mystery science

Lesson: “Are magic potions real?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! So, back when I was in about third or fourth grade, I remember my parents had this barrel that they used to plant flowers in. One fall, when the flowers were done blooming, my dad took out the dead flowers and the soil and he left the barrel sitting there empty. Well, that got my imagination going. In that barrel, I could imagine a wizard's cauldron, and it gave me an idea. I asked, "Can I play with this?" My dad said sure, he didn't mind. So I started mixing together everything I could find. I put in dirt, water, sand. I mixed in some soap bubbles. This stuff looked nasty, but I was having fun—even if just for a few minutes, I felt like a wizard or a witch. I pretended that I had made something amazing. Have you ever done anything like this? If you have, you've probably noticed it never seems to work out, does it? Most of the time it just makes a mess. Like, on your dinner plate, if you mix a bunch of ketchup with a bunch of mustard, you just get ketchupy mustard. But in stories, wizards and witches are always brewing such interesting things. Potions, they call them. You know, they mix up a potion that turns someone into an animal—poof. Or a potion that makes something invisible—poof. Now, wizards and witches, they're just the stuff of stories these days. But potions? Hmm...could they be real? Could there really be a potion that does something amazing or valuable? What do you think?

EXPLORATION VIDEO 2

It turns out, a long time ago, there was actually a group of real-life people who acted like wizards or witches. Some of them even wore pointy hats. In fact, they became the inspiration for the wizards and witches you read about in stories. They were called the alchemists, and just like wizards or witches, these people were convinced that actual potions were possible, that they just had to figure out a way to invent them. So, the alchemists experimented with mixing lots of things together to try and invent potions. What kind of potion did they want to create? Well, there are lots of things you might love for a potion to be able to do. Many of the alchemists were interested in being wealthy, having lots of money, so they focused their effort on trying to invent a potion that could transform something ordinary, like a lump of iron or steel, into something extraordinary and valuable, like a piece of gold. Now, I don't know how much you know about gold, but gold is one of the most valuable materials in the world. People are attracted to its shininess and its beautiful color, so you see it used for jewelry, things like necklaces, bracelets, and rings. And gold is worth a lot of money. Compared to other metals, it's just not even close. Like, check this out. Here's a less valuable metal, this is copper. An ounce of copper, that's something this size, is worth about $2. An ounce of steel, that's worth even less. This is worth about 10 cents. But now, an ounce of gold—that's about this much gold—it's worth more than $1,000. So, if there were a potion that could turn something made of ordinary metal into gold, that would definitely make you very wealthy. You can see why alchemists would want a potion like that. But, why even think this is possible? I mean, is there any reason at all to think you could make a potion that does this? Well, again, the alchemists realized that if they were going to invent a new potion, that meant they were going to have to experiment. They could mix different substances together, then they could test what they created to see if it did what they

wanted it to. That's what you're going to do today. You're going to try your hand at being an alchemist. Now, you won't start out by trying to find a potion that makes gold. That is not going to be easy. If it were easy, you probably would've heard about it by now. But, could you discover a potion that transforms a piece of dull copper into one that's new and shiny?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to experiment like an alchemist. Your goal is to transform a dull, brown penny into a shiny, bright one, like this, using a liquid. You'll work with four different liquids that real alchemists experimented with. You have water that's soapy, water that's salty, vinegar—a liquid people use in cooking and salad dressing—and a mixture of salt and vinegar. I'll show you how to get started, step by step.

ACTIVITY PART 1 STEP 1

If you're in a class, form a team of four. Each person will test a different liquid. If you're working alone, you can do all four tests yourself. When you're done with this step, click the arrow on the right.

ACTIVITY PART 1 STEP 2

Get a worksheet for your group. Each person should already have one penny.

ACTIVITY PART 1 STEP 3

Discuss.

ACTIVITY PART 1 STEP 4

Teams, decide who will test each liquid. This shouldn't take long, ten seconds should do it. I'll start a timer. Ready? Okay, time's up, go to the next slide.

ACTIVITY PART 1 STEP 5

Take a penny and go to the liquid you're testing. Get ready but don't dip the penny in yet. In the next step I'm going to give you a tip and I'll time you so that everyone dips the penny for the same amount of time. Go to the next slide when everyone is near their liquid.

ACTIVITY PART 1 STEP 6

Before dipping the penny in, here's a tip: You're just going to dip the penny halfway into each liquid. You'll hold it there for 15 seconds and take it out. When you take the penny out, you can compare the half that got wet with the half that didn't. This way, you can see what the penny looked like before you dipped it in and after. All right, everyone, hold your penny above your liquid. When the timer starts, dip your penny halfway in your liquid. When it stops, take it out. Okay, I'll start the timer now. Dip your penny halfway in. Hold it there until the timer runs out. Five, four, three, two, one. Okay, time's up. Take out your penny. Great, go to the next step.

ACTIVITY PART 1 STEP 7

Place each penny on its spot on the worksheet and compare them. What happened? When you see what happened, go to the next step. If you're working alone, repeat the last step until you've run all four tests.

ACTIVITY PART 1 STEP 8

Here's what we saw: The part of the penny that was dipped in the salt and vinegar got shiny.

ACTIVITY PART 1 STEP 9

Get these supplies for each person. You'll get more supplies later.

ACTIVITY PART 1 STEP 10

Do questions 1a and 1b on your worksheet. You're going to draw a picture of what you think happened and then brainstorm what more you want to know to help solve the mystery.

ACTIVITY PART 1 STEP 11

Discuss, then advance the slide to watch the next video.

EXPLORATION VIDEO 3

Why did the vinegar and salt make the penny shiny? You might have had different ideas. Before we can answer this we need to think about other questions that might have come up while you did this activity. Like, why are some pennies dull and dark brown at all? Well, have you ever noticed that pennies have a year written on them? Like this one here, it says it's from 2002. If you pay attention to the date on each penny, you might spot a pattern. Have a look at these pennies. Do you notice anything? Take a few seconds to look. Okay, you ready? You might have noticed it's the older pennies that are dull and dark brown and only the newer years still look shiny. So, pennies don't start out dull and dark brown. When pennies are first made at a place

called the mint, they're made using shiny, brand new metal. They only get dull and dark brown over time. What is this dark brown stuff then? It's tempting to think maybe it's just dirt that's building up over time, as the pennies get handed around. But remember, you dipped the penny in soapy water and the brown stuff didn't come off. If you wash a brown penny with lots of soap and water the brown stuff still won't come off. Soap and water can wash off dirt, so the dull stuff on the penny can't be dirt. Why do shiny pennies turn dull and dark brown over time? Well, not all of them do. Look at this one, check out the year. You'll see it's really old. It's from 1909, over 100 years old. Now, I promise this has not been dipped in vinegar and salt. It's a penny that's been saved all these years by a coin collector. Notice the container that it's in. Now, it's hard to see what kind of container this is, but it's an airtight container. Even after 100 years it didn't get dull brown like most pennies do. So pennies will stay shiny if they're sealed in a container with little to no air. Whoa. So the reason a penny turns dull over time has something to do with air? I don't know if that surprises you, but think about it. You can probably think of other situations where exposing something to air causes it to change color or appearance, like certain fruits and vegetables—an apple, a banana, an avocado. All of these things turn brown over time as they're exposed to air. It may seem surprising, but scientists figured out it's the same process with pennies. You'll learn more about this in middle school. Scientists call this *oxidizing*, from the word *oxygen*, one of the gases in the air around us. So that's why shiny pennies turn dark brown over time. It has to do with air. Now, there's one more question I thought of, though. What do you think? Does the oxygen in the air turn the penny dark brown all the way through or is it just on the surface?

EXPLORATION VIDEO 4

So is the dull, dark brown just on the surface or did it go all the way through the penny? One way to find out is if you were to scratch at a dull penny with sandpaper, so let's try it. Wow, you see that? So there's shiny, new copper underneath. So pennies are only dull on the surface, where the air has come in contact with the penny. Now we can return to the original question. When we dipped a penny into the vinegar and salt, what did the vinegar and salt do? Why did this liquid make a dull, dark brown penny look shiny again? Well, let's imagine the penny from the side, like this. Now, remember, before you dipped it in the liquid, the penny was all brown. We came up with three things that might be going on. Maybe you thought of one of these, too. Idea number one: Maybe the vinegar and salt removed the dull, outer layer, revealing the shiny, new copper underneath. Or, here's another idea: Maybe the vinegar and salt added a shiny layer of copper on top of the dull layer. Or, idea number three: Maybe nothing was added or removed, but instead the vinegar and salt somehow changed the dull layer itself from being dull to shiny copper again. Do you have any ideas for how you could figure out which of these three ideas might be true?

EXPLORATION VIDEO 5

Of the three possibilities of what the vinegar and salt were doing, how could we test them to see which one was true? Well, with idea number two, shiny layer added, we thought of something simple we could do. If a shiny layer of copper were added on top of the dull layer, then there should still be dull brown copper inside it, underneath the shiny layer. So if we just scratch the shiny copper on one of the pennies after it was dipped in the vinegar and salt, we could test it out to see if there's a dull layer still underneath. Let's try that. Okay, we're going to scratch it with

a piece of sandpaper really hard. It's still shiny. Okay, so we can see, there's not a dull layer underneath. So that means we can rule out idea number two, shiny layer added. That leaves the other two ideas. Idea number one, maybe the dull layer was removed. Or idea number three, maybe it changed in place. Nothing was added or removed, the liquid just changed the dull layer to being shiny. Now, hopefully you thought of some ways to test these two ideas as well. Here's one thing we were thinking about. If the dull layer were removed, then shouldn't we be able to see little bits of dull, brown copper come off? Like, shouldn't we be able to see some of it in the liquid? Why or why not? What do you think?

ACTIVITY PART 2 STEP 1

Discuss.

ACTIVITY PART 2 STEP 2

You probably have some new ideas about why the dull, brown penny became shiny. Answer questions 2a and 2b on your worksheet to revise your model. Your drawing can include things you can't actually see, just be sure to label them.

ACTIVITY PART 2 STEP 3

Here's a thought we had: Maybe there are little bits of dull, brown copper in the liquid, but it's just such a tiny amount that you can't see it. If so, maybe we would be able to see it if there were more dull copper put into the liquid. Go to the next step and we'll test this idea.

ACTIVITY PART 2 STEP 4

Let's test out the idea. Dump all the pennies you tested today into the salt and vinegar. And give them time to soak. In the next Mystery, we're going to take a look at it and see what happened. Stay curious, and see you next time!