Lesson: “Why can you smell things you can't see?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi. It's Esther from the Mystery Science team. In 2005, someone in New York City called 3-1-1 for help. 3-1-1 is a hotline some cities have that people can call when they need help with minor city issues. Think changing bus schedules and cats stuck in trees, that kind of thing. But this caller had a weirder problem than that. They called 3-1-1 because of a smell. They could smell something in their apartment. It wasn't a bad smell; it was a nice smell. Actually, a sweet smell like maple syrup, the sweet gooey stuff people pour on pancakes and waffles. But here was the thing: the caller wasn't making pancakes or waffles. They didn't even have maple syrup in their home at all, and yet, they could smell this smell, this strong, sweet, maple syrupy smell. They wanted to know if the city helpline could explain what was going on, but the helpline couldn't explain it. No one at the helpline had any idea what was going on. But soon, more people started calling and complaining about a strange maple syrup smell. And then, even more people. They could smell it in their homes. They could smell it where they worked. They could smell it on the street, everywhere. This was happening all across the city. A dog walker at the park all the way up here could smell the same thing as a grocery shopper all the way over here. Some people were really worried. Was this smell dangerous? Where did it come from? What did it mean? Over the course of a few months, thousands of people called the city about this. And

another weird thing was people seemed to smell this smell on certain days, but on other days, it was totally gone. What do you think was going on here?

EXPLORATION VIDEO 2

The New York City government got to work investigating what the mysterious maple syrup smell was and where it was coming from. They started mapping where people had reported smelling maple syrup and looking around for any likely causes in those neighborhoods. But at first, government experts were stumped. The source of this smell was not obvious. The smell seemed to be totally invisible. This is a weird thing about smell, isn't it? When you taste something like a chocolate chip cookie, you have to actually put it in your mouth. You can't taste a cookie from across the room, but you can smell a cookie from all the way across the room. You don't have to shove the whole cookie up your nose to smell it. So how does that work? How does the invisible smell of something get from an object to your nose? What do you think?

EXPLORATION VIDEO 3

Take a look at this cookie. Imagine how great it smells. How is it that we can smell this cookie without putting the whole thing up our noses? Well, let's think about this. Imagine you break off a piece of this cookie. Now imagine you break off a crumb from that piece. Then do it again. That tinier crumb is made up of parts and pieces too. Imagine you could break off a teensy tiny tiny fleck of that tiny tiny cookie crumb. This piece is so small, we have to use tweezers to pick it up and a magnifying glass to see it. Okay. Now imagine you take a tinier piece of that, and a tinier piece of that one, and a tinier piece of that. Now your piece might be so small you'd have to use a microscope to see it. I'm going somewhere with this, I promise. If you keep breaking off tinier and tinier parts of this cookie, eventually, you'll get down to a piece that's so small, you can't see

it even with a microscope. But even though this tiny piece is teeny, teeny, teeny tiny, it's still there. It's matter, which means it takes up space and has weight. It just only takes up a tiny bit of space and weighs a tiny amount. A teeny tiny piece like this is called a particle. Your teensy tiny crumb is a particle from a cookie. This whole cookie is made up of millions and millions of tiny particles. If you break just one tiny particle off this cookie, the cookie might not look that different, but it has changed. This cookie is one particle lighter and one particle smaller than it was before. Cookies aren't the only things made of particles. In fact, everything around you is made of particles. Pencils, pizza, squirrels, sneakers, or even, you guessed it, maple syrup. All things are made of tiny particles. And like cookie crumbs, particles break off from their sources all the time. And when they do, they are often so tiny, they can actually float in the air.

Okay. So now let's go back to thinking about smell. We know that we can smell a cookie without literally putting it in our noses, and we know that tiny particles sometimes break away from their sources. Could those two things be connected? Let's see if we can find out.

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to investigate what role particles play in how we smell things. We know that tiny particles break off of things, like cookies, and float into the air. But where do those cookie particles go? That's what you're going to figure out. Since particles are so tiny that we can't see them with our eyes, we'll use models to help. Just like these kids have a plate of cookies in a park, you and your partner will have a map of an area with a cookie in the center. This is where your particle will start. There are also drawings of noses on the map. Those are models of people who are nearby the cookie. You'll use spinners to see what direction and how far your particle will go each turn, and you'll draw where the particle goes on your map. Where will your particles end up? Will they reach someone's nose? Once you're done, you'll use your

observations to figure out who can smell the cookie and why. You may even find some clues that can help you solve the mystery of the maple syrup smell in New York City. Can you figure out this particle puzzle? We'll get you started, step by step.

ACTIVITY STEP 1

In today's activity, you'll work with a partner. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Get your supplies.

ACTIVITY STEP 3

You're going to use spinners to help you move your particles. Cut your spinner sheet along the dotted line, like this.

ACTIVITY STEP 4

Each partner will be in charge of making one of the spinners. Use a pencil to carefully poke a hole in the center of your spinner, like this.

ACTIVITY STEP 5

Now let's finish making the spinners. Watch this whole step before doing it yourself. Find the large opening in your paper clip, this part right here. Put the fastener through the opening like this. Make sure not to put it through the small opening. Then put those through the hole in the

front side of your spinner. Finally, pinch your fastener like this and fold the arms down. It should look like the letter t when you're done. Check if it spins. If it isn't spinning, check the T shape. Make sure that there's a small gap between the T and the paper. When you're done, you should have two spinners that look like this. Now it's your turn. Finish making your spinners.

ACTIVITY STEP 6

To see where a particle goes after breaking off the cookie, you'll move it around a map. First, cut along the dotted line of your Cookie Particle Path sheet. Then put that page on top of the other so that they can make a full map. Be sure to match up the lines on both sheets so that they aren't crooked, like this. Hold the sheets together while the other partner puts stickers on the top and the bottom, covering the rectangles that say sticker goes here. When you're done, your map should look like this.

ACTIVITY STEP 7

Decide who will be the Spinner first and who will be the Mapper first. Don't worry. You'll have a chance to do both jobs.

ACTIVITY STEP 8

You're going to work with your partner to move around the map as a particle. Your particle will start in the center of the map on the cookie space. Spinner. Your job is to find out where your particle will go in one move. The spinner with arrows will tell you which direction to go, and the spinner with numbers will tell you how many boxes to move. Mapper, your job is to draw where your particle moves on the map with your colored pencil. Let's see what one move might look like. Our spinners landed on this arrow and 4. So our mapper will draw this on the map. Now it's

your turn. Do one move, then go to the next step. If your particle hits a gray nose space like this, stop drawing. You'll learn more about this soon.

ACTIVITY STEP 9

Now you'll do the same thing again. Spinner, you'll flick your two spinners. And Mapper, you'll draw where your particle moves on your map, starting from where you left off last turn, like this. There are two ways that a particle can stop moving. The first way is if your particle ever hits a gray nose space or a wall like ours just did. It stops and stays there. That particle is now stuck in the nose. Its journey is over. To help us remember where it stopped, we'll draw a dot. When this happens, you'll start again at the cookie space as a new, different particle that has broken off of the cookie. The other way your particle stops is after it moves five times, like this. One, two, three, four, five. After that, it lands wherever it is. Try your best to remember what turn you're on as you move around the map. Once your particle's journey is over, start back at the cookie space in the center as a new particle again. If you forget what to do, there's a reminder of the rules on the side of the board. Keep moving particles around your map until time is up. I'll put a four-minute timer on the board in case that's helpful. Where will your particles go? Let's find out. Ready? Three, two, one, go. Okay. Time's up. Go to the next step.

ACTIVITY STEP 10a

Discuss these questions. Where on your map did the particles land? Do you think anyone smelled the cookie? Why or why not?

ACTIVITY STEP 10b

Here's what our map looked like. Yours probably looks a bit different than ours. That's okay. Our particles went in all different directions. Some particles landed on noses like these, while others did not. On our map, particles landed on the noses of Caleb, Mia, Emma, and Jaden. When those people breathed in, the particles actually went inside their noses. And when the cookie particles went inside their noses, they smelled the cookie. Meanwhile, the particles that landed outside of a nose were not smelled. I wonder, though, what if we added something else to this model? In real life, the air isn't perfectly calm. What if it was a windy day? Would that affect where the particles go after breaking off the cookie? That's what you're going to investigate next. Go to the next step.

ACTIVITY STEP 11

Get your final supply. Each pair needs a marker that's a different color than the colored pencil that you already used on your map.

ACTIVITY STEP 12

Pretend there's a strong wind coming in from the left side of your map. You're a teeny tiny particle, so this wind is going to feel extremely powerful. You won't be able to move against it. From now on, your particle will only be able to move with the wind in these directions. So on your direction spinner, cross out these arrows. And on your number spinner, cross out the 1 and replace it with a 5.

ACTIVITY STEP 13

Now, you're going to map where the particles go, but this time with wind. If your spinner lands on a crossed-out arrow, spin again. Use your marker to draw your particle paths on your map this time. Now switch jobs with your partner. Work together to see where your particles go. I'll set a timer for four minutes in case that's helpful. How will wind affect your particles? Let's find out. Ready? Three, two, one, go. Okay, time's up. Go to the next step.

ACTIVITY STEP 14

Compare where your particles landed when there wasn't wind versus when there was wind. Here's what our map looks like in case it's helpful. Yours may look a bit different. That's okay. Discuss. How did the wind affect where the cookie particles landed?

ACTIVITY STEP 15

Now imagine that the wind was blowing in a different direction. Imagine it's blowing this way. How would this affect where the particles go? Discuss. How would this wind direction affect where the particles go?

ACTIVITY STEP 16

Think back to the mystery of the maple syrup smell in New York City. Here's a simple map of the area around the city. These noses represent people that smell the maple syrup. Miles away across this river, there's a factory that makes something that smells very sweet. Discuss. Based on what you observed in your cookie particle model, why do you think that people in New York City could sometimes smell maple syrup?

WRAP-UP VIDEO 1

Often, when you smell something, you see the source of the smell, like a warm cookie or a dirty sock, but what you see is not what you're smelling, not exactly. What you're actually smelling is tiny broken-off particles from that source that made it through the air to your nose, like we modeled in the activity. Once the particles go inside your nose, then you can smell them. That's why you don't have to shove the whole cookie up your nose—or even worse, that dirty sock—in order to smell it. Forces like wind can change which direction these particles move through the air. Under the right conditions, these broken-off particles can travel for miles and miles in the wind. And that is exactly what caused the mysterious maple syrup smell in New York City. It turns out, miles from New York City in the US state of New Jersey, a factory was processing large amounts of fenugreek seeds, an ingredient often used in artificial maple syrup. As these seeds were processed, particles broke off them. Those tiny particles floated through the air and spread out into the wind. Strong winds carried those particles this direction, all the way to the noses of thousands of people in New York City. This discovery was a big relief. All those people who had called and worried about the smell now had their answer. It was just tiny particles of a sweet-smelling seed carried by the breeze. Even though these particles turned out to be totally safe, it was still a good idea for the city to investigate this mystery. Can you think of any situation where particles in the air might be a bad thing?

WRAP-UP VIDEO 2

All matter is made up of tiny particles too small to be seen. Anything that takes up space and has weight is made of particles. That means solids, like pancakes or plastic—those are made of particles. Liquids, like maple syrup or bleach—those are made of particles. Even gases that can

seem odorless or hard to see, like air or car exhaust—those are made of particles too. Substances made of particles include everything from sweet-smelling treats to dangerous poisons. And that's important to know because the matter in some substances can be dangerous for humans, even in small amounts floating in the air. Take smoke, for instance. The particles of burnt material in smoke are often too small to be seen individually, but breathing in smoke is not good for your lungs. When humans consume too many particles from dangerous substances, even if those particles are tiny and invisible, that can cause harm. But luckily, in the case of the mysterious maple syrup smell in New York City, the tiny particles were harmless. Their smell was just a sign of the incredible power tiny particles have, even when we can't see them. The mystery was solved, and it turned out New York City was totally fine, just a little sweeter smelling when the wind blew just right. So keep your attention on the tiny things. They may hold the answers to big questions. Think small, and stay curious.