Lesson: “What's the best way to light up a city?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi. It's Jay from the Mystery Science team. When I travel, I love it when I get to fly into a city at night. If you're sitting by a window, you can see the light sparkling down below. From up here, it looks like the whole city is glowing. Once the plane lands, you can see that the glow you saw from above comes from thousands and thousands of individual lights. Car headlights, streetlamps, billboards, TV screens, and more. Each one of those lights is powered by electricity. Imagine how much electricity it takes to power enough lights that you can see the city glow from a plane. If you live in a city, this might seem normal to you. You see a bunch of lights like this every day. But if you think about it, it's really impressive. That's so much electricity. How does this happen? How does a city get electricity to power all these lights at once? Let's start by looking at just this one electric desk lamp. You probably know that to make the lamp work, you have to plug it into the wall using a power cord. Electricity flows from the outlet through the cord into the lamp and lights it up. Great. But where does the electricity in the outlet come from? Maybe you've wondered about this before. Inside the walls of many modern buildings, there are wires and cables we don't usually see. Those wires bring electricity to outlets like this one. Okay. But where do the wires in the wall get electricity from? If you keep following those electric wires and cables, you'll see that they actually leave the house, and they keep going through power lines like these and more lines and more and on and on. If you keep

following these power lines, eventually you might reach something that looks like this. This is a power plant. And if you go inside this power plant, deep inside you might find this: fire. Wait, fire? Why is there fire in here? What does fire have to do with electricity? I wonder if you have any ideas.

EXPLORATION VIDEO 2

The fire at this particular power plant is made by burning a material called coal. You may hear about different materials burned in other power plants too, such as something called natural gas. What these materials have in common is that when you set them on fire, they burn hot for a long time. Heat is a kind of energy. Electricity is also a kind of energy, electrical energy. The machines in this power plant do something incredible. They transform heat energy from this fire into electrical energy. This power plant doesn't make brand new energy. It just converts energy from one form, heat, into another, electricity. This might seem surprising, but you've probably seen energy transform before. When you turn on a lamp, for example, that's electrical energy transforming into light energy. So, in short, fire has heat energy, which the power plant changes to electrical energy. That electrical energy can then travel through power lines, more power lines, into the wires in this house, out through this outlet, into this lamp's power cord and then tada! The lamp lights up. The trouble is when you burn something you get more than just energy. Other things are left behind. Take a look for yourself. What do you see coming from this fire?

EXPLORATION VIDEO 3

When a fire burns out it stops releasing heat energy, but it often leaves behind stuff like this: ash. What exactly that ash is made of and how much ash there is depends on the material that's

burning, but there's usually something left behind on the ground. And then there's stuff fire releases into the air, like this smoke. Just like with ash, how much smoke there is and what's in that smoke depends on what material is burning. But in general, most fires leave behind stuff in the air and stuff on the ground. And these leftovers can create big challenges for power plants that burn things because if too much leftover burned stuff gets into, say, the water we drink or the air we breathe, it can make people, animals, and plants sick. That's called pollution. Sometimes pollution is easy to spot. This is a photo of the US city of Los Angeles from many years ago. See that band of smokey-looking air right above the buildings? That's caused by air pollution, smoke and other stuff in the air. That pollution can make people unhealthy if they breathe too much of it for too long. Over the years, Los Angeles has taken a bunch of steps to reduce its air pollution. This is a more recent picture. You can see the air looks a lot clearer. But unfortunately, pollution can cause problems even when we can't see it. When smoke floats into the air or ash mixes into water, sometimes it seems like it disappears, but it's still there. Pollution is a problem in many places throughout the world. Of course, we don't want pollution to make us sick, but we do want electricity to power our homes and towns and cities. So, is there any way we can get electricity without burning stuff? Power plants transform heat energy into electrical energy. Maybe there are other kinds of energy we could transform into electrical energy too. Like check out this. During the day, the sun provides lots of light energy or what's called solar energy. These solar panels can transform that light energy into electrical energy. No burning needed. Just like the electricity from the other power plant we saw, electricity from solar panels can travel throughout power lines, more power lines, and into buildings where it can power things like this lamp. And solar energy isn't the only source of energy we can transform into electricity. Let's take a look at another energy source at work in two different machines. Compare these two machines. What's similar about them? What's different?

EXPLORATION VIDEO 3

I don't know how you answered, but you might have noticed that one thing they have in common is that they both move. In particular, they both have parts that turn or spin. That spinning is actually energy. Anything that moves has energy. This bowling ball rolling down a bowling lane, that has energy. This pinwheel spinning in the wind, that has energy. This bicycle tire turning around and around? Energy. That's how this machine works. These are wind turbines. You might have heard them called windmills before. When the wind blows these blades, they move. The machine inside then transforms that wind energy into electrical energy. The same idea is how water power works. This machine is called a water turbine. As water flows downhill, it pushes these blades making them move. The machine then transforms that water energy into electrical energy. Both wind power and water power transform energy from movement into electrical energy. That energy then travels through power lines, more power lines, and into buildings. So there's actually a lot of energy sources to choose from. But as we've seen, these sources each work differently and have different advantages and disadvantages. Think back to that coal fire. One problem we saw was that burning things for energy can create pollution. But there's another problem too. Once the fire is finished burning, you can't burn that ash again. When we burn something, we can only use it for energy one time. That's it. There's a limited amount of things to burn in the world. We might eventually run out. With energy from the sun, wind, and water, we don't have to worry about that. That's why these energy sources are sometimes called renewable energy sources because we don't have to worry about permanently using them up. So, if a city decides they want to use a renewable energy source for their electricity, how do they choose? How do you think cities decide what energy source to use for electricity? I wonder what you think.

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 1

Boulderville wants to use an energy source that doesn't involve burning something.
In the activity, you read about three options, wind, sunlight, and water. Each one had advantages and disadvantages. The town of Boulderville is a made-up example but real cities and towns really have to make this decision, and these are some real options they consider. Some places get their electricity from power plants that burn things like coal and gas. Others use renewable energy like solar, wind, or water. What energy source to use is a big and important decision, one that impacts just about everyone and everything living in that place.

Let's take a look at the choices some real towns made. Check out this town in the US state of Missouri. This was the first US town to get its electricity entirely from wind. Wind energy has some interesting advantages. It doesn't involve burning anything, which helps limit the pollution wind turbines create. But for wind energy to work, it needs to be windy. You saw from the graph that in Boulderville, most of the time, it's not windy enough for wind to be a dependable source of energy. Solar panels are another interesting choice, especially for Boulderville where there's plenty of sunlight year-round. Let's take a look at this real town in the US state of Florida. This place gets its electricity entirely from solar panels. You might even spot some of them on the roofs of the buildings here. Solar panels can produce lots of energy if the sun is shining.
But even in the sunniest places, the sun isn't out at night. Any place relying on solar panels has to store some electrical energy produced during the day in batteries like these and rely on that stored energy until the sun comes up again. Luckily for this Florida town, these solar panels produce more electricity than the town needs during the day so they can store the leftover energy to use overnight. There's one more option you considered in the activity, water energy. You saw from the map that Boulderville has a flowing river that could be a source of energy. If there's a dry spell where the river doesn't flow much, a lake created by a dam could help keep the water power plant working. But creating a lake with a dam is a big deal. Changing how the water flows can disturb living things in and around the water. Boulderville is a made-up town, but it's based on a real place. Boulder City in the US state of Nevada. Boulder City gets a lot of electricity from water power plants that rely on dams like this one. The city also built an entire field of solar panels to capture energy from the sun. The things you considered about energy today are just the beginning. If this were a real life decision for a town, there would have been many other questions you'd want to get more information about. If you were deciding between

wind, solar, and water power for a real town, is there anything else you would want to consider before you made your decision that we didn't consider in the activity?

WRAP-UP VIDEO 2

When you're choosing how to power a whole city, there are so many things to consider.
For example, how much does it cost to make a wind turbine or a solar panel or a dam for water power? Who is going to do the work of building these things? What materials will we need to build them? Where do those materials come from? And how much electricity does each of these options give us? These questions are complicated and important. Scientists and engineers are still working on finding answers. You may have ideas on how to solve some of the problems with the different energy sources we use. Maybe we could find better ways to reduce pollution from power plants that burn things so we can keep living things healthy. Maybe instead of producing more and more electricity, we could also find ways to use less electricity by, say, turning off electronics when we don't need them or inventing machines that don't need as much energy. You may even have heard of other sources of energy we haven't talked about yet. So many things in our lives depend on electricity. How can we power our cities and towns in a way that's affordable, dependable, and keeps our environment healthy? There are lots of challenges left to solve. Maybe you'll be the one to help solve them. Have fun and stay curious.