Full Transcript:
“*The Science of Ocean Sounds*”

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LP: Hi I’m Lindsay.

ME: And I’m Marshall. Welcome to Tumble, the show where we explore stories of science discovery.

LP: Today, we’re exploring the sounds of ocean science.

ME: What kind of sounds? Waves? Bubbles? Fish singing?

LP: Sounds like this: *(MUSIC STOPS)*

SFX: Underwater volcano

ME: Whoa, what is that?

LP: We’re about to go on a sound science scavenger hunt to find out.

MUSIC

ME: Okay what was going on with that sound? It sounded like I was in the wheel of a bulldozer.

LP: You mean this sound?

SFX: Underwater volcano

ME: Yeah! What is it?

LP: Hmmm. I don’t think I’m going to tell you just yet.

ME: Is this one of those mysteries where I’m going to have to figure it out on my own?

LP: It is! Because it’s a sound scavenger hunt episode.

ME: Alright! Scavenger hunts. Is this where we go house to house looking for clues?

LP: You can stay in the same place because we’re going to use our ears. So here’s the setup. We’re about to meet a scientist who uses sound to study the ocean. And I’m going to play a few of the sounds that we’ll be searching for throughout the episode. So listen carefully. Here’s the first sound:

SFX: Sound beacon

ME: All right, that is a sound.

LP: Here’s the second:

SFX: Sonification tones

ME: Ooookay

LP: Here’s the last:

SFX: Underwater volcano

ME: I’ve already asked about this one - what is it?

LP: All will be explained, soon. But I’ll give you one tiny little clue. One of the sounds is used to collect data about the ocean and the other two are used to help understand the ocean.

ME: Okay... that’s not much of a clue.

LP: That’s all I’m giving you to go on. So are you ready to start?

ME: Sure!

LP: Okay great. Let’s meet the scientist behind the sounds. Her name is Amy Bower.

Amy Bower: I'm a scientist who is trying to understand how the oceans work. Specifically, I'm trying to map out all the ocean currents right down to the bottom of the ocean - from top to bottom.

ME: So she’s like an ocean map maker!

LP: Amy is an oceanographer!

ME: It just makes so much sense.

LP: Amy has always been curious about how the ocean works since she was little.

Amy Bower: I grew up on the ocean, so, you know, I was naturally very interested in what the ocean was doing all the time. Why are those waves bigger today? Why? Why? What makes the tides work?

ME: So basically, she was observing the ocean - like a kid ocean scientist!

LP: Yeah! But years later, when Amy was in school to become a scientist, she discovered something about the ocean that would fascinate her for decades.

Amy Bower: That's when I first started to learn that there were these giant rivers in the ocean, otherwise known as ocean currents that carried huge volumes of water - of seawater - all around the globe. I had no idea that was true before then. And I just thought that was awe-inspiring.

ME: Wait, there are giant rivers in the oceans? How can there be rivers in a body of water?

LP: Ocean currents are patterns of fast-moving seawater, powered in part by the wind.

Amy Bower: So the water next to the current is not moving that much. And then you have a strip of ocean that is moving pretty quickly.

ME: How big are these currents? Are we talking big river? Or narrow stream?

Amy Bower: Some of the biggest currents in the ocean are equivalent to a thousand Mississippi rivers.

ME: So like, one Mississippi is pretty big. Then you’ve got two Mississippi, three Mississippi...

LP: By the time you get to a thousand Mississippi, it’s a lot of Mississippi.

ME: That’s a mind-boggling amount of water.

LP: What’s even more mind-boggling is how little we know about these currents.

Amy Bower: Part of what I'm trying to understand is where are all of the currents? You know, where are they anyway? And, how strong are they? What path do they follow? There are many questions like that that we don't have answers to yet in the deep ocean. So we don't even understand yet how our ocean functions, in many respects.

LP: That’s why Amy is making a map of ocean currents. It will help us understand how the ocean works - and its flow affects our climate.

ME: So how does Amy make that ocean current map?

LP: Using sound.

ME: Ooh I feel like this might be a clue to our scavenger hunt.

LP: Maybe! So first, Amy heads out into the ocean.

Amy Bower: Oceanographers like me, many of us go out on these ocean expeditions.

ME: Ooh adventure on the high seas!

LP: A big research ship takes Amy and her colleagues to places where she wants to map the currents. Once they’re there, they take out a special buoy - a container designed to float underwater - and capture data about the water’s temperature, speed, direction, and more.

Amy Bower: We just drop those over the side, they sink down to the depth of the current that we want to investigate, and then they, we just go away and they drift.

ME: Wait, they just drift out on their own?

LP: These buoys act like explorers, following the currents and keeping a log of their travels. And scientists track them using sound.

Amy Bower: At the same time, we put the buoys out, we anchor the sound beacons in the general area where we think the buoys are gonna drift. Those sound beacons emit a sound.

SFX: Buoy sound

ME: I got it! That’s one of the sounds we were listening for!

LP: Yes! It's a signal that communicates with the drifting buoys in the ocean.

SFX: Buoy sound

Amy Bower: So several times a day they send out this signal, and the drifting buoy has a hydrophone, which is like a microphone for underwater.

ME: Wait, does it do an underwater podcast?

LP: It’s really more of a “listening” microphone and the buoy sound is kind of like the speaker.

Amy Bower: The hydrophone on the drifting buoy is listening for just this particular signal.

LP: The instruments inside the buoy records the time it hears the signal.

Amy Bower: So we know how long it took the sound to go from the sound beacon to the drifting buoy. We also know the speed of sound in water.

LP: Using some simple multiplication, Amy can figure out the distance between the sound beacon, and the drifting buoy.

ME: So the sound beacon is tracking the drifting buoy.

LP: Yeah. And there’s a bunch of these sound beacons anchored to the ocean floor. So it’s sort of an ongoing game of Marco Polo, as the buoy moves through the current.

Amy Bower: So we have to have two parts to this system. There's the drifting buoy itself, plus the sound beacons.

LP: Using sound, Amy can pinpoint the position of the buoy, and map its movements across the ocean.

ME: So that’s how she makes the ocean current map! So what has she found so far?

LP: She’s found that ocean currents do some unusual things. For example, Amy told me about the time she used two of these buoys to study a mysterious current off the coast of Spain and Portugal.

Amy Bower: After about a year, each one of those buoys popped up to the surface and gave us the data. And then we were able to reconstruct where each buoy went while it was underwater in this current.

LP: The buoys had some surprising information to share. The data showed that the current didn’t follow the path that Amy thought it would. Instead, it broke into pieces.

Amy Bower: And these are not small pieces. These are big pieces that are maybe 50 miles wide and circular. We call them eddies, a sort of swirling vortex.

LP: They discovered these eddies can capture warm seawater, and transport it all the way across the Atlantic, like little swirling islands.

ME: So currents aren’t just rivers, they’re also islands? That’s bizarre.

LP: Totally. But like Amy says, we can’t see how the ocean works - bit by bit, sound is revealing what’s deep beneath the waves.

ME: Yeah because let’s face it - moving water in more water is essentially invisible.

LP: And that’s not the only way that Amy’s using sound to study the oceans. After this quick break, we’ll find out how Amy uses sound to understand her data - and why she wants to share it with everyone.

AD BREAK

LP: We’re back and continuing on our scavenger hunt! So you heard how Amy uses sound to map ocean currents. But she also uses sound to understand the data - and share it with others.

Amy Bower: I'm doing some exploration of how we can use sound to “visualize” data.

ME: “Visualize data?” Is she talking about using *sound* to be able to *see* what the data is telling us? I’m confused.

LP: Yeah. So usually, scientists turn the numbers from their data into visual forms like charts and graphs. But that doesn’t really work for Amy.

Amy Bower: I'm a blind scientist, so in fact, the data I'm collecting and measuring, is now pretty difficult for me to see on a graph.

LP: Amy became blind while she was training to become an oceanographer. So that led her to experiment with something called “data sonification.”

Amy Bower: Data sonification - it's a big word - is basically just translating numbers into sound.

ME: Whoa that sounds really interesting. So is it like, each number is a sound?

LP: That’s the basic idea! Each number is assigned a frequency - or pitch. Here’s how Amy describes how it works.

Amy Bower: So you say okay, I'm gonna give that the frequency that sounds like, “Ooh”, okay? So every time the number two comes up, there'll be a “ooh” sound coming from my computer.

Amy Bower: Then I say, okay, the number four, we're gonna have, ooh, (higher pitch) okay? So every time number four comes up, the sound “ooh” will be played by my computer.

Amy Bower: So if you were just switching back from two to four to two to four, go, “ooh, ooh, ooh, ooh.”

Amy Bower: Now I usually have a lot more numbers than just two to four, right? I got a whole bunch of numbers. And so you end up with something that might sound sort of like, ooh (sings long, varying pitch)

Amy Bower: And that's telling me that the numbers are changing a lot across a particular range.

ME: Oh man. That’s so cool. So instead of seeing numbers go up or down in a graph, you actually *hear* them. But did I hear one of our scavenger hunt sounds in there?

LP: You did! It’s Amy singing her numbers. It’s just one example of how data could sound.

Amy Bower: There are other much more sophisticated ways where you could say, use different instrument sounds to represent different types of data.

LP: Say, wind data could be a wind instrument, and ocean data could be a horn.

SFX: Wind instrument and horns

ME: I’m getting excited - you could have a whole chorus or orchestra of data!

LP: Yeah. There are some really cool projects that play with data sonification. There are a lot of cool projects to share the sounds of data. Amy’s working on one for an underwater volcano. Do you want to hear what it sounds like?

ME: Yes of course.

SFX: Underwater volcano.

ME: We found all three! That’s our second sound from the beginning of the episode!

LP: You got it. This data comes from a sensor that measures pressure, or force, beneath the seafloor - right next to an underwater volcano.

Amy Bower: It turns out that this volcano erupts every now and then - maybe every few years, five years or so. When it's not erupting, the magma is building up under the sea floor. And the sea floor is slowly rising, being pushed up by the magma underneath.

ME: Wait so the seafloor itself actually moves up?

LP: Yes! The sensor measures that movement.

Amy Bower: If you are a visual person in a visual display, you can see this rise and fall of the sea floor. But if you're not a visual learner or you're visually impaired, you can't see that.

LP: So Amy wanted to figure out the best way to share the story of the seafloor data - with an explosive ending. She worked with a sound designer to find sounds that both corresponded to the numbers of the data - and felt like an undersea eruption.

Amy Bower: And so in this data you can see, day after day, year after year, the sea floor is rising up as the magma is growing, and then suddenly the nearby underwater volcano explodes and all the magma comes out of the magma chamber out into the ocean and the sea floor drops because the magma underneath is now gone.

ME: That’s incredible. I think hearing a volcano is a bit more fun than looking at a graph, though looking at graphs is actually really fun.

LP: Totally. Different versions of the sonification add more information - like how much time has passed.

SFX: Clip with dates

LP: Or narration that gives context, like a map’s legend.

SFX: Voice narration.

ME: So it really gives you all the information that a visual would - but you process it through your ears, instead of your eyes.

LP: Exactly. And that could be a valuable perspective on data.

Amy Bower: Scientists are finding out that the ears can actually pick up information from the data that the eyes have more difficulty seeing. The ears and the brain just work together differently in such a way that they can perceive patterns in the data that the eyes can't see. I think that's pretty cool.

ME: Whoa, so you could actually hear something in the data that you might not see.

LP: Yeah! Plus, it means that more people can experience science - and be a part of it. Amy wants everyone to be able to follow their curiosity like she did.

Amy Bower: So I'm determined to help make science as accessible as possible for everyone.

ME: It sounds like that’s exactly what she’s doing.

LP: Yes! It also sounds like we’ve come to the end of our sound science scavenger hunt. You did a great job finding them all.

ME: You know, I just feel like I was really tuned in, heavily focused. Definitely a sound-finding superstar.

LP: I could see the sweat coming off your brow as you listened!

MUSIC OUT

ME: Now that you’ve learned how Amy converts data to sound, you can make your own data sonification!

LP: Choose a few different sounds that you can make - you can sing them, or make them with the objects around you. Assign a number to each sound - and challenge your family to follow along with the numbers that you play.

MUSIC

LP: Thanks today to Dr. Amy Bower, senior scientist at Woods Hole Oceanographic Institution.

ME: You can learn more about Amy’s work on the bonus interview episode on our Patreon, at patreon.com/tumblepodcast.

LP: And we’ll have more free resources to learn about ocean currents and Amy’s work to make ocean science accessible, available on the blog on our website, sciencepodcastforkids.com.

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ME: Sara Robberson Lentz edited this show and designed the episode art. Peter Walters is our editorial consultant for the series. Elliot Hajjaj is our production assistant. And Gary Calhoun James engineered and mixed this episode.

LP: I’m Lindsay Patterson and I wrote this episode.

ME: I’m Marshall and I made all the music and sound design. Tumble is a production of Tumble Media. Thanks for listening and stay tuned for more stories of science discovery.