Brains On (APM) | Brains On! Why is the ocean salty? 1QDE6EF00SK8RAWXC4ZS7QDCKM

MOLLY BLOOM: Brains On listeners, I have a favor to ask. You like podcasts, right? Some of you are nodding your heads, I can tell. But you know what? Some of your friends and teachers don't even know that podcasts exist. That's why we're participating in trypod, that's T-R-Y-P-O-D. All this month, we want you to recommend a podcast to someone, kind of like show and tell, except for your ears. And if they don't know how to subscribe to a podcast, show them how. It's important to share your knowledge. One show we recommend to you is the show about science.

It's hosted by the fabulous six-year-old Nate who talks to scientists all over the world. We think it is great. Of course, you can tell people about Brains On too. If you have access to a social media account, use the #Trypod to share your recommendations, that's # T-R-Y-P-O-D. Now let's start the show.

[MUSIC PLAYING]

You're listening to Brains On from American Public Media. We're serious about being curious. I'm Molly Bloom. I don't know about you, but the times that I've gone in the ocean, I always keep my mouth closed tight because I do not like how that water tastes. It is really, really salty. Ugh, grosses me out just thinking about it. Still, it raises an interesting question.

SUBJECT 1: Our question is, why are oceans salty while lakes and rivers are not? That's Corinne and Sophie with what sounds like a simple question. And you'd think there would be a simple answer, but this is one of those times when things are a little more complicated than you might think. Here to explain is Phoebe Lam.

PHOEBE LAM: I'm a Chemical Oceanographer at University of California, Santa Cruz.

MOLLY BLOOM: When we're talking about salt in the ocean, it's important to know what that means. Is it the same as the salt in our food?

PHOEBE LAM: The way they defined it originally was they would take a kilogram of seawater and then they would evaporate it, and they would measure what was left. And you'd get like a pile of white powder at the end and you weigh it. And that was how salinity was defined was the mass of dry solid in a kilogram of seawater.

MOLLY BLOOM: Salinity tells us the amount of salts that are dissolved in water. So the higher the salinity of the water, the more salty.

PHOEBE LAM: Seawater has a salinity of what we call 35 parts per 1,000. And that means you take a kilogram seawater, you end up with 35 grams of solid stuff at the end of it. If you were to analyze the chemical composition of that solid stuff, most of it would be sodium and chloride, but there are other things.

MOLLY BLOOM: It turns out there are many kinds of salt. In fact, a salt is just a certain kind of chemical compound. The majority of the salt in the ocean is sodium chloride, which is the same as table salt, but there are also a bunch of other salts made from other minerals too.

PHOEBE LAM: Magnesium and sulfate and calcium and potassium and all sorts of other elements.

MOLLY BLOOM: So when you taste sea salt, salt that's actually been harvested from seawater, it has some of these other elements in it, which gives it a slightly more bitter taste than regular old table salt. So with all of these minerals in the ocean, it leads to our next question, how did all this stuff get there in the first place?

PHOEBE LAM: It comes from the rivers. So ultimately, all of the saltiness in the ocean got there from rivers. And you would probably ask, well, rivers aren't salty?

MOLLY BLOOM: Exactly, and that's what Corrine and Sophie want to know.

SUBJECT 1: Why are oceans salty while lakes and rivers are not?

MOLLY BLOOM: Actually, rivers and lakes do have salt in them, just not as much as the ocean. And the reason for that is because lakes have outlets, places where the water escapes. Even if you can't see a big river or stream coming off a lake, there are still outlets. Eventually, smaller outlets lead to rivers, and these rivers lead to the ocean. So the water is constantly going into lakes and flowing out of them. The ocean is kind of like a big lake, but with no outlet.

And even though water keeps coming in, the ocean isn't getting bigger. That means it's also losing water through evaporation. And when water evaporates off the ocean, it concentrates the salt brought in by the rivers. There are actually a handful of lakes with no outlets too. And guess what? They are also salty. If you're ever in Utah, check out the Great Salt Lake. The name kind of says it all.

(SINGING) Ba ba ba ba ba ba ba ba ba ba ba Brains On.

Now we know how salt travels into the ocean, but how do these minerals get into the rivers and lakes in the first place? It's from erosion. Soil and rocks near lakes and rivers slowly break down. When they do, they drop bits of minerals into the water. And those minerals eventually flow to the ocean where they collect. This leads to the next question, if these salts keep coming into the ocean, why isn't it getting saltier and saltier all the time?

PHOEBE LAM: So the salts are coming in, but they're also being removed from mineral precipitation.

MOLLY BLOOM: Usually, we hear the word precipitation and think rain. Water on land evaporates and becomes rain clouds. It turns out minerals do something similar. Mineral precipitation in the ocean happens when dissolved minerals come out of the salty solution and form solids again. Some of these minerals that precipitate out fall to the ocean floor and end up forming sedimentary rocks like gypsum. That's the main component in sheetrock, the stuff that makes the walls in your house or school.

So in a way, your home may have very well been formed by this ocean cycle. This precipitation helps the ocean keep its balance, that 35 parts per 1,000 that Phoebe mentioned earlier. But there are regional differences due to precipitation and evaporation. For instance, parts of the Atlantic are as high as 37 and parts of the Pacific are as low as 32, but the average is 35. And it's been about 35 for millions of years.

There are lots of factors that come into play to keep this balance going. Water evaporates, fresh water is added by rivers and rain, minerals come in through these rivers and through underwater openings called hydrothermal vents. In fact, hydrothermal vents are also one of the ways minerals are being precipitated out. More on hydrothermal vents later in the show. The ocean is this sort of complicated machine that balances how salty it is.

PHOEBE LAM: I teach it in my graduate chemical oceanography class. So it does end up being a little bit more complicated.

MOLLY BLOOM: Maybe the best way to get this all across would be to write a song.

PHOEBE LAM: Oh, cool. That's awesome!

MOLLY BLOOM: Yeah, we'll call it the Salty Sea Cycle. But before that salty song, it's time for some natural noises to knock on your eardrums. It's time for the mystery sound.

GIRL: Mystery sound.

MOLLY BLOOM: Here it is. We'll be back with the answer and the debut of our song right after this.

[MUSIC PLAYING]

Right now we're working on an episode about pianos. You know what a piano sounds like, right? We want to hear your ideas for a different sounding piano. What sounds would you like to come out of your piano? I think I would like a piano that makes a sound that instantly puts a one-year-old to sleep when it's nap time. That would be nice. Send your ideas to Hello@BrainsOn.org. And if you have any other questions, mystery sounds, high fives or drawings you'd like to share with us, you can send those to that same email address.

Now's the time in the show when we thank the awesome kids who keep the show going with their ideas and energy. Here's the most recent group to be added to the Brains Honor Roll.

[LISTING HONOR ROLL]

Ready for that mystery sound again? Here it is. Here's the answer.

HANNAH: We're Hannah.

ABBY: Abby.

BERT: And Bert from Sydney, Australia.

HANNAH: That was the sound of a kookaburra laughing. I hear them every morning outside my bedroom window.

ABBY: Kookaburras have a short, thick body, and a medium length tail. They are my favorite Australian bird.

BERT: I like this mystery sound because it makes me laugh.

MOLLY BLOOM: (SINGING) The kookaburra sits in the old gum tree. Merry merry king of the bush is he. I'm sorry. That's not the song you're waiting to hear, but I couldn't help myself. This is the song you're waiting to hear. Here it is, our salty sea shanty.

[MUSIC PLAYING]

Oh, rocks erode and minerals flow to the ocean where they have nowhere to go. These minerals stay dissolved in the sea where they taste salty to you and to me. But the ocean has found a balance so sweet that is 35 parts per 1,000 salinity, a balance just right. We all give a cheer! 35 parts or swimmingly near. 35 parts or swimmingly near. 35 shout the waves, the fish, and the shore. 35 is the number that we're going for. 35 parts say the kelp and the rest. 35 parts per 1,000, is so good to us.

As new salts flow in, other salts leave, precipitating so they can be rocks once more, sedimentary. Evaporates like gypsum come out to the sea. The Atlantic, Pacific, Indian too, these oceans make up a great salty stew! Their waters will find a way to maintain 35 parts. It all stays the same. 35 parts, it all stays the same. 35 shout the waves, the fish, and the shore. 35 is the number that we're going for. 35 parts say the kelp and the rock. 35 parts per 1,000 is so good to us.

MOLLY BLOOM: (SINGING) We're going to make a video of this song and we'd like to include some of your drawings in it. Send us a drawing of something you would see on or under the ocean. It could be a magnificent sea creature or a seaworthy vessel. Send your drawings to Hello@BrainOn.org, and we'll include as many as we can in the video.

CHILDREN: Brains On!

MOLLY BLOOM: Now we're going to travel to the silent depths of the ocean. Hydrothermal vents, also known as underwater hot springs, are super fascinating and also very important in helping minerals come in and out of the ocean. These vents occur where there are underwater volcanoes. Seawater goes down into the crust and is heated up by very hot magma.

DEBORAH KELLEY: Over 70% of the volcanic activity on Earth occurs underwater, but most people don't know it because they never get to see it.

MOLLY BLOOM: That's Oceanographer Deborah Kelley from the University of Washington. These vents are referred to as black smokers because they're basically chimneys that spew out superheated water. The water coming out of the vent looks like black smoke because it contains fine mineral particles, making it darker than the water around it. She's had the opportunity to go deep underwater in a small submarine to study these vents up close.

DEBORAH KELLEY: It's one of the most fantastic things I've ever done. I've been down more than 50 times, and I would drop anything easily to go down there. And the first 300 feet or so or more are kind of sunlit because the light penetrates. And then you go into complete darkness, and a lot of the organisms are bioluminescent, so they, so to speak, glow in the dark. And the vehicle is dark inside. And you can put your face up against a window, and it looks like you're falling through the stars.

Almost every time we go down there, we see something new or you know that you're the first human eyes to ever, ever see that.

MOLLY BLOOM: Scientists have learned a lot from these underwater hot springs, but they weren't discovered until relatively recently. Scientists did not know they existed until the 1970s.

DEBORAH KELLEY: In my world, they're probably one of the most profound discoveries on the planet because before then, most people thought that life was driven by sunlight. And so in this environment where life is in perpetual darkness, and so the organisms there when they first discovered them really transformed how we think about life on this planet and where it can thrive on other planets as well.

Around that area, there's large crabs, there's worms that grow six feet tall that can live 100 years. I was also in the Atlantic. There's billions of shrimp that cover these hydrothermal hot springs because there are a lot of bacteria there. Many people think that life started within the hydrothermal vents on the planet. And so these organisms, they tolerate almost anything that would kill humans.

Certainly, microbes, not only in the hydrothermal vents, but in the world's oceans, are incredibly important. They process chemicals. They are the food chain for lots of other organisms.

MOLLY BLOOM: These tiny organisms can actually take toxic metals out of the water. So mining companies are using them to clean water. Scientists are working to see if these organisms could be used to capture carbon dioxide or possibly even develop new medicines. Deborah Kelley stumbled into this field, but she's very excited about all there is to learn in the future.

DEBORAH KELLEY: Oh, I definitely stumbled. I started out as a music major, but I wanted to be a Russian interpreter. And then I went into graphic design and took a geology class and fell in love wandering around volcanoes.

MOLLY BLOOM: And this love of volcanoes led to an interest in hydrothermal vents.

DEBORAH KELLEY: When I was growing up, I wasn't the smartest kid, I worked hard, but I always thought that discoveries were for somebody else. And right now in oceanography, the oceans really govern the health of our planet. And I think understanding not only the hot springs, but the oceans that we live in, is going to be more and more critical.

And as kids come up through k-12 and into college, this is one of the areas where there's a potential for a really huge discovery, and many of them, not just a couple. The ocean really is the last frontier on Earth.

MOLLY BLOOM: That's it for this episode of Brains On. Many thanks to Veronica Rodriguez, Tim [? Miney, ?] Jessica Corelli, and Ignacio Pujana. We'll be back soon with more answers to your questions. Thanks for listening.

[MUSIC PLAYING]