

# But Why: A Podcast for Curious Kids

## Why Are Whales So Big?

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**Jane** [00:00:20] This is But Why: a Podcast for Curious Kids from Vermont Public Radio.

**Jane** [00:00:25] I'm the host, Jane Lindholm. On this show you tell us what you are interested in and what your questions are about that thing you're interested in. And we use your questions to guide what we talk about on the show.

**Jane** [00:00:38] Your curiosity dictates what we explore. When I was young, I really wanted to be a marine biologist. That's a scientist who studies things that live in the oceans. And lots of you are interested in marine biology, too. We've done episodes about fish and about why the sea is salty and other things related to oceans like, are jellyfish really made out of jelly? Spoiler alert, they're not. But now we're going to focus on one particular type of animal that lives in the oceans that, like me, a lot of you are fascinated by.

**Jane** [00:01:15] Can you guess what animal we might be discussing? Whales!

**Jane** [00:01:24] That is the sound of a humpback whale singing. And that sound comes courtesy of the federal government's NOAA Fisheries Web site.

**Nick** [00:01:34] But we're not going to focus on the way whales communicate today. That's going to be a future episode, so be sure to listen for that one, too. We want today to have a better understanding of what whales are and how they move through the oceans and occasionally through rivers, too. Here's our guide for today's episode.

**Nick** [00:01:55] My name is Nick Pyenson. I'm a paleontologist at the Smithsonian in Washington, D.C..

**Jane** [00:02:01] Tell me what a paleontologist is?

**Nick** [00:02:04] A paleontologist looks for any trace of life that lived a long, long time ago. And they tend to look for fossils, which can be bones, footprints, leaves, any kind of trace of life that isn't around now, but we know existed millions, even billions of years ago. One of the challenges and one of the things I like most about being a paleontologist is that you don't get all the clues that you'd like to. So we don't get a full skeleton. Sometimes we do, but mostly not. So you have to make the best you can do with a little bit of information. And that's what makes paleontology for me a lot like a detective story.

**Jane** [00:02:46] So, Nick, some of the kids listening now might be scratching their heads because they know that this episode is about whales. And you just told us you're a paleontologist. So you look for signs of life that doesn't exist anymore. But whales still exist.

**Nick** [00:03:04] Right? I got in to science because I really liked looking for fossils. And that led me eventually to looking at whales because whales are mammals that live in the ocean. And some of them live in the rivers. But you're probably more familiar with ones

that live in the oceans that are really big, that have flippers, that have flukes. They look from the outside a bit more like a fish than a mammal. But what's really neat about them is that we know that they're mammals and that they're closely related to other hoofed mammals, specifically the mammals that have even toes, two toes.

**Nick** [00:03:43] And those mammals are cows, pigs, deer, camels, sheep. That's who whales are most closely related to. And if you look at a whale and you look at all of its near cousins that are alive today, you realize that whales look really, really different. And what explains why they're so different has to do with how they evolved, how they came to be. And going back to fossils, we're really fortunate in being able to find fossil whales that tell us how those changes happened. So I'm lucky enough to be able to work with teams of scientists to go around the world and look for fossils of whales and then try to understand how those fit in with what we know about whales today and also where they're going, because the earth has always changed and it's still changing.

**Jane** [00:04:32] I want to get to some of the questions that our listeners have sent us. But just before we do, I want to pick up on something that you said, which is that whales are really closely related to even-toed hoofed animals, but they look really different. So if they look really different, how can two animals be very closely related? Because you'd think they'd be more closely related to something else that they look like, like a shark or a fish.

**Nick** [00:05:00] Right. Just because something lives in the water or looks like a fish doesn't mean they're all related to each other. Whales, sharks and fish, the last time they shared a common ancestor was probably nearly half a billion years ago. Let's get more precise about whales, as related to other mammals. We have a lot of different ways of knowing how organisms are related to each other. We can look at their DNA, which tells us directly about their relationships in a way that's that doesn't connect to how they look. It has more to do with their genetics, right? DNA tells us the whales fit in with all these other mammals and the whales are mammals. And that's something you would know probably from just looking at the fact that they breathe air. They have babies that drink milk from their moms. They do have hair. If you ever get the opportunity to be close enough to a whale and even if you've seen photos of baby dolphins, they have little tiny whiskers on their snout. They lose them pretty quickly. But those are all telling you about their deeper ancestry. And you want to use all the different kinds of evidence available to you, whether it's DNA that might tell you one story or fossils that tell you a story that maybe sometimes is a bit different. And that's why I say that fossils tell us something that we wouldn't otherwise know. We can have a family tree of animals based on DNA and then fossils tell us about those branches of the tree that we wouldn't otherwise know about. And for whales, that's what tells us that the earliest whales lived on land. We find these fossils, the earliest whales with four legs. They had tails that probably didn't have flukes. They had snouts that were long in their nostrils, were at the end of their snouts instead of right over their head. The first scientists who were able to dissect whales that had sometimes been stranded on the beach. And it's obviously a very sad thing, but it's also a huge opportunity to know about an animal that is otherwise very hard to study. One of the amazing things they found were that whales have multi chambered stomachs. Their stomachs have different parts to them. And the mammals that are most like that are hoofed mammals like cows and sheep. And so that was one of the clues that scientists even over 100 years ago said, you know what, whales look really weird, but I think they're very closely related to this group of mammals.

**Jane** [00:07:27] But let's be clear. Whales have been frolicking in the ocean's waters for a very, very long time.

**Nick** [00:07:34] Whales have been around for 50 million years and they've been aquatic animals for about 40 million years of that time. So for four fifths of their history, they've been in the water and they've been in the world's oceans.

**Jane** [00:07:50] Well, let's get to some of the questions that our young listeners have for us about whales, because I think a lot of kids, I was certainly, one, find whales and marine mammals really fascinating. So I'm really glad you're here. So one of the first questions that maybe we could tackle is from Huckleberry, who lives in Washington and is four and a half.

**Huckleberry** [00:08:11] My question is why are whales so big? .

**Jane** [00:08:15] Why are whales so big?

**Nick** [00:08:18] Huckleberry's question is a good one, because I think that that's one of the most obvious features of a whale. If you don't know anything else, you know, the whales are really big. Why? How'd they get that big. That's where studying fossils can be very useful, because one of things you definitely know from a fossil, even if it's incomplete, is roughly how big that extinct whale once was. And when you line them up through time, a really cool pattern, you see, is that it takes a while for whales to get really, really big. So for most of the time that whales have been around on this planet, we don't find big whales like the ones we see today, like blue whales, fin whales, right whales, sperm whales. We don't find those in the fossil record and we think it happened very rapidly, very recently.

**Jane** [00:09:09] Nick says he and some other paleontologists believe that the size of whales is related to changes in the oceans that happened a couple million years ago. So I should point out that when Nick says:

**Nick** [00:09:23] We think it happened very recently.

**Jane** [00:09:25] Very recently is a relative term. You and I might think of recently as something that happened last week or maybe even last year. Nick thinks of recent as something that might have happened a few million years ago. That's paleontologists for you. Nick says that in the last few million years, starting about four and a half million years ago, the Ice Age changed the Earth's oceans in a way that made the ocean have lots and lots of the food that certain whales eat, like huge schools of krill and small fish. But these food sources were only in certain parts of the oceans at certain times of year. So the whales had to travel long distances over the course of a year to find their food. Being really big helped them travel farther, faster. And it also made sure they had enough fat or blubber stored in their bodies to give them the energy they needed to get to those food sources during their long migration. There's still a lot more that scientists need to do to study this idea and to learn why whales are so big. But it's pretty amazing to note that not only are the biggest whales today way bigger than whales were millions of years ago. They're also the biggest creatures that have ever been on Earth. The blue whale is the biggest animal alive today, and it's bigger than the biggest dinosaur. Speaking of blue whales, here's a question from five year old Julia, who lives in San Jose, California.

[00:11:01] Why are humpback whales so fat and blue whales so long?

**Nick** [00:11:08] Boy, I love this question from Julia. Because it's very perceptive. It shows that Julia was paying attention to what these different kinds of whales look like. So

humpback whales, they have very long flippers and they have these kind of bumps on them. They go all the way down and even their snout looks kind of bumpy. I always think that their snout looks like kind of texture of a pickle. It's got all of these bumps on it and they have big wide tail flukes. By contrast, a blue whale is much more blue in color and it's a longer and skinnier whale, which is funny because everybody knows blue whales are the largest of all whales. And so you think a big whale would be even bigger and fatter and rounder. But blue whales don't really look like that. They're actually very long. And to me, very sleek looking whales. Julia's question is why? What's the difference between them? And I think there's two answers. The first one has to do with how the whales move through the water. If you've ever been fortunate enough to go on a whale watch and see a humpback whale or you can watch video on YouTube, these whales can turn on a dime underwater. They're acrobats. And, yes, they jump out of the water. But in the water, they can turn and maneuver very quickly. A lot of that has to do with having very, very long flippers. So humpback whales are able to maneuver and turn really quickly under water. Blue whales migrate very, very long distances and been long in slinky and sleek has a lot to do with being efficient for moving slowly and consistently over long distances. They don't need to turn that rapidly. Instead, they just need to propel themselves over long distances. So they look much more like arrows. Now, of course, both blue whales and humpbacks, when it's time to feed, they open their mouths wide and they have these flexible throat pouches that are kind of like parachutes that expand out rapidly and that fills with water. And a lot of that water ideal is filled with fish or krill or some of their food that they're then able to close their mouths and push that volume of water out through the baleen that hangs from the roof of their mouth. And that strains out the water, but keeps the food inside and they can slurp down the food. And all that happens in less than a minute in this kind of an amazing process of filter feeding. And so humpbacks and blue whales are actually feeding on different kinds of food. The prey items are different. Humpback whale tends to feed on fish and krill can do a lot of different things. It's a mid-sized whale, if that makes any sense. And so has the flexibility of eating different kinds of food items.

**Nick** [00:13:49] Whereas the blue whales at the very, very large end and they're are specialists on krill, is tiny, tiny little shrimp like animals who live in the ocean, but they live in very large concentrations. So blue whales are eating a lot of krill, almost like a big animal taking a bite out of a cloud, except with that cloud was made out of krill. And they travel very far distances to get to the place, the right time under the right conditions were krill is in the kinds of concentrations that make it make the return on that trip worth doing.

**Jane** [00:14:22] You mentioned that they push they take a big gulp of water and there's krill in the water and then they can push the water through their baleen, which, you know, it's kind of looks like it's kind of like just a filter, right? So that the water can go through, but the krill gets stuck inside. But not all whales have baleen, right? So not all whales eat that way.

**Nick** [00:14:42] That's right. So when I look at today's whales, the whales that are alive today, I talk about them living in two houses. There's the house of the baleen whales, the ones that filter feed. And then there's another house of the toothed whales. Now, not all the toothed whales have teeth and some of them have really funky teeth.

**Jane** [00:15:01] How can they be toothed whales if they don't have teeth?

**Nick** [00:15:03] Well, their ancestors had teeth. And so in some cases, they've lost teeth, but they don't have baleen and all toothed whales hunt using echolocation, using sound that's emitted from their forehead. It's another crazy thing that whales do.

**Jane** [00:15:19] And people might know this from bats to right. So with echolocation, you send a sound out and the sound then comes back to them, and based on what that sound is like, the way it sounds, they can tell how far away a fish is, right? They can sort of that because of that sound bounces back differently. If it's a big fish that's far away or a bunch of small fish that are closer.

**Nick** [00:15:40] Right. It's the same way that a submarine can navigate underwater. It's a principle that different animals have evolved, the ability to do. And whales, or toothed whales are the only animals that have evolved the ability to do this underwater. And they do it to depths that really blow, I think, anybody's mind, miles deep for over an hour. They'll take a deep breath, hold it and go dive deep. Look for squid or fish. Chop them down and come back to the surface and breathe and then go back and do it again. And you could see how using echolocation, sound to navigate an environment, is really useful, because when you dive deep enough, there's no light. You can't really use your eyes to see. If you've ever tried to navigate through a dark room at night, you know that you'll probably bump into something. If you're able to navigate with sound. You wouldn't need light to see. You could just bounce sound off of the room that you're in and figure out where you need to go. So not only is it an amazing navigation tool, it also allows you to have another way to communicate with other whales nearby as well.

**Jane** [00:16:48] When we're thinking about whales and their size, we can think about how we might measure them swimming alongside a whale and measuring. But one of the other questions we have is from Sonia.

**Sonia** [00:17:00] I live in Oakland, California. And I'm six years old. My question is, how much do blue whales weigh and how do you weigh them?

**Jane** [00:17:10] How do you weigh a whale?

**Nick** [00:17:12] Boy, these are really good questions. And I had these questions when I was a little kid, too. So I'm going to step back a bit. We're going to go back even before I was born 100 years ago was a time when people were whaling and killing whales in very large numbers in places much closer to the South Pole than anywhere in the Northern Hemisphere.

**Jane** [00:17:32] And they were doing that for a couple reasons. A lot of it was to get fuel. But there are a lot of other products that people have used whales for as well, and in some cases for food.

**Nick** [00:17:43] One of the reasons that many companies had so so they were killing whales for for profit, for money, because they're a source of fuel, their source of oil that people used for soap, for kitchen products, perfume. Yeah. If you go far enough back people were using it for perfume. So whales were were used for commercial products. That's why companies where were hunting them and there weren't any rules about how many you could hunt or where you could hunt. So it's a bit of a different world. And one of the things they did as they hunted all these whales and they'd bring him back to a big factory and they would actually chop up these dead whales into parts. And it sounds kind of gory. And once they cut them into smaller parts, they were able to weigh them. And then

you add up all the parts together and you have something that you can total as a whole mass of that whale. That was the first time that people were able to get some kind of sense of how much a whale weighed. And for blue whales the numbers they got were in the range of over 100 tons or 150 tons. And to make sense in terms of pounds, that is in the neighborhood of 250,000 pounds or a quarter of a million pounds. Now, today, we would do this in a different way. And that's not just because we don't hunt whales anymore, but also we have different tools available. And one of the tools we have is with remote sensing. And we can do this with drones. You may have, you may have a toy drone, a pocket drone, or you've seen other people use it and they have cameras onboard.

**Nick** [00:19:22] And one of the things you can do if you are a scientist and you can get close enough to whale is you can use those cameras to take a precise photo with an object of known size in some cases, this tends to be a boat that is near the whale. And if you know how long your boat is, you can then take that picture and figure out how long that whale is. And with a little bit more sophisticated calculations making estimates about the volume and the shape of the animal, you can actually get at the weight. And this is important because we can track individual whales through seasons, through years to know how they change in weight. And when they get really, really fat, when they eat a lot of food in the summer and when they get skinnier in the wintertime. And so this is one of the amazing things about technology today, is that it can tell so much more about the lives of these animals that are really, really hard to study.

**Jane** [00:20:15] So we're not picking them up and weighing them with the scale or figuring out like the volume of water in a tub and then putting the whale in and see how much water it displaces and...

**Nick** [00:20:24] Really, really hard to do that.

[00:20:26] My name is Drako and I am five years old and I am from California. And my question is why are blue whales blue.

**Jane** [00:20:37] Drako wants to know why blue whales are blue.

**Nick** [00:20:41] This is such a good question. I don't know it. Nobody really does. Here's what we know. We know that whales tend to have this pattern of coloration that we call counter shading. So they're dark on top and light on the bottom.

**Nick** [00:20:57] And that is true for blue whales, even though they're blue. If you look at their bellies are a little lighter than their backs. And that is true for most kinds of whales. Not true universally across the board, but they tend to have counter shading. And that is true for other predators that live in the oceans, too, like sharks. And the argument is that this is a really good way to blend into your environment. Makes you hard to see from the top down and from the bottom up. And this is also why military planes all use the same kind of coloration, too. And it's a it's a useful technique. Now, it also may be really useful for signaling to members of your species or clan or kind.

**Nick** [00:21:41] So there may be advantages that are not necessarily related to the environment, but more for how you behave and communicate with other whales that are more like you. And we think that that's also a way that evolution works by selecting on those kinds of funny features that relate to color. Or, you know, if you're if you're a bird, it would be the different kinds of feathers you have.

**Jane** [00:22:04] Do any whales have really wild or cool colors or patterns?

**Nick** [00:22:07] Oh, yeah. I mean, there's different species of pink dolphins. Dolphins have much more pink colors. Now, what's interesting is those dolphins tend to live closer to the shore. Some of them live in the rivers. You would not be wrong if you're a kid for pulling a pink crayon to color in a whale or a dolphin because some species look like that.

**Jane** [00:22:26] We are studying whales today. And in just a minute, we're going to discover whether or not whales have belly buttons. Do you think they do or do not? We'll also talk about the fact that you could be the one to discover a new species of whale if you become a marine biologist or a paleontologist yourself. Nick Pyenson says there are still whales that have not yet been discovered.

**Jane** [00:22:53] This is But Why: a Podcast for Curious Kids, like you! Today, we're learning about whales with Nick Pyenson. He's a paleontologist who works at the Smithsonian Institution in Washington, D.C. and he's the author of a book called Spying on Whales: The Past, Present and Future of the Earth's Most Awesome Creatures. Nick knows so much about how whales came to be the massive and fascinating creatures they are today. And he's answering some of the questions you've sent us about them, like this one.

**Olive** [00:23:26] Hi. My name's Olive. I live in Cleveland, Ohio. I'm five and a half years old. And my question is do whales have belly buttons?

**Jane** [00:23:40] Olive wants to know if whales have belly buttons.

**Nick** [00:23:44] This is a great question, Olive. And the answer is yeah. Whales do have belly buttons because they're mammals, just like you and me. And the belly buttons that we all have are a sign that we were once connected to our mothers, in our mother's womb. And whales have belly buttons just like all other mammals. They're hard to see. You'd have to look under a whale. And they're kind of folded in. But yeah, whales have belly buttons.

**Penelope** [00:24:12] Hi, my name's Penelope. I'm eight years old. I live in Reno, Nevada. And my question is, how do mammals that live in the ocean like dolphins and whales drink if mammals can't drink saltwater?

**Jane** [00:24:24] How do mammals that live in the ocean, like dolphins and whales drink if whales can't drink saltwater?

**Nick** [00:24:32] Right. This is perceptive. If whales are mammals and they're living in the water, how are they drinking any kind of freshwater? And there's two kinds of answers to that. One is that they get all the freshwater they need from the food they eat. So fish when freshly caught. Do you have a little bit of water in them? And that's true for krill. Whales are definitely not drinking the ocean water. They can also break down water from the fat in their bodies as well. But we do know that their kidneys are shaped in a specific way for getting rid of salt from their body. They do have salt excretion mechanisms. Excretion means getting rid of something.

**Cord** [00:25:14] My name is Cord. I'm five years old. My question is, how do whales get water into their water spouts?

**Jane** [00:25:23] How do whales get water into their water spouts?

**Nick** [00:25:28] Blowholes are really important because that's how whale breathes. They don't really breathe through their mouth. Sometimes we breathe through our mouth, especially her nose is stuffed up, but they breathe through their blowholes, which is the equivalent of our nostrils. And those blowholes have big, fleshy openings, right. If you've ever seen a video, the whales come to the surface in their blowhole opens up and it's this big flap of skin.

**Jane** [00:25:50] Kind of poofs out.

**Nick** [00:25:51] Yeah. Kind of puts out. Yeah. It's a good way of describing the reason why you see a spout, that kind of spray coming out of it is because there's a lot of air that's being pushed out of it very rapidly. So there's a big volume of air. It's moving through it very rapidly. That also has a little bit of water around it. So you can kind of do that, too. And I don't encourage you to do that maybe at the dinner table, but maybe do it in the bathtub or in the sink if you get water around your mouth. You can take a big breath of air and push out like you're breathing through a straw and spray that water. And so whales do the same thing. So that's why you see that spray. And what's cool is that different kinds of blows from different kinds of whales have different shapes in those shapes are really specific to different species. So humpback blows looked really different from blue whale blows, which look really different from gray whale blows.

**Jane** [00:26:42] So if you're in a boat and you were just looking at the surface of the water and you saw a little bit of whale peek up and then a blow in that spray of water and air, you might be able to tell what kind of whale it is just by looking at it and hearing it.

**Nick** [00:26:55] For sure, for sure.

**Jane** [00:26:57] How long can whales hold their breath for?

**Nick** [00:26:59] Oh, this is a really neat question, because there was just a new discovery published last month that showed that some whales can hold their breath for over three hours,.

**Jane** [00:27:11] Three hours!

**Nick** [00:27:12] That is just mind blowing. And that's why this discovery made the newspapers, because until then, we thought to a little over two hours was the record holder and in this new discovery broke all the records. And it kind of blew the scientists minds, too, because what they did is they put a removable suction cup tag on the back of these kinds of whales are called beaked whales, and they are specialists for diving deep. And they put a tag on and had to wait at the surface until it came up. Imagine you taking a single breath and then running for an hour or two to go find your lunch, eat your lunch and then take a breath at the end. Its kind of mind blowing. That tells you, you know, even now we're learning new facts, record breaking facts about living whales that we didn't previously know. They're very hard animals to study. And I think that's as a paleontologist, I have a lot of incomplete information. I get you find fossils that are fragmentary in parts. And I kind of think that's that's useful way of thinking about the challenges that we have for studying the animals that are still alive today. We still don't know that much about them.

And that's what makes me really excited as a scientist, is that there's so much more to learn.

**Jane** [00:28:23] That's actually really cool because there's so much more to learn that it's not like if we all want to study whales when we grow up now, there's not going to be anything for us to do to teach people about.

**Nick** [00:28:33] There's so much we do not know. I'll just give you an example. We don't even know how many kinds of whales there are on the planet. We are still finding new species of whales, as of last year. These are living species of whales that are alive in the oceans right now. And I can tell you there's more yet to be found. And that's because many species of whales are known from just a few bones found on a beach. We don't know what their color looks like. We don't know how big they really are. We don't know what kind of food they eat. But we can tell from their skull and from their DNA they are definitely something new.

**Jane** [00:29:08] And you think they're still out there to be found?

**Nick** [00:29:10] Oh, we know they're still out there for sure. That makes me excited. I think that shows you that there's a lot we still need to know. So we need more scientists. We need more scientists to study all these living whales. And I can tell you, there are so many fossil whales yet to be discovered as well. Many that are sitting on museum shelves, we just don't have enough scientists to study all them.

**Jane** [00:29:29] So that's your cue. Curious kid listeners, you could be the scientist who discovers a new species of whale that's basically unknown to humans right now. Thanks to Smithsonian paleontologist Nick Pyenson for helping us understand the world of whales.

**Jane** [00:29:47] His book is called *Spying on Whales: The Past, Present and Future of Earth's Most Awesome Creatures*. You'll notice that we didn't talk at all today about how whales communicate. We're hoping to do that in another episode soon. So stay tuned. And in the meantime, if you have other topics you'd like us to tackle, send us a question. Have an adult help you record it using a free phone app and then send your file to [questions@butwhykids.org](mailto:questions@butwhykids.org).

**Jane** [00:30:18] *But Why* is produced at Vermont Public Radio by Melody Bodette and me, Jane Lindholm. We're distributed by PRX. And our theme music is by Luke Reynolds. We'll be back in two weeks with an all new episode. Until then, stay curious!