Lesson: “How is an ice cube like a crayon?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hey. It's Jay from the Mystery Science team. When I was a kid, my favorite thing to make in art class were sculptures. Sculptures are artworks that aren't just flat like a piece of paper. Maybe you've made a sculpture before too. I liked working with clay the best, but you can use all kinds of materials for sculptures. A material is what something is made of, like how a sculpture can be made of pipe cleaners or cardboard or even cheese. Deciding which material to use really depends on the sculpture you want to make. That's because each material has its own properties. A property is something you can observe about a material, like how it looks or what it does. Like these pipe cleaners, they're fuzzy and flexible, so you can bend and twist them to make a fuzzy sculpture. Or this cardboard, it's stiff and rigid, so you can cut it into pieces that slot together and stand up on their own like this. Now this sculpture is made of a material you might not find in art class, but its properties are very cool. Maybe you can tell what this ferocious dragon is made of. It's ice. This dazzling diving mermaid is also made of ice, and so is this life-sized elephant. Artists created these sculptures at the World Ice Art Championships in the US state of Alaska. Artists start out with huge blocks of ice like these. Then they use chainsaws and other power tools to cut and shape the ice, as well as sharp metal chisels to add details. At night, colorful lights make the finished sculptures shine. You've probably seen much smaller blocks of ice around every day, like in your water or lemonade. Like any material, ice has a

variety of properties, and I'm curious what things you've noticed about ice. What might be some helpful things about using ice to make a sculpture and what might be some difficult things?

EXPLORATION VIDEO 2

Ice has some really interesting properties. Because it's pretty much clear, you can carve things that are see-through and change your sculpture's color just by shining different lights through it. And see how this mermaid's hair seems to float behind her? The artist could carve it that way because ice is hard and can hold a shape, the same way this cardboard can stand up on its own. Ice is so hard that artists need those sharp, strong tools to cut it, but they have to be careful. That hard ice can also crack and break into pieces. And while these ice sculptures are incredible, we don't usually see them alongside other artworks in museums. That's because ice sculptures need to be someplace that's the right temperature. It needs to be cold, like Alaska in winter cold. To have an ice sculpture show like this one, everything has to be kept inside a very cold space. It's so cold that visitors need to wear big coats to play there. This show actually took place in the sunny state of Texas. And if we move the ice outside on a hot Texas day, the warm sun would heat up the ice and eventually, it would melt. That's what happens with epic ice sculptures. Eventually, they become epic puddles. Seeing an artist's hard work melt away might seem sad, but hear me out. I think melting might be one of the best things about sculptures made of ice, and that's because ice has the power to undo. I'll show you what I mean. Picture this. You've got a miniature ice sculpture shaped like a star. You can use an ice tray like this to make one in the freezer. No chainsaw needed. Then you leave your ice sculpture out in a cup, and it starts to warm up. When you come back, it's totally melted. But even though your star is gone, you still have the material that it was made of. It's right there in the cup. It's water. That's what ice really is, right? It's just water that's frozen. But now that the sculpture has melted, it has

different properties from when it was frozen. Take a moment to observe how this water looks and how it moves. Compared to when it was frozen, how are the properties different now? Can you think of any way to undo those changes and turn the water back into a sculpture?

EXPLORATION VIDEO 3

Now that your miniature ice sculpture has melted, the water it's made of has different properties. It's flowy. You can pour it and it spreads out to fill the container. Those are properties of water in its liquid state. The ice you started with wasn't flowy. It had properties like being hard and could hold a shape. Those are properties of water in its solid state. That's another thing we can call ice, solid water. When we say that ice can melt, we really mean that water can change from its solid state to its liquid state when it gets warm enough. How the water looks and how it moves changes, but it's still the same material. It's still water. In fact, you can even take this flowy water and change it back into your ice sculpture. Just pour the liquid water into the same star shaped ice tray, put it in a cold freezer, and an hour or so later, ta da, it's back to how it was before. That's what freeze really means. It's a material changing from its liquid state to its solid state when it gets cold enough. And you don't have to stop there. You could warm up the mini ice sculpture again, and this time, pour it into an ice tray with a different shape. Then cool it down, and now that same flowy water is frozen into a new solid shape. You could try it out dozens of times, all by warming up and cooling down the same water again and again. And if you don't like the shape, just warm it up to undo. That's the power to undo that I was talking about. Water can start as a hard solid, change into a flowy liquid, then undo that change and go back to a hard solid again. So when a big ice sculpture warms up and melts, there's an undo fix. You can't get the exact sculpture back, but you've still got the same material there in that puddle. That liquid water could be scooped up, cooled down, and changed back to a block of solid water, and that

ice can be cut into something new. Water seems like a pretty amazing material, but I wonder if there are more materials out there that can also change back and forth. What do you think? Are there other materials that have the power to undo like water?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to explore different materials and figure out if any of them have the power to undo or change back and forth after they've been heated up and cooled back down. To do this, we're going to have a competition between a bunch of different materials. This is the Ultimate Undo Showdown! In each matchup, two materials will compete head to head. To figure out which materials have this undo power, you'll need to focus on the materials' properties, the things you can observe about them. First, you'll observe the materials' properties at the start. Are the materials drippy, solid, squishy? Once you know the materials starting properties, then you'll observe what happens when things heat up. The two materials will enter the Hot Ring. After, you'll observe how each material's properties were changed by the heat. Finally, you'll observe what happens after these changed materials enter the Chill Zone and are cooled back down again. Will they have the power to undo and change back how they were at the beginning? Will they be changed by the heat forever? Let's find out. We'll get you started step by step.

ACTIVITY STEP 1

In today's activity, you'll work with a partner. Click the arrow on the right when you're ready to move on.

ACTIVITY STEP 2

Get your supplies.

ACTIVITY STEP 3

It's time! The moment you've all been waiting for. It's the Ultimate Undo Showdown! Let's meet the materials competing in our first match up. The Breakfast Brawl. In this corner, full of protein packed power, it's Egg. And in the opposite corner, the dairy delicacy, the tasty topping on your toast. It's butter. Find your worksheet that says Breakfast Brawl at the top. This half of the sheet is where you'll keep your observations for Egg. Write “egg” in the box that says Material 1. The other half of the sheet is where you'll keep your observations for Butter. Write “butter” in the box that says Material 2.

ACTIVITY STEP 4

Now let's take a closer look at our competitors in round one. To be able to figure out if these materials have the power to undo, you first need to know what their properties are like at the start. Observe Egg closely. Pay attention to how it looks and how it moves. As you watch, circle the words that best describe its properties here in the round one section. Circle one word per pair. If you notice anything else about Egg's properties, you can write that here on the line. We'll play the video a few times. Ready? Here we go. When you're done writing down your egg observations, click the arrow on the right.

ACTIVITY STEP 5

Now observe Butter closely. Just like last time, pay attention to how it looks and how it moves. As you watch, circle the words that best describe its properties here in the Round 1 section. Write anything else you notice here on the line. Ready? Here we go.

ACTIVITY STEP 6

It's time for Round 2, the Hot Ring. In the Hot Ring, you'll see what happens as these materials heat up. Here they go now. Don't worry about circling anything yet. Now, let's take a closer look at their properties. Let's start with Egg. While you watch, circle the words that best describe the material's properties here in the Round 2 section and write anything else you notice on the line. How did it handle the heat? Let's find out in three, two, one. Now let's see how Butter handled the heat. While you watch, circle the words that best describe Butter's properties after being heated up here in the Round 2 section, and write anything else you notice on the line. Here we go in three, two, one.

ACTIVITY STEP 7

Next, these two materials will face a new challenge. It's time for round three, the Chill Zone. In the Chill Zone, you'll see what happens as these materials are cooled down. Here they go now. Don't worry about circling anything yet. Now let's take a closer look at their properties. Let's start with Egg again. While you watch, circle the words that best describe its properties here in the Round 3 section and write anything else you notice on the line. How did it handle the cold? Let's find out in three, two, one. Now let's see how Butter handled the cold. While you watch, circle

the words that best describe its properties after being cooled down here in the Round 3 section, and write anything else you notice on the line. Ready? Three, two, one.

ACTIVITY STEP 8

And that's the end of the Breakfast Brawl. Now that you've had a chance to see both materials heat up and cool down, discuss with your partner. How did the materials change after being in the Hot Ring? What about after being in the Chill Zone?

ACTIVITY STEP 9

Now that you've reflected on how Egg and Butter have changed over the rounds, it's time to decide which materials have the power to undo. Is it Egg, Butter, both, neither? Discuss with your partner, which materials have the power to undo. How do you know? Remember, a material has the power to undo if its properties go back to the way they started after being heated up and cooled down. When you're done discussing, answer the can it undo question for both materials on your worksheet.

ACTIVITY STEP 10

Without further ado, your Undo Champion of the Breakfast Brawl is Butter. But that's not all. The changes keep coming in the Ultimate Undo Showdown. It's time for matchup two, the Art Supply Standoff. Let's see what materials will be competing this time. In this corner, the waxy stick with a colorful tip, it's Crayon. And in the opposite corner, brown, round, and from the ground, it's Clay. Find your worksheet that says Art Supply Standoff at the top. This half of the sheet is where you'll keep your observations for Crayon. Write "crayon" in the box that says Material 1.

The other half of the sheet is where you'll keep your observations for Clay. Write "clay" in the box that says Material 2.

ACTIVITY STEP 11

Now let's take a closer look at our competitors in Round 1. Observe Crayon closely. Pay attention to how it looks and moves. As you watch, circle the words that best describe its properties here and write anything else you notice on the line. Ready? Here we go. In three, two, one. Now observe Clay. Circle the words that best describe its properties here and write anything else you notice on the line. Ready? Here we go. In three, two, one.

ACTIVITY STEP 12

Let's see what happens to these materials when they are heated up in Round 2, the Hot Ring. Crayons are ready, but Clay needs a special Hot Ring, this huge hot fire. Here they go. Don't worry about circling anything yet. Now that they're out, let's take a closer look at their properties. Let's start with Crayon. While you watch, circle the words that best describe the material’s properties here, and write anything else you notice on the line. How did they handle the heat? Let's find out in three, two, one. Now let's see how Clay handled the heat. While you watch, circle the words that best describe Clay's properties after being heated up here and write anything else you notice on the line. Here we go in three two one.

ACTIVITY STEP 13

Next, these two materials will be cooled down in Round 3, the Chill Zone. Here they go now. Don't worry about circling anything yet. Now that they're out, let's take a closer look at their properties. Let's start with Crayon's again. While you watch, circle the words that best describe

the material's properties here, and write anything else you notice on the line. How did they handle the cold? Let's find out in three, two, one. Now let's see how Clay handled the cold. While you watch, circle the words that best describe Clay's properties after being cooled down here and write anything else you notice on the line. Here we go in three, two, one.

ACTIVITY STEP 14

And that's the end of the Art Supply Standoff. Now that you've had a chance to see both materials heat up and cool down, discuss with your partner. How did the materials change after being in the Hot Ring? What about after being in the Chill Zone?

ACTIVITY STEP 15

Now that you've reflected on how the materials have changed over the rounds, it's time to decide which ones have the power to undo. Is it Crayons, Clay, both, neither? Discuss with your partner which materials have the power to undo. How do you know? When you're done discussing, answer the Can it Undo? question for both materials on your worksheet.

ACTIVITY STEP 16

Without further ado, your Undo Champion of the Art Supply Standoff is crayon. And that's the end of the Ultimate Undo Showdown. I wonder though, what other materials would you like to test in the Hot Ring and Chill Zone next to see if they can undo? Discuss. What other materials would you like to test to see if they have the power to undo?

WRAP-UP VIDEO 1

In the activity, you put materials to the test with temperature. In each material match up, you made three rounds of observations, at the start, after heating up, and after cooling down again. You saw that temperature can change a material's properties in a variety of ways, but only some materials have the power to undo those changes. For instance, heating up a crayon changed it from a hard solid stick you can draw with to a drippy liquid you can stir. The cooled down crayon has a very different shape from the stick you began with, but its other properties are back to how they started. It's hard and holds its shape. It's a solid again, so you can draw without getting your fingers goopy. That's the power to undo. It's like you saw with water. It can go from a solid to a liquid and back to a solid, all by heating up and cooling down. An ice cube and a crayon actually have a lot in common. And maybe you noticed that the butter followed a similar pattern. It started out as a solid you can squish and slice. After heating it up, it changed into a flowy liquid you can pour. But cooling it down can undo that change. The liquid butter goes back to a solid again. When you can undo a change to a material, that's called a reversible change. Reverse, like when things go backwards, because you can go back to properties the material had before. You saw Butter and Crayon go through reversible changes. That's why they're undo champs. But what about the other materials you tested? After heating up and cooling down, Egg didn't go back to how it started, neither did Clay. Those materials didn't have the power to undo, but that doesn't mean they aren't useful. There are times when you need a material that can change its properties and then stay that way. Think about the changes that you saw with Egg and Clay. Why might it be helpful that they can't undo?

WRAP-UP VIDEO 2

You saw the egg start out as a thick, drippy liquid, all runny and raw. Then heating it up changed the egg into a solid, and the see-through part turned white. Now imagine if you had to rush to eat that cooked egg before it changed back into a goopy liquid. Thankfully, cooling it down doesn't uncook an egg. If it did, there'd be no such thing as leftovers. Then there's the clay. It started out as a bendy, squishy solid. After spending time in a hot fire, it was still a solid, but its properties changed a lot. It became much harder. And no matter how long you leave it in the cold, it's not going back to being squishy again. That's what makes fired clay such a great material for things like bricks. We can build strong structures because it doesn't undo. I guess you could call that the power to stay. You can also call that an irreversible change. That "Ir-" in the front means "not" because the material cannot reverse back to the properties it had before. It's sort of the opposite of a reversible change, but both kinds of change can be helpful. Now that you know temperature can cause reversible changes in some materials and irreversible changes in others, see if you can spot these changes happening around you. Like this lake, during hot summers people can swim in it, and during cold winters they can skate on it. As the temperature changes with the seasons, the lake's water can freeze and melt and refreeze and re-melt again and again. That kind of reversible change is really important to the living things that depend on this lake year round. Maybe you can find more materials that have the power to undo like water. Heating up this solid cheese changes it into a gooey liquid. What happens when it cools down? Or check out what happens to this marshmallow near a campfire. Could cooling it down change it back? Keep looking for changes, stay cool, and stay curious.

ACTIVITY EXTENSION

ACTIVITY EXTENSION INTRODUCTION VIDEO

It's time for a bonus matchup of the Ultimate Undo Showdown. Observe Chocolate and Pancake Batter's properties as they go head to head in the Hot Ring and the Chill Zone to see which material has the power to undo. This is the Sugary Showdown.

ACTIVITY STEP 1

Get your supplies.

ACTIVITY STEP 2

It's time for the Ultimate Undo Showdown bonus match up, the Sugary Showdown. In this corner, the tastiest of treats. You know it from ice cream, cookies, and even its own bars. It's Chocolate!And in the opposite corner, it's ooey, it's gooey, it's Pancake Batter! This half of the sheet is where you'll keep your observations for Chocolate. Write "chocolate" in the box that says Material 1. The other half of the sheet is where you'll keep your observations for Pancake Batter. Write "pancake batter" in the box that says Material 2.

ACTIVITY STEP 3

Now let's take a closer look at our competitors in Round 1. Observe Chocolate closely. Pay attention to how it looks and moves. As you watch, circle the words that best describe its properties here and write anything else you notice on the line below. Ready? Here we go. In

three, two, one. Now observe Pancake Batter. Circle the words that best describe its properties here and write anything else you notice on the line. Ready? Here we go. In three two one.

ACTIVITY STEP 4

Let's see what happens to these materials when they are heated up in round two, the Hot Ring. Here they go. Don't worry about circling anything yet. Now that they're out, let's take a closer look at their properties. Let's start with Chocolate. As you watch, circle the words that best describe its properties after being heated up here and write anything else you notice on the line. How did it handle the heat? Let's find out in three, two, one. Now let's see how Pancake Batter handled the heat. While you watch, circle the words that best describe its properties after being heated up here. And write anything else you notice on the line. Here we go. In three, two, one.

ACTIVITY STEP 5

Next, these two materials will be cooled down in Round 3, the Chill Zone. Here they go now. Don't worry about circling anything yet. Now that they're out, let's take a closer look at their properties. Let's start with Chocolate again. While you watch, circle the words that best describe the material's properties after being cooled down here. And write anything else you notice on the line. How did they handle the cold? Let's find out in three, two, one. Now let's see how Pancake Batter handled the cold. While you watch, circle the words that best describe its properties after being cooled down here, And write anything else you notice on the line. Here we go. In three, two, one.

ACTIVITY STEP 6

And that's the end of the Sugary Showdown. Now that you've had a chance to see both materials heat up and cool down, discuss with your partner. How did the materials change after being in the Hot Ring? What about after being in the Chill Zone?

ACTIVITY STEP 7

Now that you've reflected on how the materials have changed over the rounds, it's time to decide which ones have the power to undo. Is it chocolate, pancake batter, both, neither? Discuss with your partner. Which materials have the power to undo? How do you know? When you're done discussing, answer the Can it Undo? question for both materials on your worksheet.