### Audio Transcript – Blue is the loneliest color

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[old-fashioned Christmas special mux swells]

**Nate Hegyi:** Hey, this is Outside/In. I'm your host, Nate Hegyi.

**Taylor Quimby:** And I am producer Taylor Quimby. And I want to start by telling you a quick story. Nate.

**Nate Hegyi:** Okay, shoot.

**Taylor Quimby:** So, it takes place on Christmas Eve, 1968. We can presume that some people are wrapping presents, roasting chestnuts, uh, maybe watching some Christmas specials on their new color TVs. But over 220,000 miles away from all of that, three guys are jammed into a tiny metal spaceship.

***Apollo 8 mission control:*** *Uh, Apollo eight, this is Houston. When you go into the dark, uh, in about, uh, 7 or 8 minutes, I have some...[fades out]*

**Nate Hegyi:** This is one of the, uh, the missions that did not make the moon, right? Eight.

**Taylor Quimby:** Yeah. So this is this is before the moon landings. It’s Frank Borman, James Lovell and William Anders, and they're the first people to leave Earth's orbit and circle the moon.

**Nate Hegyi:** Yeah. This is the Phantom Menace. This is, uh, the prequels. Yeah.

**Taylor Quimby:** Yeah.

**Nate Hegyi:** The real.

***Apollo 8 archival audio****: The flight plan looks a lot fuller than it did in Florida.*

***Apollo 8 mission control*** *Roger. Understand.*

**Taylor Quimby:** They're orbiting the moon every two hours for just about a whole day. One of the astronauts, you know, he says it was really spectacular at first, but ultimately, the moon is just desolate.

***Apollo 8 archival audio:*** *Okay. Uh, Houston. The moon is essentially gray. No color. Looks like plaster of Paris.You know, or, uh, sort of a grayish beach sand.*

**Taylor Quimby:** And it actually got pretty boring.

**Nate Hegyi:** The amount of money we spent to send a guy up there to tell us that the moon looks gray. It's pretty great.

**Taylor Quimby:** But on their fourth trip around the moon – and the audio here is a little hard to hear – one of them looks up and sees something kind of shocking, and I think it's the most excited you hear these astronauts on the entire trip. You know what it was?

***Apollo 8 archival audio:*** *Oh my God, look at that picture over there. There's the earth coming up. Wow. That pretty.*

**Taylor Quimby:** It was the color blue.

***Apollo 8 archival audio:*** *Give me a roll of color quick. Oh, man. That's crazy. Where is it? Quick.*

**Taylor Quimby:** It's this blue, beautiful half-moon earth rising over the horizon.

**Nate Hegyi:** This image sounds familiar to me, Taylor. I feel like I've seen this before. Perhaps one of these astronauts took a photo of it. Like, I feel like that photograph is in every elementary classroom I went to as a kid.

**Taylor Quimby:** But more than more to the point, like before this moment, and this might sound kind of silly, people did not actually have a good image of what the earth looked like from space.

**Nate Hegyi:** Mhm.

***Apollo 8 archival audio:*** *Of course you take several of them here. Give it to me. Let me just get the right setting here. Calm down. I got it. Oh, that's a beautiful shot.*

**Nate Hegyi:** So great story.

**Taylor Quimby:** Thank you.

**Nate Hegyi:** I love knowing about how that photo was taken, but like, why did you tell me? Like what was the point?

**Taylor Quimby:** Well, today we are opening the mailbag and answering listener questions on the subject of blue, a color that we associate with all of planet Earth, as we just heard, but one that I have recently discovered is relatively hard to find in nature.

**Nate Hegyi:** As usual, thanks for sending us down all these interesting rabbit holes. And why don't we get started and open the outside inbox?

***Tenisha:*** *Hi, this is Tenisha calling from Toronto, Canada, and I'm calling to ask what's up with the color blue? I've heard that blue eyes aren't actually pigmented blue. And I've heard the same thing about blue morpho butterflies. Um, are these statements true? And I've heard that blue is a rare color in nature. And is that true? Like, is blue actually rare? Um, yeah. Just basically like, what is up with the color blue? Thank you.*

**Nate Hegyi:** That's neat. Well, I'm looking outside at a very blue sky, but when I think, like, biologically, are there a lot of blue things besides some wildflowers and, uh, blueberries and huckleberries?

**Taylor Quimby:** Are blueberries even really blue?

**Nate Hegyi:** No, they're more purpley.

**Taylor Quimby:** So I think to answer this question properly, you really have to start big and ask a very basic question, which is what is a color really? Right. Um, you may remember this from, you know, grade school science. We've got a visible light spectrum that is broken up into a series of frequencies: Roy G. Biv. Red. Orange. Yellow. Green. Blue. Indigo. Violet. Red has lower energy, Violet is more intense, has a higher energy level. And when something is pigmented, what is happening is that pigment is absorbing all of the other colors and reflecting the color that you see back at you.

***Kai Kupferschmidt:*** *If you talk to a chemist or a physicist, they will not even call it blue. They always call it “red absorbing.”*

**Nate Hegyi:** Not helpful.

**Taylor Quimby:** Physicists.

**Nate Hegyi:** Know. Why do scientists always come up with a more complicated way?

**Taylor Quimby:** I know! So this is Kai Kupferschmidt. He is a science journalist and author of Get This Blue in Search of Nature's Rarest Color.

**Nate Hegyi:** That's a great source. Good job, Taylor.

**Taylor Quimby:** And for starters, Kai told me that in one sense, like you said, blue is super common, right? On a clear day, the sky looks blue. Sometimes the ocean looks blue. But all that said, actually finding genuine blue pigments in nature is indeed pretty rare.

***Kai Kupferschmidt:*** *If you think about the cut flowers that we all know and like. Right? Like roses, carnations, um, orchids, tulips, chrysanthemums. None of these exist naturally in blue.*

**Nate Hegyi:** That's a good point. They're always just dyed.

**Taylor Quimby:** Yeah. And to keep this analogy going, imagine you're looking through the vegetable aisle at the grocery store. And like you said, aside from blueberries, which aren't really that blue, there's not much there either.

***Kai Kupferschmidt:*** *You don't really have anything that's blue in the way that that lemons are yellow or oranges are orange or peppers are red and green doesn't really exist in nature.*

**Nate Hegyi:** I am going through my mental grocery store right now trying to prove him wrong, and I can't. Are gushers… Do gushers, uh, exist in the natural world?

**Taylor Quimby:** Yeah. [laughs] You know the gusher plant?

**Nate Hegyi:** Yeah.

**Taylor Quimby:** So we could get into some pretty complex chemistry to explain why that is. And I'll be honest and say that after talking to Kai, I'm not even sure I totally understand. But I did get the overarching idea, which is that it is surprisingly hard for living things to build the sorts of molecules that absorb that low energy light from the low end of the visible spectrum and only reflect the blues, he told me. These blue pigment molecules, they tend to be bigger and more complicated. And, you know, there are some plants that can do it, like the cornflower, which. Have you ever seen a cornflower?

**Nate Hegyi:** I don't actually know what a cornflower is.

**Taylor Quimby:** Uh, Google it real quick.

**Nate Hegyi:** Okay. Cornflower. [typing sounds] Oh, those are pretty.

**Taylor Quimby:** Yeah. Very blue.

**Nate Hegyi:** Blue! That's very blue.

**Taylor Quimby:** Yeah. But, you know, there's a cost for any adaptations that require more energy. And so clearly evolution has just steered a lot of plants towards easier to produce pigments. So that's why there's not that many animals. On the other hand they are almost never making genuine blue pigment. So if you take the Blue Morpho, this gorgeous, almost fluorescent blue butterfly, and you were to zoom in really close to its body, what you'll see are these weird little structures that look like Christmas trees. Um, and instead of absorbing all of the other light frequencies and bouncing back blue, they are using a sort of optical trick.

***Kai Kupferschmidt:*** *So we call that structural colors, because it's really the patterning on the on the surface of these wings, on the surface of these scales, that manipulates the light physically in a way that only the blue light is reflected. And from most angles all you see is the blue light.*

**Nate Hegyi:** So it's not even really blue pigment then.

**Taylor Quimby:** No it’s not. I think, that's what I really love about this subject, is that color is like this blend of science, culture and philosophy and perception. Like you can talk about why something is the color blue. You can talk about what the color blue symbolizes for a particular group of people. And then and this is a real debate, you can ask, are colors real?

***Kai Kupferschmidt:*** *I mean, is color a real thing? Because the object, again, like the cornflower that I see out there, it looks blue to me. But that's because it absorbs red light. Like, in what sense is that blue? And also it appears blue to me, but an animal that doesn't have the same receptors as us is going to see it in a different color. So. So can we really say that the color is real.*

**Nate Hegyi:** Thus red absorbing.

**Taylor Quimby:** The physicists, though know-it-alls, may be right. Yeah. \

[mux swell]

**Taylor Quimby:** Uh, okay. So one part of that question, Nate, was about blue eyes, which, like the blue morpho butterfly wings we talked about are actually kind of an optical illusion. But, Nate, you looked into another question. We got about eyes from Ricardo on Instagram. He wants to know if blue eyes are recessive, will they disappear completely in the future?

**Nate Hegyi:** Before we answer that, Taylor, I can't remember. Do you have blue eyes?

**Taylor Quimby:** You don't know the color of my eyes? We we look at each other on zoom every day.

**Nate Hegyi:** I’m sorry. I know.

**Taylor Quimby:** They're hazel. Yeah, they're greenishy.

**Nate Hegyi:** Okay, so I have I have boring brown eyes and I say boring because I'm like 80% of the world.

**Taylor Quimby:** I think brown eyes are beautiful, so just don't sell yourself short.

**Nate Hegyi:** I didn't say they weren't beautiful. I just said they're kind of boring. You know, everybody's got them. But folks with blue eyes, they make up only 8% of the world population. And it's actually a little bit more in the US, about a quarter of the population here. But get this, Taylor, back in the 1900s, half of all Americans had blue eyes.

**Taylor Quimby:** What?

**Nate Hegyi:** Yeah, yeah. Number obviously is dwindling, but will it disappear? Probably not. So the reason blue eyes are rare is because they're a recessive trait, right? Like, both parents have to carry the blue-eyed gene for their kids to have blue eyes. And back in the 1900s, when half of all Americans had blue eyes, we tended to marry within our own ethnic groups. More so, blue eyed people predominantly come from northern Europe, and northern Europeans were marrying northern Europeans. But nowadays we pick partners for a whole lot of different reasons. Like I'm Hungarian, my wife is Greek. I did not marry her for her spanakopita, as delicious as it is. Um, so you have blue eyed people marrying brown eyed people. And because brown eyes are a dominant gene, you get more brown eyes. But here's the thing, Taylor. Brown-eyed people, they can still carry a recessive blue-eyed gene. So there is always a chance that your kid could have blue eyes. So might dwindle, but it's not going to disappear.

**Taylor Quimby:** Gosh, I wonder if I just think about, like, the science that would have been done then and whether or not we would have, like, biased information in the first place. You know, like we were only surveying white folks.

**Nate Hegyi:** That's a great point. The survey could be flawed. A lot more people had blue eyes than they do now. We could say that, but I think you're probably right.

**Taylor Quimby:** And yet it says something about the speed of which humans as a, as a species, can sort of physically shift in different directions over what is a super short period of time.

**Nate Hegyi:** Well, it's interesting too, because there's research out there that suggests that the blue-eyed gene, it came from a single ancestor like way, way back in, I think, Central Asia. And so not even that way, way back, but like 10,000 years ago, 8000 years ago.

**Taylor Quimby:** That person must have blown minds. There must have been like a whole mythology around the first person to have blue eyes.

[mux swell]

Okay, so before we get to our next question, two things. First, we are in the middle of a fundraiser right now. And when you, dear listeners, support the show, your gift will be matched dollar for dollar.

**Nate Hegyi:** Yeah. So what that means is if you give ten bucks a month, we'll wind up getting $20, which will help us make the show. But we'll also thank you by sending you an outsider hat and a pair of honestly, the comfiest wool socks I have ever put on my feet from Minus33, though you don't get the ones that I put on my feet. Trust me, you get new, you get new ones, you don't get mine.

**Taylor Quimby:** [laughs] Nate's used socks.

**Nate Hegyi:** So check out the deets in the show notes. And thank you so much.

**Taylor Quimby:** And thing number two, our theme for the next Outside/Inbox questions is a favorite of mine from my days reading comic books as a kid. And it is “what if?” Like, what if dinosaurs were still alive today?

**Nate Hegyi:** Or what if humans were cold blooded?

**Taylor Quimby:** Yeah. What if we ran out of helium?

**Nate Hegyi:** No more balloons. We've already got a lot of great questions, but we haven't picked our next set, so please send them our way via voice memo or email to outside-in radio.org.

BREAK

**Nate Hegyi:** Welcome back. This is Outside/In. I'm Nate Hegyi here with Taylor Quimby. We've got our blue suede shoes on for the day as we tackle our questions about the color, the vibe, the feeling that is blue.

**Taylor Quimby:** And we're switching gears for this next question, which was answered by producer Felix Poon. It is not so much about the color blue, or even the vibe for that matter, but it is about something that we associate with the color blue, which is water.

**Felix Poon:** We got a question from Todd in Buffalo, New York, and Todd works on a boat on Lake Erie, and.

***Todd:*** *We have a water intake facility that takes in hundreds of millions of gallons of water a day through a 12 foot wide pipe. And I just don't understand how we built that. If you can help me out, how do we build things underwater?*

**Felix Poon:** What are your thoughts? How do you think they build things underwater?

**Nate Hegyi:** I think that they build it outside of the water. And then. Well, I guess it probably they have like, divers that, like, lead it down and they like the divers just smash it into wherever it needs to go.

**Felix Poon:** It's not a bad guess. I spoke to Justin Alves. Justin's a pile driver, and he builds offshore wind turbines. In fact, he was at work on a ship just off the coast of Halifax, Canada, when I called him.

**Nate Hegyi:** Oh, cool.

**Felix Poon:** And Justin says diving is part of some types of underwater construction, but that's not the case for most projects, and probably not the case with this underwater pipe either.

***Justin Alves:*** *I would imagine they built a cofferdam, you know, you would barrier that off and you would be able to do your work in that area.*

**Nate Hegyi:** Barrier it off? Like they would create like a dam, just like where it like moves the water away?

**Felix Poon:** Yeah. Pretty much humans have been using Cofferdams for literally thousands of years. They could be as simple as building walls out of dirt if it's a shallow project. But for deeper projects, they use different materials, like these tall sheets of steel that get pounded down into the ground underwater and linked together, kind of like Legos.

Once the area is totally sectioned off and the water is drained out, then they get to work. So that's probably how this pipe got put in under Lake Erie. But the work Justin's doing, he doesn't need to move water out of the way. He's building support structures for things like piers and wharfs, bridges and offshore wind turbines. And these foundations are made from piles, basically, these giant poles or tubes made of steel or concrete that go deep into the ground. The ones used for wind turbines are called monopiles.

***Justin Alves:*** *They start with a monopile. They put that in the ground, hammer it in the ground, and then they put what's called the transition piece. On top of that.*

**Felix Poon:** I mean, these things are basically manufactured onshore. Yeah. And then they bring them out on these barges, and the barges have these giant, massive cranes.

***Justin Alves:*** *The capacity of this crane for the vessel that I'm on, it's 5000 tons.*

**Felix Poon:**  Justin's job as a pile driver is actually a lot of rigging, like tying and hooking up monopiles. So, then the crane picks it up, puts it in the water, puts it in place, and then the big hydraulic hammer keeps hitting the top again and again, like, thousands of times, driving it down into the ocean floor.

**Nate Hegyi:** So there's no like, divers or anything else like that. Like, is he ever diving?

**Felix Poon:**. No, they don't need to do that because they have robots with cameras that can see underwater.

***Justin Alves:*** *They use what's called ROV, which is remote operated vehicles. They kind of just navigate with controls. Honestly. It's like playing a video game for these guys.*

**Nate Hegyi:** I should have thought about drones. The fact that they have, like these underwater drone robots that would do all the work of divers these days.

**Feix Poon:** Yeah, exactly.

**Nate Hegyi:** A lot safer.

[mux swells]

**Taylor Quimby:** You know what's weird, Nate? Uh, ever since Felix originally answered this question about building things underwater, I've been getting Instagram Reels where people are, like, building things underwater. And this, like, cool boat that is like a bell that suction cups over the ground. But it's just brought back that whole thing of like, is my phone listening to my edits with you guys.

**Nate Hegyi:** I've been thinking about this a lot more lately. Okay. So did you search anything when you were editing Felix's script?

**Taylor Quimby:** Oh, undoubtedly. I mean, I that's the nature of editing, as I was definitely looking up pictures of stuff that he was talking about.

**Nate Hegyi:** Yeah, that's that's what it is. It's getting really good. It's kind of frightening.

**Taylor Quimby:** All right, well, creepy aside. We have another question from a listener that you answered. Um, this one is kind of a classic, I think. Why is this sky blue?

**Nate Hegyi:** Yes, it's a great question. I have wondered the same thing. And so I'm going to make this quick. We can blame the sun, Taylor.

**Taylor Quimby:** [laughs] Stupid Sun!

**Nate Hegyi:** So, sunlight. It looks white, right? But it's actually all the colors of the rainbow. That's what makes up white. And when it hits the molecules of our atmosphere, all those colors scatter. Like when light hits a prism. And the blue light waves happen to be scattered more because their wavelengths are shorter. So that's why the sky looks blue.

Don't ask me, by the way, to explain it any deeper than that, because everything I could find online… the thing I always was like, why? If the wavelengths are shorter, why does it scatter more? I don't understand that, but I was literally looking at like National Geographic Kids and they were like, “oh, it's because the wavelengths are shorter children.” And I was like, okay, I guess that's something I should understand.

**Taylor Quimby:** That's one of those things where it's like… I kind of knew that answer and yet it doesn't. It's not satisfying in a way…

**Nate Hegyi:** No, it’s not!

**Taylor Quimby:** …because it's like a layer of physics that you can't actually see with your eyeballs. And so it's kind of like you just have to trust it.

**Nate Hegyi:** It's very physics-y. It's not one of my strong points.

**Taylor Quimby:** Yeah. Google it next time, people!

**Nate Hegyi**: [laughs] Yeah**,** come on. You guys ever heard of Google?

**Taylor Quimby:** Just kidding. We want your questions.

**Nate Hegyi:** We do.

**Taylor Quimby:** Okay. We have got one more. And I gotta say, I'm pretty excited for this one, which was submitted by Calvin from Des Moines, Iowa.

***Calvin:*** *I'm interested in the etymology. So what is the history of the word blue? And is the idea of the color consistent throughout history and in different cultures? Anyway, thanks. Love the pod.*

**Nate Hegyi:** That's a very heady question. I've never really thought about any colors that way.

**Taylor Quimby:** Yeah, and I love etymology questions, but to your point, they are heady because language is so fluid and messy that it's really hard to wrap an answer up in a nice, neat little bow. Yeah, that being said, I will do what I can.

The English word blue is Germanic in origin. It has roots in Old French and Old Norse, and the various words that it, uh, translated to back when it was a slightly different word were things like sky colored or lead colored.

**Nate Hegyi:** Both things that we see are blue. Well, actually, I've never known that lead was blue. I know the sky is blue. I thought lead was just… I don't know what color lead is. Kind of grayish?

**Taylor Quimby:** Yeah, but there's like a bluish tint. Slatey. And I think that's interesting because there's a lot of other languages that have different roots for the color blue. And if you go back, you'll, you'll often find them connecting etymologically with words for *other* colors. So a lot of Indo-European languages have some word for the color of the sea. That's a mix of green, blue, and gray. Accurate because the sea isn't just like one color. It's, you know, kind of changing and shifting. Right. And all this reminds me, um, well, do you know which came first, uh, Nate? The color orange or the fruit orange?

**Nate Hegyi:** I'm gonna say that the fruit orange came first.

**Taylor Quimby:** You are correct. And, you know, one way to think about it is like cavemen weren't naming colors just for funsies. Yeah, like, historically, humans have tied colors to objects that have that color. Right. Um, so in most languages, if you go back, the first colors to get a name are black and white or light and dark, you know, think about it that way. Um, and partially because there are so few things in nature aside from the sky that are a true blue. The way that a lemon is yellow or an orange is orange, blue is typically the last color to get a name at all.

***Kai Kupferschmidt:*** *In fact, there's still a few quite a few languages in the world where green and blue are the same word, where there's just one word for those two colors. Huh?*

**Taylor Quimby:** This, again, is science journalist in our resident blue expert for today, Kai Kupferschmidt.

***Kai Kupferschmidt:*** *There's different arguments to why that might be, but one argument has been that you really only need a word for a color once you're able to separate that color from an object.*

**Nate Hegyi:** Oh, so if the only thing that's blue in your world is the sky, you're not… You're just going to be like, “oh, that looks sky colored.”

**Taylor Quimby:** Yeah.Basically like until you can take the pigment out of that thing and dye other things with it. The color isn't itself namable. It's like it's not its own quality. Right? You know what I mean?

**Nate Hegyi:** Oh yeah. Absolutely. It's why we call things orange.

**Taylor Quimby:** So Calvin also asked if the idea of the color blue is consistent across cultures, and I'd say the answer is a pretty resounding no. Um, it's been used to signify royalty. But then also you've got like blue collar workers. Yeah, baby blue is a color of innocence, but it can also be used to mean something obscene or pornographic. If you've ever heard of blue laws or blue movies, yes, that's what that means. Um, the comedian Hannah Gadsby has a really good stand up bit about these kinds of contradictions.

***Hannah Gadsby special*** *If you're feeling blue, you're sad. But optimism blue skies ahead. A blueprint is a plan. But if something happens that's not on the plan, where does that come from? Out of the blue.*

***Kai Kupferschmidt:*** *And again, I think it's partly because blue doesn't have these very fixed objects attached to it, like, say, red and blood. Um, I think it's kind of more open to different associations.*

**Nate Hegyi:** Again, because there's not so many things in the real world that are the color blue, like red as he mentioned, that is the color of blood…

**Taylor Quimby:** The color of love, of passion.

**Nate Hegyi:** Fire. Yeah, exactly. Got a lot of red in this world.

**Taylor Quimby:** And color definitely influences human behavior, right? So yeah, one little example from the 90s was this study that suggested placebo pills that were meant to act as stimulants, placebo being, you know, it's like a sugar pill, but you're pretending it's a stimulant. They were more effective if they were a warm color like red or orange. Yes, more effective as depressants if they were a cool color like blue. But the way that we feel about colors, why we prefer some over others, it does seem to have to do with a big mix of factors. And maybe the most important one is the cultures we grow up in and the associations that we build with them over time. So, you know, you could take the color brown and associate it with chocolate or poop, and you might feel very, very differently about it depending on where your mind goes, you know. Yeah, that's very true.

**Nate Hegyi:** Or if you see chocolate and you think, oh my God, I think that's poop, then you're like, oh, it's chocolate.

**Taylor Quimby:** Oh, it's like those, those horrible baby showers where they put like chocolate melted chocolate in a diaper.

**Nate Hegyi:** Oh, I didn't know they did that. That's gross.

**Taylor Quimby:** Oh it's this terrible thing. Yeah.

**Nate Hegyi:** That's disgusting. Yuck. Oh bad idea. Everyone stop doing that.

[mux swells]

Taylor. I'm blue that this episode is over.

**Taylor Quimby:** Oh, nice. Well done. Pun. I didn't write that pun. You just did that all by yourself.

**Nate Hegyi:** I made that one up. I was telling Justine, I'm getting into dad age at 36, 37, and I'm beginning to warm up to puns. I feel like it just comes naturally with this age.

**Taylor Quimby:** Good.

**Nate Hegyi:** Anyways, thanks for listening. If you want to send us a question on the theme of what if, send us a voice memo or email us at outside in radio org. This episode was produced by Taylor Quimby, Felix Poon and me Nate Hegyi. It was mixed by Taylor and Felix, edited by Taylor with help from Rebecca Lavoie, and our team also includes Justine Paradis. Rebecca Lavoie is NHPR's Director of On-Demand audio. Music by blue Dot sessions. Outside/In is a production of NHPR.

**Taylor Quimby:** Or should we call them “Red Absorbing Sessions?”