mystery science

Lesson: “Where does energy come from?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! Who's the oldest person you've ever known? Like, have you ever met someone who's 100 years old? Or even older than that? Well, would you believe me if I told you that I once knew someone who lived in the 1800s? Back when I was a boy, my own great-grandmother was still alive. She lived to be very old, and she was born in the year 1897. Not the 2000s, not the 1900s—the 1800s. That's her right there, and that's me giving her a big old smooch. She was my great-grandmother, Lucia. I miss her a lot today, and I still think of her often. You see, one day, when I was a little kid, I was sitting next to Grandma Lucia, and I got curious. “Grandma,” I asked, “what was your life like when you were a kid?” I was shocked by what she told me. Grandma Lucia lived a life that was totally different from anything I had ever known. She'd been born in Italy during the late 1800s. She told me she didn't even go to school for very many years. Her parents needed her to stay home to help with work, just so her family could survive. Every day she would go out and gather food so that they'd have something to eat. Then, she and her siblings would have to go out to the forest and chop wood for burning in their furnace. That way, their family could cook food and stay warm at night. As I sat there listening to her story, I thought of how different my life was. I didn't have to go out and gather food. In fact, my parents would just go to the grocery store. There was always some kind of food in our kitchen. And I definitely didn't ever have to chop wood. I don't even know if I would've known

how to chop wood that young. In our house, if you were too cold, you could just adjust the thermostat. Poof—like magic, hot air would come on and blow through the house. What changed? Why was my childhood life so much easier than my great-grandmother Lucia's? What do you think?

EXPLORATION VIDEO 2

Why was my childhood so much easier than my great-grandma Lucia's? You might have thought of how many different inventions and devices there were by the time I was growing up. By the time I was growing up, there were grocery stores and refrigerators for our food. Heaters and air conditioning to control the temperature in our houses. It's not just the inventions, though. After all, any of these inventions require energy in order to work. Some of it is electrical energy, like the energy that runs refrigerators and your computer. And some of that energy is heat energy, like the energy from burning natural gas in this stove. We'll talk in a different Mystery about how exactly people generate electrical energy. But, even without getting into that here, my point is, by the time I was growing up, toward the end of the 1900s, we had so much more energy than my great-grandma Lucia did growing up in the 1800s. When Grandma Lucia was growing up, it's not that people did everything by hand. They had the idea of using energy to help them do work. But the sources of their energy were very limited. For example, I mentioned that in order to heat their homes, they had to chop and burn wood. That took a lot of work. By the time I was born, people were using sources of energy other than wood. Sources of energy that contained a lot more energy. One of the most popular was this stuff: coal. Like wood, coal is something that takes a lot of work to get. It's a type of rock, and it has to be mined out of the ground. And also like wood, it has to be burned in order to release its energy. But, a chunk of coal contains over 10 times more energy than a chunk of wood the same size. That means, a

chunk of coal releases enough energy to heat a stove for 10 more hours than a chunk of wood. So, given a choice between burning wood to heat your home versus burning coal to do so, coal clearly had a lot of advantages. There was another advantage to coal, too. You know that when you burn wood, it produces smoke. If you've ever had the smoke blow into your face, you know how uncomfortable it makes you. It makes your eyes start to water and sting. You start coughing. Breathing in smoke is actually dangerous for your health if you breathe it in every day. Now, when it's just one campfire, that's not going to harm you, as long as you sit somewhere out of the way of the smoke. But in the village where my great-grandma Lucia grew up, everyone was burning wood from their furnaces every day. That meant a haze of smoke would often hover in the air around them on the days when it wasn't windy outside. Their eyes would sting, and it wasn't good for their health. So, burning wood can produce a lot of smoke. By comparison, coal burns a lot more cleanly than wood. It produces far less smoke, which means the air quality would be better if people who were burning wood burned coal instead. During the 1900s, more and more people were switching from burning wood to burning coal. This is a major reason why, by the time I was growing up, there was so much more energy, which made my childhood a lot easier than my great-grandma Lucia's. And coal wasn't the only new source of energy that could be burned to release energy. What other sources of energy have you heard of? Are any of them ones that you burn to release energy?

EXPLORATION VIDEO 3

It wasn't just coal that became an important source of energy during the 1900s. There were other new sources, too. Things that were packed with energy. You're familiar with petrol, or gasoline, which is used to power so many cars. Americans sometimes call it gas for short—confusingly, because it's actually a liquid. It's a liquid that we get from oil that's been

drilled out of the ground. There's also natural gas which is really a gas. You might recognize it if you have a stove like this. It's powered by natural gas. It's also used in many heaters. Like coal, gasoline and natural gas have some things in common with wood. They're all sources of energy that have to be collected. Also, they're all things that have to be burned in order to release their energy. But, unlike wood, coal, gasoline, and natural gas are each packed with lots more energy than wood has, which means that burning them releases more energy than we can use. Having all of this energy is what allows us to do the otherwise huge amount of work that's needed in order for us to build things like skyscrapers and cities. To power machines and refrigerators and computers. To grow and harvest food for billions of people, and much, much more. The fact that today we have lots more energy is a huge part of why my childhood was so much easier than my great-grandma's. The fact that when I grew up, there were energy sources like coal, gasoline, and natural gas. All of these things meant I didn't have to go out and chop wood. I didn't have to go out and gather food, and so on. Having more energy saves us the time from having to do all the incredibly difficult work we used to have to do by hand, which means more of us can now spend more time being relaxed and having fun, and, most important of all, having more time means having the time to work on new challenges that we couldn't work on before—and here is one of those challenges. We have power plants to generate the electrical energy we need, but those power plants still involve burning things. We could go so far as to call these sources of energy “the burnables.” While the burnables like coal, natural gas, and gasoline are packed with energy and have some clear advantages, they have some definite disadvantages as well. For example, we talked about how burning wood generates a lot of smoke, which, if you're breathing in a lot of it, can be dangerous for your health. When you just burn a little coal, it doesn't produce much smoke that you can see, but once you burn lots and lots of it, the smoke can become really noticeable. Here's an example you can see for yourself.

This is the view from Beijing, China, on a busy day. It looks like it's a foggy day, but that's not fog—it's smog, fog mixed with smoke from burning coal. Over 70% of China's energy today comes from burning coal. Even though burning coal produces so much less smoke than burning wood, China has over one billion people. That means they're burning a lot of coal, enough to where the small amount of smoke can build up and create very bad air pollution. It's not just China either. Here's the view from Los Angeles, California, where the smog from cars burning gasoline can be really noticeable, especially when there's no wind blowing. What can be done about the problem of air pollution from burnable sources of energy? This is an important problem that many scientists and engineers work on today. Scientists are exploring ways to use sources of energy that don't involve burning anything. These are called alternative sources of energy. Alternative is another way of saying different. In this case, they're different from burning. What kinds of alternative sources of energy have you heard of?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to help a town get all of the energy they need without burning wood or coal or anything else. The town is Boulderville, Nevada. Right now, Boulderville gets its energy by burning coal. But the people of Boulderville want to get their energy using alternative energy sources. To help Boulderville figure out a plan, you'll travel to three towns across the United States. These towns don't burn fuel. They use sunlight, wind, and flowing water to make electricity. At each town, you'll gather information. Then, you'll make a plan that will let the people of Boulderville get all the energy they need without polluting the air. I'll show you how to get started, step by step.

ACTIVITY STEP 1

Find a partner. You'll travel together and make a plan. If you're working alone, that's okay, too. When you're done with this step, press the arrow on the right.

ACTIVITY STEP 2

Go ahead and get these supplies for your trip. You'll get more supplies later.

ACTIVITY STEP 3

First, you're going to fly to Greensburg, Kansas. A little town located on the plains. While there, you meet the town's mayor to talk to her about what kind of energy they use. The mayor hands you this report to read. Go ahead and read the report from Greensburg on the wind energy to yourself now. Once everyone has read it, go to the next slide.

ACTIVITY STEP 4

Read questions one, two, and three aloud as a class. Then read the report again with your partner and write your answers.

ACTIVITY STEP 5

The mayor tells you that two windmills can power a town the size of Boulderville. Look at this map of Boulderville. We've included a windmill so that you can see how big one is. Discuss.

ACTIVITY STEP 6

Take a few minutes to look at this graph of wind speed in Boulderville. Discuss: do you think Boulderville can use windmills for their energy? Why or why not? You might need to look at the report for a clue.

ACTIVITY STEP 7

Answer number four on your Wind Energy sheet.

ACTIVITY STEP 8

Now you're going to fly to Ranchtown, Florida. There you meet the town's head engineer and you talk to her about what kind of energy they use. In response, the engineer gives you this report to read. Go ahead and read the report from Ranchtown on the Sun Energy sheet to yourself.

ACTIVITY STEP 9

Read the report again with your partner, looking for answers to questions one, two, and three. Write your answers, and then go to the next slide.

ACTIVITY STEP 10

Before you head to your next town, have a look at this map of Boulderville. To use energy from the Sun to power Boulderville, you'd need a whole field of solar panels. Discuss.

ACTIVITY STEP 11

This map shows how much energy from the Sun that different places get. Boulderville has 1,000 houses. Do you think it's sunny enough in Boulderville to use solar energy?

ACTIVITY STEP 12

Answer number four on your Sun Energy sheet.

ACTIVITY STEP 13

Finally, you're going to fly to Aspen, Colorado, a town that's high in the mountains. While there, you meet the town's historian and you ask him what kind of energy they use. In response, the historian shows you a picture of what they use and gives you this report to read. Go ahead and read the report from Aspen on the Water Energy sheet to yourself.

ACTIVITY STEP 14

Read the report again with your partner, looking for answers to questions one, two, and three. Write your answers, then go to the next slide.

ACTIVITY STEP 15

Have a look at this map of Boulderville, then discuss.

ACTIVITY STEP 16

Now, look at this map of Boulderville and discuss.

ACTIVITY STEP 17

Have a look at this chart. Afterward, discuss. Here's a hint: you might need to look back at the report.

ACTIVITY STEP 18

Go ahead and answer number four on your Water Energy sheet.

ACTIVITY STEP 19

All right, time to get your last supply.

ACTIVITY STEP 20

With your partner, decide what type or types of energy you'd recommend for Boulderville. You could choose more than one if you want. Use this sheet to write a letter to the town. You can draw where you'd put windmills, solar panels, or dams on the map if you'd like. Fill in the worksheet now.

ACTIVITY STEP 21

For your plan, you decided to use a certain kind of energy for Boulderville. Look around the room for a poster that matches your plan. Then, go to that poster. Discuss these questions with the others at that same poster.

ACTIVITY STEP 22

Can your class agree on what Boulderville should do? Your teacher will lead a class discussion. Afterward, be sure to watch the final video.

WRAP-UP VIDEO

Boulderville wants to use an energy source that doesn't involve burning something. In the activity, you read about three options. For each one, you had to consider the advantages, or pros, and the disadvantages, or cons. Wind has some interesting advantages, especially that it doesn't involve burning anything, but for it to be a source of energy that people can depend on, it needs to be windy. You saw from the graph that, at least in Boulderville, most of the time it's not windy enough for wind to be a dependable source of energy. Solar panels were another interesting choice, especially since Boulderville is located in the desert. There's plenty of sunlight year-round, however, one disadvantage is that solar panels can only produce energy when the Sun is shining, and we can't forget that even though Boulderville is a sunny place, the Sun isn't out at night. So solar panels are an interesting option as long as you keep in mind that they wouldn't be a completely dependable source of energy, at least not if they're the only thing that Boulderville used. That left one other option you considered in the activity: water power, or hydroelectric energy. In other words, using the energy from flowing water to spin turbines to produce electricity. You saw from the map that Boulderville has a river and that the river flows enough for it to be a source of energy for the town. Now, if there's a dry spell where the river doesn't flow much, a lake created by a dam could be a source of energy. So, building a dam would be an option for Boulderville if they want to use a source of energy that doesn't involve burning fuels. In the activity, Boulderville was just a made-up example, but it's based on a real

town: Boulder City, Nevada, in the U.S.A. Burnable fuels are the most common source of energy for towns and cities today. For example, many towns and cities rely on burning coal for their energy—but not Boulder City, Nevada. They have a huge dam, The Hoover Dam, which generates enough electricity for over a million people in three different states. Boulder City also put in an entire field of solar panels to capture energy from the Sun. Now, since this might have been the first time you've thought much about energy and where it comes from, keep in mind that the things you learn about energy today are just the beginning of your learning. If this were a real-life decision for a town, there would've been many other questions you'd want to get more information about. Maybe you thought of some of these. For example, how much does it cost to produce a windmill or a solar panel or a dam? What materials are these made from? And where do they come from? And how much energy do each of these give us? You might also have wondered, since the Sun goes down at night, is there any way we could store the energy that we get from solar panels during the day? There are so many more questions left to explore. There are even other sources of energy we haven't talked about yet, like nuclear power. How we get energy is a topic that you'll have the opportunity to learn even more about in middle school and high school. That's because it's an important topic that scientists and engineers are still working on. We live in a world that's made possible by us having lots of energy available to us. Whatever way we get that energy, we're probably going to benefit from even more it in the future. How can we get energy in a way that's affordable, dependable, and that won't cause air pollution? There are lots of challenges left to solve. Maybe you'll be someone who helps to solve them. Have fun, and stay curious!