Lesson: “Where's the best place to build a snow fort?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hey, it's Jay from the Mystery Science team. When I was a kid, my family often spent winter break visiting my grandparents in the U.S. state of Florida. Sometimes, during our visits, we'd see something weird. See that? That's an iguana falling out of a tree. Don't worry, she'll be okay, but she's not the first iguana to fall to the ground during a Florida winter, and she won't be the last. In fact, warnings about falling iguanas are sometimes even included in the weather report in Florida news. If you don't live in Florida, raining iguanas might seem pretty wild, but to this kid, it's old news.

- Do iguanas fall out of trees when it's cold outside? Yes, they do.

Notice, he's wearing a warm coat and mittens, totally prepared for chilly weather. Iguanas fall out of trees when the temperature gets too cold. Iguanas are used to living in very warm places, even warmer than Florida. When it's cold, iguanas have a hard time moving, so they can't keep their grip on the trees where they live and can't climb back again until the temperature gets warmer. When I was a kid, this seemed funny to me. See, I grew up in the U.S. state of Wisconsin. Winter in Wisconsin often looks like this. Compared to what I was used to, winter in Florida was super warm. Before we go on, I'm curious, how do you know it's winter where you live? What changes do you notice? Are the changes big or small?

EXPLORATION VIDEO 2

Winter can look and feel really different depending on where you live. Florida and Wisconsin both get colder in winter, but there's a big difference between Florida winter cold and Wisconsin winter cold. In Wisconsin, I knew it was winter when I had to put on leggings, a winter coat, a scarf, a hat, thick gloves, and boots just to stand outside my house and wait for the school bus. But my grandparents in Florida knew it was winter because it got cold enough to wear a sweater outside. Our bodies react to the temperatures we feel. We shiver and feel chilly when we're too cold, and we sweat and feel hot when we're too warm. Other living things can change in colder temperatures, too. Like some birds migrating south for the winter, leaves turning red, or iguanas falling out of trees. We also have tools that can tell us exactly how hot or cold it is. Maybe you've seen one of these before. These are thermometers that measure the temperature outside. Some modern thermometers just show a number for the temperature. Others show the temperature like this. The first time I saw a thermometer like this, I thought it looked really complicated. How do I even know where to look to find the temperature? On this kind of thermometer, the hotter it gets, the higher the colored bar rises, and the colder it gets, the lower that bar falls. To read a thermometer like this one, look at where the colored bar ends at the top. The number it stops at is the temperature. But maybe you noticed that on this thermometer, there are different numbers on either side of the colored bar. On this side where the colored bar ends, it says 10, but on the other side, it says 50. So which is it? It's both. This thermometer shows two different ways of measuring temperature in numbers. The letter C on top of the thermometer stands for Celsius. And if you see the tiny circle symbol next to it, that stands for degrees. Most of the world measures temperature in degrees Celsius, but the U.S. and a few other countries, measure temperatures in degrees Fahrenheit. The letter F at the top of the

thermometer stands for Fahrenheit. This thermometer shows that it's 50 degrees Fahrenheit or 10 degrees Celsius outside. That's the same temperature, just a different way of measuring it. For today, I'm going to talk about degrees Fahrenheit because that's what I used when I was growing up. I used to have a thermometer like this one outside my front door in Wisconsin. I'd check it in the morning before I went outside to wait for the school bus. Imagine you're reading this thermometer before you head outside. What temperature does the thermometer show here? Do you see any other clues that tell you if this temperature is hot or cold?

EXPLORATION VIDEO 3

This thermometer shows that it's 35 degrees Fahrenheit outside. At this temperature, a tiny change can have big impacts. Check out what happens when the temperature gets colder, to below 32 degrees Fahrenheit. If you were playing outside here, you might not even feel colder if the temperature dropped by that little. You might not see anything change either, at least not right away. But over time, if the temperature stays this cold, you might start to see this. Liquid puddles begin to freeze to solid ice. Water dripping from rooftops might freeze to solid icicles. Those plants get covered in a layer of icy frost. But what happens if the temperature moves the other way? Take a look at this snowy park. Someone built a snowman. The temperature here is below 32 degrees Fahrenheit. But what if the temperature gets a little warmer, above 32 degrees Fahrenheit? How do you think this place will change if it stays that temperature for many days? What will look different?

EXPLORATION VIDEO 4

While the temperature is colder than 32 degrees Fahrenheit, the snowman stands tall. There’s snow piled all over the ground. Scientists call 32 degrees Fahrenheit the freezing point of water.

Watch what happens to a glass of water when it's left outside below 32 degrees Fahrenheit. It freezes solid. And as long as the temperature stays below the freezing point, snow and ice, which are made of water, stay frozen too. But now watch, if the temperature rises above the freezing point, everything made of water will start to melt. Solid ice will melt into liquid water, and any snow will turn into puddles. Growing up in Wisconsin, it was exciting when the temperature dropped below freezing. Even as a kid, I loved building things. Sometimes when it snowed, my sister and some friends and I would build big snow forts. The closer the temperature got to freezing, the closer it was to snow fort weather and the longer the temperature stayed below freezing, the more we could add to our snow fort and the longer it would stay standing. But sometimes I dreaded the temperature dropping. The colder it got, the more uncomfortable it was to be outside, even in many layers of warm clothing. If the temperature dropped below 25 degrees Fahrenheit, I didn't want to be outside for even a moment longer than I had to. Where I lived in Wisconsin, some winter days were too cold or too hot to build a snow fort. But we usually got some days each winter that had perfect snow fort-building weather. How about where you live? Imagine you want to build a snow fort in your city or town next winter. Will the weather be good for building a snow fort where you live next winter? How do you know?

EXPLORATION VIDEO 5

There are many ways scientists predict future weather. They track storms, winds, and temperatures as they change from moment to moment. They study clouds and use high-tech instruments to detect tiny changes before they become big ones. But maybe you thought of a simpler way to predict if you'll have good snow fort weather near you next year. Depending on where you live, maybe you thought, “Well, it was definitely snowy here this winter,” or, “It never snows here in winter, of course there won't be snow here next winter.” That's a method

scientists use too. To make predictions about the future, scientists often start by collecting information from the past and present. One year when I was a kid, I noticed that the temperature in my grandparents' town in Florida never dropped below freezing during our trip in December. And the next December, I noticed that the temperature never got below freezing either, or the December after that. What if I decided that the year after that, I'd use a thermometer to measure the temperature throughout December and see if it was the same as years before? By observing and recording the weather, I could gather information to help me answer a question. A scientist might call that information *data*. In this case, my data showed something interesting. I noticed that the temperature stayed above freezing year after year after year after year. Scientists call something that happens again and again and again a *pattern*. Patterns are super useful because they can help scientists predict the future. If something happened the same way again and again in the past, it's likely to happen that way again in the future. By looking at the weather in your town in the past winters, you might find a pattern that can help you predict what the weather will be like next winter. Suppose you wanted to find a great spot to build a snow fort next December. What kinds of data could you collect to find a place with great weather for snow fort-building?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to decide where to have a snow fort festival where people build big, beautiful snow forts. You know that the weather is really important when you're building a snow fort. If it gets too hot, the snow starts melting. And if it's too cold, it's no fun to be outside building a fort. So you'd really like to find a place where the temperature is just right. You've chosen a time for your snow fort festival: the last week in December will be when people build their forts. Then you'll have a big party on January 1st, New Year's Day. Towns in three different

U.S. states are excited about having a snow fort festival. In the activity, you'll learn about these three towns from a kid who lives in each place. The kids will give you data about what the weather was like in each town last December. You'll use that data to predict what the weather in each town will be like this coming December when you plan to have your festival. Finally, you'll compare the three towns and choose the one where you'll have your snow fort festival. No place will be perfect. Every town has days that are a little too hot or too cold. You'll have to pick the town that you think is the best of the three. We'll show you how to get started, step by step.

ACTIVITY STEP 1

For this activity, you'll work with a partner. Once you have a partner, decide who will be Snowball and who will be Icicle. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

You're going to hear about three different towns that want to have the festival. But first, get your supplies.

ACTIVITY STEP 3

Town number 1 is Madison, Wisconsin. Jackie is here to tell you about her hometown. She says, "We have plenty of snow every December. One year, right in the middle of town, thousands of students had one of the world's biggest snowball fights. I hope you choose my town for the festival." You'll look at the data from Madison first. Icicle: write Madison, Wisconsin beside Town Number 1 on your "What's the Weather?" chart.

ACTIVITY STEP 4

Before you do anything else, you need to make sure you know how to read the temperature on a thermometer. Let's practice. Last December, Jackie checked her family's thermometer every day. She drew a picture of what it looked like. Look at Jackie's pictures on your Thermometers worksheet next to where it says Madison. These show the temperatures from the last week of December. Discuss with your partner.

ACTIVITY STEP 5

Let's start by marking all the days in Madison that were above the freezing point, warm enough that snow was starting to melt. We'll call those days Too Hot. Snowball: on the Thermometers worksheet, find each day in Madison where the temperature was above 32 degrees Fahrenheit. In red, cross off each day that was too hot. Icicle: count the number of days that are crossed off.

ACTIVITY STEP 6

Now get your Weather Chart. This chart will help you organize the data from the Thermometers worksheet. Icicle: in the chart, find the row where you wrote Madison, Wisconsin. This row is where you'll put all the data for Madison. Find the column for Too Hot days. Write down the number of Too Hot days in Madison.

ACTIVITY STEP 7

Madison had one day that would be hot enough to melt some snow. Now let's see if they had any days that were so cold you wouldn't want to be outside building a fort. Snowball: on the Thermometers worksheet, find each day in Madison where the temperature was below 25

degrees Fahrenheit. In blue, cross off each day that's too cold. Icicle: on your Weather Chart, find the column for Too Cold days. Write the number of Too Cold days in Madison's row under Too Cold days.

ACTIVITY STEP 8

You found days that are too hot and days that are too cold. Any day that doesn't have an X was just right for snow fort-building, not too hot and not too cold. Snowball: with a pencil, circle those days. Icicle: count the Just Right days and write that number in Madison's row under Just Right days.

ACTIVITY STEP 9

Think about the weather in Madison. Discuss.

ACTIVITY STEP 10

Town number 2 is Fairbanks, Alaska. And Nicky is here to tell you about his hometown. He says, "We know how to have winter fun here in Alaska. My town holds winter sports competitions each year. I'd love to have a snow fort festival here." Did Nicky gather data on the temperatures in Fairbanks during December last year? Icicle: write Fairbanks, Alaska, beside Town Number 2 on your Weather Chart.

ACTIVITY STEP 11

Now you and your partner will switch jobs. Snowball: look at the thermometers for Fairbanks. If you forget what to do, look at the key on your worksheet. Cross out any Too Hot days in red. Cross out any Too Cold days in blue. Circle any Just Right days. Icicle: once your partner has

marked the days, count the number of each kind of day. Write those numbers on your Weather Chart in the row for Fairbanks.

ACTIVITY STEP 12

Fairbanks is one of the coldest cities in Alaska. Maybe you noticed that you couldn't find any Too Hot days to mark. Compare Madison and Fairbanks. Discuss with your partner.

ACTIVITY STEP 13

It's time to learn about Town Number 3. Jose is here to tell you about his hometown, Truckee, California. He says, "Most people think that California is all beaches and sunshine. Nope, my town is high in the mountains and we get lots of snow. I love to go sledding and skiing. I hope the snow fort festival is here." Jose has collected data for you. You'll look at this data next. Icicle: write Truckee, California, beside Town Number 3 on your Weather Chart.

ACTIVITY STEP 14

Now you and your partner will switch jobs. Snowball: look at the thermometers for Truckee. Mark Too Hot days, Too Cold days, and Just Right days. If you're not sure what to do, look at the key on your worksheet. Icicle: once your partner has marked the days, count up the number of each kind of day. Write those numbers in Truckee's row on your Weather Chart.

ACTIVITY STEP 15

You need to choose where to have your festival, but no town has the perfect weather. That makes your decision difficult. Look at your weather chart. Compare Madison, Fairbanks, and Truckee. Discuss.

ACTIVITY STEP 16

So far, you've only looked at the temperature in these towns. Discuss.

ACTIVITY STEP 17

Maybe you thought about wind or clouds or snowstorms. We thought it would be good to know how many snowstorms each town had last December. That would help us predict how many snowstorms each town might have next December. On this chart, a snowflake marks each day there was a snowstorm. Icicle” write Snowstorms in the box that says More Data. Snowball and Icicle: count how many snowflakes you see for each town. Then write the number of snowflakes for each town under Snowstorms.

ACTIVITY STEP 18

Think about how snowstorms might affect your snow fort festival. Discuss.

WRAP-UP VIDEO 1

When you looked at the temperature data for Madison, Fairbanks, and Truckee, it was clear that none of these places had perfect snow fort-building weather last December. Even so, some towns had better weather for a snow festival than others. Fairbanks, Alaska, had zero days above freezing, not a lot of risk of snow forts melting there, but often it was too cold. We marked six days too cold to build. Madison, Wisconsin, was the opposite. Madison had just two days when the weather got too cold for building, but there was also one day when the weather got too warm. Still, most of the days were just right for building. And Truckee, California, was about the same. It had five days where the temperature was just right for snow fort building and no days

warm enough for snow to melt. But Truckee did have two days that were too cold. The data about snowstorms made choosing a town even trickier. Truckee had five snowstorms in the last week of December last year. That's a lot of snow. A lot of snow might be a good thing, more to build with, but too many big snowstorms could be a bad thing—especially if they come with strong winds too. Who wants to build in the middle of a blizzard? There's no perfect answer here. As a matter of fact, in real life, people have made amazing things out of snow and ice in all three of these places. From this huge snow tower in Madison to this ice sculpture in Fairbanks to this giant snowman slide in Truckee. Predicting future weather is complicated. There are so many different things that can shape what the weather is like: temperature, snow, rain, wind, seasons, and more. And just because the weather was a certain way last year, that doesn't guarantee the weather will be the same next year. We know it's likely that the weather in Madison last December will be similar to the weather in Madison next December, but sometimes unlikely weather happens. You've probably had experiences where the weather you thought would happen didn't happen. Maybe you went to a mid-summer cookout expecting blazing hot sun and found yourself shivering in a cold drizzle. Or maybe you brought an umbrella to school because the weather report predicted rain, but it never rained a drop. So if we know it's nearly impossible to predict exactly what the weather will be like in the future, why do we even try? What's the point of gathering data and making predictions if we know that at least some of them will be wrong? I wonder what you think.

WRAP-UP VIDEO 2

Predictions based on the past can be wrong sometimes. The more specific a prediction you try to make, the harder it is to predict correctly. If you tried to predict what the temperature will be at 2:35 PM on December 26th in the year 2047 on Audrey Drive in Fairbanks, Alaska, it would be

really hard to make a correct prediction. Even places that have strong weather patterns—places that are almost always cold, or hot, or rainy or dry, for example–aren't going to be the exact same amount of cold or hot or rainy or dry every single hour of every single day. But that doesn't mean that the patterns we noticed in past data aren't useful. We might not know exactly what temperature it will be next December 26th in Fairbanks, but past weather patterns show that it is very, very, very likely that it will be below freezing for most of December. And you're definitely way more likely to see good weather for snow fort-building in Fairbanks than you are someplace like Key West, Florida. In Key West, past weather patterns show that there's almost never been weather cold enough for snow, let alone enough for a snow fort. Studying patterns can help us prepare for future weather before it comes, and understanding patterns can also help us spot the difference between a small change in daily weather and a big change in weather patterns. Like, what if you decided to make the snow fort festival a yearly event? Let's say you picked Truckee, California, as the spot to hold the festival. Every year, when the festival begins, weather conditions will probably be a little different from the year before. That probably wouldn't surprise you too much. You know your weather predictions will sometimes be close but not exactly right. But what if one year, temperatures in Truckee were too hot for snow fort-building all December? That's way different from your prediction. And what if the next year has no snow either? Or the next. Or the next. That would mean something big is going on. The weather pattern itself is changing. A change in the pattern means your prediction should change too. If you can't reliably predict that there will be snow in Truckee next December, you'll need to find a different place to hold the festival. The more weather data we collect and study, the better predictions we'll be able to make, and the better we can plan ahead. So keep an eye on the weather near you, see what patterns you can discover and what changes you notice. Have fun, and stay curious.