Lesson: “How much salt is in the ocean?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Jay from the Mystery Science team. My family is from the U.S. territory of Puerto Rico. Puerto Rico is an island in the Caribbean Sea, so it's totally surrounded by the ocean. The part of Puerto Rico where I lived is called Cabo Rojo, which is right here, near the western coast of the island. When I was a kid, we'd sometimes visit the beaches in Cabo Rojo, like this one called Playa Sucia. I actually just went back for a visit not long ago. The view of the ocean here is beautiful. You can look out from the beach and see nothing but bright, blue ocean water for miles and miles. Standing here, it feels like there's way more ocean than land, which is true. 71% of the Earth's surface is covered by the ocean. That's so much water, but thinking about all that ocean water made me curious about all the other things in the ocean besides water. The ocean isn't just made of water droplets, after all. It's a huge mixture of water and all sorts of other stuff in the water. What is in ocean water that we might not see from the shore? There may be more than you'd think. I wonder how many different kinds of things you can come up with.

EXPLORATION VIDEO 2

I don't know how you answered, but the first things that came to mind for me were the big things in the ocean, like whales, and sharks, and shipwrecks. There were probably smaller things that came to your mind, too—animals and plants like fish, seaweed, sea turtles, clams, or objects

like rocks, pebbles, or, unfortunately, trash. Maybe you thought of some even tinier stuff that exists in ocean water, like shrimp or sand. All of these things—shipwrecks, fish, even sand—these are things that we can see and feel in the ocean water ourselves. But sometimes what human eyes see in the ocean can be misleading. Like, check this out. This is a lagoon in Cabo Rojo. It's a body of water right next to that beach I just showed you. The ocean water off that beach is the same water that fills up this lagoon. But you probably noticed that this water looks different from most ocean water...it's pink! And not like, kind of pink—the water here is really, really pink. If you just look at this water with your eyes, you probably won't see anything in it. No sharks, no fish, not even plants. It just looks like, well, pink water. But if you took a super close look at this pink water using a microscope, you'd see something that might surprise you. Or maybe I should say, a lot of things that might surprise you. See this? The water in the lagoon is filled with millions of teeny tiny pink living creatures. The water itself isn't pink, but because there are so many pink creatures in it, and they're so small, to human eyes, it looks like the water has turned pink. You might be wondering why so many of these little pink creatures live in this lagoon. Turns out, the answer has to do with a part of the ocean water mixture we haven't discussed yet: salt. Many plants and animals can't survive in salty places, and even animals and plants that can live in water with some salt can't always live in water that has too much salt in it. But it turns out these little pink creatures can. In fact, they often live in very, very salty places. So, perhaps that means that the ocean water in this lagoon is salty. Maybe even really salty. Now, you've probably heard that the ocean is salty. If you live near the ocean or have had the chance to visit one, maybe you've had experience with sea water that smelled or tasted salty. But if you look at ocean water, do you see salt? I don't. To me, it just looks like water. When you put your feet in the ocean, you can feel the grains of sand on the ocean floor, but you can't feel any grains of salt in the water. With the pink lagoon water, we had to look at it under a

microscope to find the tiny creatures in it. Let's take a look at some ocean water under a microscope and see if we can see the salt. Hm, no salt. Lots of tiny living things, but no salt. So, what's going on here? Is there really salt in the ocean? And if there is, how much salt? I'm curious if you have any ideas about how to find the answers to these questions.

ACTIVITY INTRODUCTION VIDEO 1

In today's activity, you're going to make a Tiny Ocean. You'll start with some water in a sandwich bag. It's a really tiny ocean, no room for fish or sunken ships. But with this Tiny Ocean, you will gather evidence to show that the ocean water contains a lot of salt, even when you can't see any salt in it at all. You'll make observations, you'll draw graphs, and using what you learn, you'll figure out how you could estimate how much salt is in a real ocean. Your Tiny Ocean is a model, a small version of the real ocean. Scientists have many ways to figure out the answers to big questions, and making models is one of them. We'll show you how to get started, step by step.

ACTIVITY PART 1 STEP 1

Find a partner. Decide who will be the Wave Maker and who will be the Salt Boss. If you're working alone, that's okay too. You'll do both jobs. When you're done with this step, click the arrow to the right.

ACTIVITY PART 1 STEP 2

Get your supplies.

ACTIVITY PART 1 STEP 3

Put the piece of black paper on your plate. Put the bag that will hold your Tiny Ocean on top. Having a black background will help you observe what's happening in your Tiny Ocean.

ACTIVITY PART 1 STEP 4

Your Tiny Ocean needs water to make it wet, and salt to make that water salty. Wave Maker, open the bag and hold it open. Salt Boss, put the ¼ cup of water into the bag. Then add 1 teaspoon of salt. Wave Maker, zip the bag closed. Salt Boss, make sure it's really closed.

ACTIVITY PART 1 STEP 5

You have salt in water, but it's not quite like ocean water yet. Wave Maker, lay the bag on the black paper. Both, notice what you see in the bag and what you can feel through the bag. Think about how your water looks different from ocean water.

ACTIVITY PART 1 STEP 6

In the ocean, the wind makes waves. In your Tiny Ocean, you'll make the waves. Wave Maker, pick up the bag and rock it back and forth gently a few times to make waves. Then lay it on the paper. Salt Boss, check the bag. Do you see or feel salt? If you do, ask Wave Maker to make a few more waves, then check the bag again. Keep on making waves and looking until the timer runs out. Okay, two minutes are up. If you're ready, you can go on to the next step.

ACTIVITY PART 1 STEP 7

Think about what the water in your Tiny Ocean looked like right after you added salt. Answer question number 1 on your worksheet.

ACTIVITY PART 1 STEP 8

Salt seems to vanish when you add it to water and mix it up. People will say salt dissolves in water. Here are some people with different ideas about what happens when salt dissolves in water. Emma says: “I think that when salt dissolves in water, it just disappears. It's gone.” Mateo says: “I think salt is still in the water, but it's invisible. It becomes as clear as the water and I can't see it anymore.” Leketa says, “I think the salt breaks up into tiny pieces. So small I can't see them anymore.” Now that you've heard everyone's ideas, discuss.

ACTIVITY PART 1 STEP 9

Right now, your Tiny Ocean is just a little bit saltier than the Pacific Ocean, but it's not nearly as salty as the water in the pink lagoon in Cabo Rojo. The tiny creatures that make the lagoon pink like their water really salty. To make your tiny ocean that salty, add another teaspoon of salt, just like you did before. Then make waves until the salt dissolves completely. After that, answer question number 2 on your worksheet.

ACTIVITY PART 1 STEP 10

You had 2 teaspoons of salt in your Tiny Ocean, but you probably can't see or feel any salt in the water. If you do see any salt in the water, it's a lot less than the 2 teaspoons you put in. Discuss.

ACTIVITY PART 1 STEP 11

Maybe you've thought about drinking some of the water to find out if it tastes salty. We don't recommend you try this since it's an easy way to spread germs, but we tried it for you. It's salty. This is evidence that some salt is still in the water, even if we can't see it, but it doesn't take much salt to make something taste salty. We wondered how much salt was in the Tiny Ocean. Go to the next step to find out about another way to gather evidence that all the salt you put in the water is still there.

ACTIVITY PART 1 STEP 12

Here's our idea. We could use a scale to measure the weight of the water, the weight of the salt, and the weight of the mixture of salt and water. Discuss.

ACTIVITY PART 1 STEP 13

Suppose we compare the weight of the ingredients with the weight of the mixture. What will happen to the weight of the water when we add salt? These people have different ideas about that. Emma says: "I think that the salt weighs nothing when it dissolves in water because the salt disappears." Mateo says: "I think that salt weighs the same in the water as it does when it's dry. It breaks up into tiny pieces, but it weighs the same." Leketa says: "I think that the salt weighs less in the water than it does when it's dry. That's because it breaks it into tiny pieces, which weigh less than big pieces." Now that you've heard everyone's ideas, discuss.

ACTIVITY PART 1 STEP 14

Let's look for evidence to support any of these arguments. You may not have a scale, so we'll help you out by doing the weighing for you. You put a ¼ cup of water into your Tiny Ocean. The scale shows how much the bag and the ¼ cup of water weigh in grams. A gram is a unit of weight. Check the scale, then write the water's weight in grams by number 3 on your worksheet.

ACTIVITY PART 1 STEP 15

You put 2 teaspoons of salt in your Tiny Ocean, so we'll weigh 2 teaspoons of salt. Check the scale, then record the weight in grams by number 4 on your worksheet. Now you know the weight of everything that went into our Tiny Ocean.

ACTIVITY PART 1 STEP 16

Drawing a picture can help you understand the numbers better. You'll use the grid on your worksheet to make a bar graph. First, you'll graph the weight of the water in your Tiny Ocean. Here's how: Find number 3 on your worksheet. That's where you wrote the weight of the water. It's 60 grams. So find 60 grams on the left side of the grid. Draw a line to mark 60 grams, like this, then draw a rectangle with that line at the top, like this—this is the bar in your bar graph. Shade in the bar so you can see it better. Your shading doesn't have to be perfect.

ACTIVITY PART 1 STEP 17

To graph the weight of the salt, find number 4 on your worksheet. That's where you wrote the salt's weight. Now that you know how to do it, draw a bar on your graph to show the weight of the salt.

ACTIVITY PART 1 STEP 18

Emma, Mateo, and Leketa all had different ideas about what would happen when we added salt to the water. Each one drew a bar to show what they think the mixture will weigh. Look at their graphs. Discuss.

ACTIVITY PART 1 STEP 19

Now let's see what the mixture weighs. We'll make a Tiny Ocean just like yours with a ¼ cup of water and 2 teaspoons of salt. Check the scale, then write the mixture's weight by number 5 on your worksheet. Then draw a bar showing the mixture's weight.

ACTIVITY PART 1 STEP 20

Discuss. Then answer question number 6 on your worksheet. When you're ready, watch the next video.

WRAP-UP VIDEO 1

You used your tiny model ocean to see that salt becomes invisible when it's mixed in water. Salt water is a special kind of mixture called a solution, a mixture where one or more substances are evenly mixed within one another. In a salt water solution, the salt dissolves—it breaks down into incredibly tiny pieces and spreads evenly throughout the water. This is why the ocean doesn't feel or look like it has salt in it, even if you examine it under a microscope. But even when you can't see or feel the dissolved salt in a salt water mixture, there are still ways to tell that the salt is there. Like all substances, salt has properties, which means it has characteristics you can measure or observe with your senses that let you know it's salt. Sometimes the properties of a

substance change when it's mixed with another substance. Before we mixed our salt into water, we could see and feel that the salt was made up of tiny white crystals. These are the familiar color and texture properties of salt. But when we dissolved the salt in water, those properties changed. We couldn't see or feel the white crystals anymore. Still, some of the salt's other properties remained the same, even in water. We could still taste the salt's familiar saltiness, and by measuring and graphing weights, we saw that the weight of the salt stayed the same before and after it was mixed in the water. The fact that both of these properties remained gave us evidence that all the salt was still there. Now you know exactly how much salt is in your tiny model ocean because you measured it before you put it in the water—but what about the actual ocean? How do we know how much salt is in there? If you can remove the salt from the ocean, that would make it a lot easier to measure, but it would be really difficult to pick all those tiny pieces of salt out. I wonder if there's a simpler way to separate the salt in water. Maybe instead of taking the salt from the water, we could remove the water and leave the salt. Can you think of a way to do that?

ACTIVITY INTRODUCTION VIDEO 2

In this final part of the activity, you're going to remove the water from your Tiny Ocean and see what's left when the water is gone. If you're still wondering how you can take the water out of your ocean water, think about the last time you saw a puddle. As the sun shines on a puddle, it gets smaller and smaller and still smaller until it disappears. When the sun warms the puddle, the water evaporates: it changes from a liquid to a gas and the gas floats away in the air. You are going to work with your classmates to make an imaginary landscape from a paper bag. Each team will find a place for their Tiny Ocean on this landscape. Then you will wait for all of

the water in your landscape to evaporate. When the water is gone, you can take a look at what's left behind. We'll show you how to get started, step by step.

ACTIVITY PART 2 STEP 1

You'll start with a landscape made from a paper bag that your class will share. Here's our paper bag landscape. Imagine this is a real landscape that you are flying over in an airplane. Discuss.

ACTIVITY PART 2 STEP 2

Take turns going to the paper bag landscape that your teacher has made. With your partner, choose a spot for your Tiny Ocean. Put your initials in that spot. While waiting your turn, discuss with your partner.

ACTIVITY PART 2 STEP 3

When everyone has chosen a spot, take turns using your teaspoon to put 2 teaspoons of Tiny Ocean water onto the spot you chose. While waiting your turn, discuss.

ACTIVITY PART 2 STEP 4

Now you have to wait while the water evaporates. Teacher, put the landscape in the sun to speed things up. Watch the next video to see what our ocean looked like when the water was gone.

WRAP-UP VIDEO 2

This is what our Tiny Ocean looked like when it dried up. We can see the white salt crystals left behind. Our dried-up model ocean reminds me of something. Not another model, but something

from the real world. Take a look. This is a photograph from space of the Earth's surface. It shows a part of the country of Bolivia called Salar de Uyuni. From space, Salar de Uyuni is a huge patch of white. Here's what it looks like up close. The white powder on the ground looks like snow, but it isn't snow. It's salt. Salar de Uyuni is what's called a salt flat. Salt flats form when salty bodies of water like seas or salt lakes slowly dry up, leaving a flat crust of salt behind on the ground. Salt flats occur all over the world, mostly in hot and dry places. In fact, we've already seen an example of a salt flat somewhere else in the world, a salt flat still in the middle of its transformation from salt water to dry salt. Remember the pink lagoon in Cabo Rojo? The name of that lagoon is Las Salinas de Cabo Rojo—the salt flats of Cabo Rojo. As the ocean water that flows into the shallow lagoon starts to dry up in the sun, the salt that the evaporating ocean water leaves behind makes the water saltier and saltier. When all the water is gone, all that's left is dry salt crystals, just like what happened in our Tiny Ocean. At Las Salinas de Cabo Rojo, people actually collect the salt left behind to sell. See that pile of white powder next to the pink lagoon? That whole thing is salt. It's certainly easy to measure salt when it's in a neat pile like that. So if we really wanted to know for sure exactly how much salt is in the ocean, one way to find out would be to dry up all of the Earth's ocean water, collect all of the salt from the enormous salt flat left behind, and measure it. No way anyone is going to do that, but you don't have to dry up the entire ocean to get an estimate of how much salt is in the ocean. Imagine you filled a one-liter bottle with ocean water. You could pour that water into a pan, so the water could evaporate. Then you could measure the salt left behind. It turns out just one liter of ocean water has about seven teaspoons of salt in it, or 35 grams. That's enough salt to season 14 servings of French fries. From there, you'll need to know how many liters of water are in the ocean. Then you could multiply the salt you measured from one liter of water by the number of liters of water in the ocean. That is the amount of salt in the entire ocean. It's safe to say that is all a lot of salt.

Some scientists estimate that if you piled all the salt in the ocean on land, it would cover every continent on earth in a layer of salt taller than a 40-story skyscraper. So next time you see a picture or video of the ocean, or if you're lucky enough to visit one in person, remember, just because you can't see salt doesn't mean it's not there. Have fun, and stay curious.