flow through the thing you're plugging in. That's why it turns on. If you unplug something, you're disconnecting those wires, shutting off the flow of electrical energy to the object. It's the same thing with a light switch. When you flip the switch on, you're connecting the copper wire in the wall to the wire leading to the light. When you flip the switch off, it disconnects the wires, stopping the electrical energy from flowing into the light bulb. All of this is just an introduction to electricity. There's so much more to explore. Like, how does electrical energy turn into light inside of a light bulb? Where exactly does electrical energy come from? And how does electricity get into our homes? Sure, from wires that connect to power lines, but where does that electricity come from? Are power lines hooked up to giant batteries somewhere? These are all great questions that I hope we'll explore in future Mysteries. In the meantime, check out the Extensions for ideas about other activities and resources you can use right now. Have fun and stay curious!