But Why: A Podcast For Curious Kids

How Do Piano Keys Make Sound?

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[Jane] This is *But Why: A Podcast For Curious Kids* from Vermont Public Radio.

I'm Jane Lindholm. Every episode we take questions from kids all over the world and it's our job to find interesting people to offer you some answers.

Today we're in a musical mood. For one thing, it's our birthday. We launched our first episode on April 1st, 2016. In our first year, we've produced 29 episodes and we've answered more than one hundred questions. We've also heard from hundreds of kids all over the world.

You listen to us in places like Australia and Chile and Peru and Switzerland and the United Arab Emirates and India and all over the United States and Canada. We love putting this show together and Melody and I are so grateful to you and your families for listening and for sending us questions. We know some of you even listen in your classrooms. Very cool. Do you have a favorite episode? You can find our Facebook page or have an adult help you find our Facebook page and tell us what episode you liked the best and what you think we should tackle in year two. We've already got a few big episodes in mind on evolution, the Big Bang, dinosaurs, death and racism. But we'd love to hear what kinds of things you want to learn about. Send an e-mail with your questions or your suggestions. Our address is questions@butwhykids.org. And again you can find us on Facebook and Twitter as well.

Now I said we were in a musical mood and there's another reason for that besides our birthday. We've gotten a couple of questions from you about instruments and we're going to dive into them today with some help.

[Annemieke] Hi, I am Annemieke McLane and I'm a pianist. I was born in the Netherlands and I studied music there.

[Jane] Now Annemieke lives in Vermont and performs with various musical groups. She knew she wanted to play piano when she was a very young child.

[Annemieke] I was like 5 when I really wanted to play, and that was a little bit too young to start lessons. So I started with playing recorder and then I tried to figure out the recorder notes on a piano and then a played the recorder and piano in different hands. And then I just taught myself like some basics and when I was seven I started lessons.

[Jane] Annemieke says her teacher encouraged her to go to a conservatory. That's a school for musicians and it was another great teacher there who helped her achieve her dream of becoming a professional musician. Now as someone who teaches piano Annemieke is doing that for other young players. So we thought she'd be a good person to tackle this question.

[Gretchen] My name is Gretchen and I am seven years old. How do piano keys make sound?

[Annemieke] First of all, the piano is like a huge frame, that is kind of the shape of the piano. Then you have the soundboard. The soundboard is sort of the bottom of the piano. The soundboard is like the back of the cello or the back of the violin or bass, you need some resonance. Without a soundboard, the sound won't go anywhere.

When you look at the key itself, it's just a white and black stripe basically in front of you. The key is a lever, basically. It pushes a whole bunch of little, it looks like a little, if you would be a surgeon, you would see all the little bones. One thing starts to move, and the other thing starts to move, and the roller rolls, and the roller rolls the hammer up and then the hammer shoots up against the string, and the damper shoots up. And so everything comes in motion at once.

[Jane] Ok if that was a little confusing to you you're not alone. Hammers in a piano? A lot of people don't know that a piano actually has strings and hammers. In fact it has about 230 strings and it's those strings that actually make the sound of a piano. So when you're looking at those black and white piano keys, they're attached to various pieces that are connected to a little hammer. When you push down on the piano key the hammer is pressed against one of those strings or sometimes it takes two or three strings together to make the sound of one note.

[Annemieke] So what happens is that when you push a key down you kind of trigger a whole mechanic and there is that hammer underneath the strings, that you don't always see, that comes up and hits those three strings all at once, or two, or the one big thick one. So what happens here, I push, for example, one key down.

And you hear a sound. And then when I let the key down, I release it, the sound stops. These are called the dampers. When you press keys down, you can press one at a time, you can press two, you can press three, you can press four. Basically you can, that's just a nice, try it and when I let it go, it's gone.

[Jane] So how do those strings make different sounds when they're hit with the hammer?

[Annemieke] Well the length of the strings makes the pitch higher or lower. So at the total right side of the piano the strings are quite short and thin.

So I can even, I just go with my nail over the tiny strings and if I do that at the bass that's a very long string it doesn't even fit in a frame so that's why it's diagonal most of the times, and it's extra twirled with iron to make them even thicker. That's like a bass and if you do that with the pedal open so the damper is now off, I will you it again. You can make a really big bass sound. So it's basically the length of the strings and the thickness that makes the pitch different.

[Jane] So if a piano has strings does that make it a stringed instrument? Well that's actually the subject of debate. But Annemieke has a firm opinion on that.

[Annemieke] For me it is. For me, the piano is a string and a wood instrument. But because of the hammers, it's also a percussion instrument according to some people. When I play I always try to think about the strings behind the keys. You can play a scale like this. Which I think is great, but I can also play it like this.

The second time I tried to do a little bit more legato, a little bit more in the key than the first time. So that the other point of playing piano is what they call the touch. The touch is like how do you touch the key down? When you do it fast, of course, it's like you know you can go really fast. But also when you go slow, you can go quieter. When you go fast, it's really hard to do that softly because you have to speed. So when you have the speed of a hammer and you want to play something quietly, you have to play fairly light, like a butterfly almost. And then when you want to do light, you can have like a very nice French, light touch.

So you have all these varieties and that is called also technique. The one thing that is very nice about the piano is that you have ten fingers and you can basically play 10 notes at once. You can combine chords and melody and you can do just melody, you can just do chords, you can accompany people, you can do different styles, you can do different rhythms you have like a whole orchestra just for yourself.

[Jane] Want to hear Annemieke play a little bit on the piano now that we have some sense of how it works? So did we.

[Annemieke] I brought a little piece by Scarlatti which I really like. Scarlatti is early music from the 1600s, into the 1700s. And why I picked this one is because it has a little bit of variety of what are called succoto which is a short touch, and then also a little more legato less, or a little scale pattern and so it is all in there and it's just I think a very sweet, jolly piece.

[Jane] Annemieke McLane sharing a little bit about how the piano works.

If there's a song you really like you want to tell people about it, right? Well how about podcasts? When you hear a podcast episode you really love you should tell a friend. The whole month of March podcasters of all kinds have gotten together to try to get the word out about podcasts. A lot of people still don't know what they are or how to get them. But you do, so tell a friend about a podcast you love. Show them how to set it up. Maybe an adult can help. And then you can have one of your adults send a note out on social media. That's like Facebook or Twitter or snapchat and you can say what episode you've shared so we can all give it a listen. Use the hash tag trypod. As in try a podcast, T-R-Y-pod. Thanks.

[Jane] We asked another musician to join us to answer two more of your musical questions.

[Emily I am Emily Taubl. I'm a cellist and I live in Burlington.

[Jane] Emily was five when she started playing the cello and now that's her job. She plays in the Vermont Symphony Orchestra, in another orchestra in Connecticut and in lots of chamber groups. And she teaches kids and adults who want to learn how to play. And she's here today to answer some of your questions.

[Kelsie] How do strings make noises?

[Franka] How do stringed instruments make sound?

[Jane] That was Kelsie, who's four and lives in Redlands, California. And Franka, who is nine and lives in Edmonton, Alberta in Canada.

[Emily] Those are great questions. I think just to address the idea of a string in general it can be made out of lots of different materials. And basically, it's probably quite thin and you stretch it as tight as you can. And then if you pull on it, depending how tight it is it will make a pitch, it will make a sound.

[Jane] Because it's vibrating?

[Emily] Because it's vibrating. Exactly, so if it's pulled really tightly the vibrations can be wide or small and make a higher pitch or a lower pitch.

So you can do that probably with lots of different materials, your clothesline, twine, who knows. There's probably endless amounts of string to use

[Jane] Even a rubber band, which is not quite…

[Emily] A rubber band makes great noise, it’s true.

And some teachers start very, very young children on cereal boxes that have rubber bands strummed on them. So just to get the idea of pulling on a string without actually holding an expensive instrument, which works really well.

As far as strings on a string instrument, like my cello, I have four strings and the higher pitch strings are very thin and then they get thicker as they go towards the bottom of the instrument as the pitch goes lower. So they're all pulled very, very tightly across a piece called the bridge which sits in the middle of the instrument and holds the strings off of the instrument, from laying on the instrument. And we pull the strings really tightly. And then when we pull on them, they vibrate. So this is the highest string.

And this is the lowest string.

You can hear a big range in the higher, the higher string is very thin. And then a lower string is quite fat, so it makes that deeper richer sound, because it vibrates at a slower speed.

[Jane] So it's the width of the string, that thicker string, that thicker steel is making a lower sound. But it's also how tightly it's pulled that determines what kind of sound it makes right because that's how you tune the instrument. Can you show us that?

[Emily] Yeah the strings, if you can imagine they come up to the top of the instrument and they're wrapped around what we call pegs, and to tune the cello or the violin or the viola or the guitar, all the string instruments, we turn the pegs so if we want the pitch to go up we'll tune the peg up. So it will pull the string tighter. And if we want the pitch to go down we just turn the peg down and let it be looser. So it makes a lower pitch.

Here's A, I will turn the peg.

You can hear as I turn it down it's getting looser and the pitch is going lower. And if I turn it back up. It’ll go back to where I needed to be.

[Jane] So it's the strings. But obviously a string doesn't make noise by itself it needs to be plucked or strummed or have some kind of thing that's touching it. And in an instrument like yours, it's also where that sound is going. So you have this big beautiful cello and it's hollow on the inside. And some of that sound goes into that hollow section and resonates. Can you talk a little bit about how what the string is attached to actually helps determine what kind of sound it's making?

[Emily] Right. So the instrument body itself, and I'll just use the cello for example since I'm holding one. It's called the body of it's called the sound box. And basically what happens is because the strings are wrapped around in the pegs and connected to the bottom of the instrument, when they touch the bridge the bridge starts to vibrate. And then that makes the top of the instrument start to vibrate. So the sound box and the

bridge are both vibrating and basically the air inside the instrument also starts to vibrate. So we have these holes carved on the front of the instrument and that lets the sound escape. They're called F holes because they're kind of carved like a cursive F and then the sound can escape from there.

[Jane] So when you play the cello usually you're using a bow and not plucking it with your fingers or strumming it the way you might a guitar. Can you talk a little bit about the different ways you can make sounds with those strings?

[Emily] Absolutely. So most of the time you're right, I am using the bow.

So a bow is a stick of wood. It's a special kind of wood that you find in Brazil called pernambuco wood. The reason we use it is because it's a little bit flexible, so it can bend as I cross the strings if I want to push harder on the string and get more sound. The bow will flex with my hand so it's that special kind of wood. And then the wood is connected to, believe it or not, a bunch of horse hair. So it's the hair from a horse's tail and it's white and we string it really tightly. And when we cross the strings that's what makes sound. Without a special thing on the horse hair, the horse hair by itself doesn't make sound so we have to put what we call rosin on it. Rosin is just a, like a clumped up version of tree sap. So it's very sticky and when you rub it on the horsehair it grabs on to all the little, the little parts of the hair and that's how it gets resistance it kind of rubs on the string and that's how we get sound.

[Jane] Why horsehair could you could you use human hair if you had long enough hair? Could you cut it and make a bow?

[Emily] When I get a haircut, I could re-use it. Honestly I don't know how that started but I do know that we have musicians and makers have tried to find other materials, synthetic materials so that we don't have to use animal products. As a cellist, it sounds picky but the reaction from horsehair is very different than a synthetic material. So we haven't quite perfected something other than horsehair yet and just because of performance practice with time we're very used to using horsehair. So as soon as they come out with a material that feels exactly responsive in the same way I'm happy to switch over and not use not use any sort of hair from an animal.

So when we pull the bow across the strings we put the horsehair down onto the string and these cello strings are made out of steel, so they're steel they're wrapped really tightly like we talked about. And then you pull the horsehair across them you can pull it really quickly or really slowly, you can bounce it and it has all different kind of, we call them bow strokes, but they're basically different articulations and different ways to make sound.

So it's nice and connected as smooth as we can make it.

And then other times we might find something where we need to bounce. Something like that.

And oftentimes we roll our bow across more than one string or we play two strings at the same time to make what we call double stops or chords. So here's, I'll roll my bow. Or I might do something a little different with the same notes. And it depends how many strings I'm pulling at the same time with my bow.

But we have all different ways to use it. We can even, a fun fact, turn the bow upside down and sometimes we bounce the stick on the string for a different sound. Something like that for an effect.

[Jane] And you can pluck it.

[Emily] It can be really bright it can be you can pull really hard and make something like that you can make really nice strums so you can do a lot as much as you can do with your fingers you can make all different sounds depending how close you are to the bridge and how far away from the bridge you are. So close to the bridge sounds pretty tight and a little too bright usually so a little further away sounds a little more gentle.

The way we change notes on a string instrument we have what we call a fingerboard so the black piece of wood that's on the top of the instrument and the string sit right above it. Very close but not touching if they touch it can't vibrate, they can't vibrate so it can't make sound. But on the fingerboard when we put our fingers down on the string it changes the pitch up or down. So if I play my A string and then I put my finger down. I changed the note higher by one note and you can put as many fingers down as you want.

You can sometimes can put two fingers down and play two strings at a time. And so the fingerboard is kind of like our piano keyboard when we put our fingers down it changes. It changes the notes.

[Jane] Now that we know how the cello works and how the strings make sounds, let's hear some music. Emily thought a good piece of music to play that would really highlight how beautiful a cello can sound would be a piece written by a composer named Johann Sebastian Bach. This is one of the most famous pieces of music ever written for a cello. Close your eyes for the next two minutes and just let this music waft over you.

It's the prelude from Bach's first suite in G-Major.

[Jane] When you're playing the cello what are you thinking about?

[Emily] So many things it depends on the day. Sometimes I am just thinking so much about this, the shapes that I'm making and the sound that I'm making that I kind of get

lost. Often I'll get offstage and it's almost like I don't remember what happened because I just kind of went into my little world. Other times I'm very aware of people. I'll look out.

I'll look out in the audience and think what a nice sweater! Or I'll think about what's for dinner. It really depends on the day.

[Jane] I asked Emily to offer some advice for those of us who don't really like to practice our instruments.

[Emily] I wish I could say that there was a way around it, or that there was a way to bypass having to spend the time practicing but there really isn't. And I like to make practicing as fun as I can. So I don't find it particularly enjoyable to sit for a long, long period of time in a room by myself and just practice something over and over and over. So sometimes I tell people to take a bag of M&Ms or something and line them up and then for every five times that they got something right they get an M&M or, or something fun like that. I have students that have colorful straws and they draw a straw. And depending on what color they drew they practice it five times or two times or that kind of thing. So to make to make practicing as fun as possible. And to play for your parents and your friends as much as possible, to make it a little more social, so it's not just you alone in a practice room trying to do something but make it more about sharing what you're learning that makes practicing a lot more and more fun.

[Jane] That was Emily Taubl, a cello player with the Vermont Symphony Orchestra. And here's another wonderful musician and also a colleague of mine to answer one more question today. A colleague is someone you work with. James Stewart is one of the hosts of our classical music station here at Vermont Public Radio. And he tackled this musical question.

[Anita] My name is Anita. I live in East Calais, Vermont. I am six years old. My question is how do records play music and how do they play music without going haywire?

[James] Anita, in order to answer your question I’m going to have to ask you to use your imagination.

I want you to picture yourself floating on the ocean moving up and down with the waves as they come in and as they go out. Sound is a lot like that. It travels in waves and our ears move with it just like our bodies move up and down with the waves on the ocean.

We've made microphones that act like our ears and move with the waves of sound capture their shape. Then we've made machines that could record the shape of those waves like a long squiggly lines. Now a record like you talked about has grooves in it in which the waves of sound have been captured and preserved when the needle of your record player is placed on the spinning record, it follows that groove and moves to the

shape of the wave. We then use machines to make that sound louder so you can hear it at any volume that you want.

So the sound is heard by a machine recorded, preserved and recreated every time you play the record. Now when I was a kid, I destroyed an LP, or a record of my dad's. I took the disc and I placed it on a lazy susan, my mom had in the middle of our kitchen table, it just goes round and around. I had my mom's sewing needle in a piece of construction paper. I made a cone out of the paper and taped the needle to the short end of the cone then I placed the needle in the groove and spun the disk around. Sure enough you could hear the music coming out of the cone without any machine needed.

Now my dad wasn't too pleased. I ended up scratching the record so badly it would no longer play on his record player. But hopefully Anita you can see how a record can play music.

[Jane] Thanks to James Stewart my friend and colleague at VPR Classical. That's it for today's episode. Thank you for giving us a reason to listen to some beautiful music today.

Speaking of music I told you at the beginning of our episode that this is our one year anniversary. So I want to send a couple of special thank yous out to people who have helped make this year such a great one, starting with this guy.

That's Luke Reynolds. He's the musician behind our awesome theme music. The song our music comes from is called *No Way To Know What's Coming*. It's from an album Luke made a few years ago. And Luke also plays with other musicians and is in a band called Guster. Thanks Luke for lending us such great music to use for this show.

Jory Raphael created our cool question bubble logo. And lots of people helped make But Why a success here at VPR including Emily Alfin Johnson, Sara Simon, Jonathan Butler, Ty Robertson, Michelle Owens, Franny Bastian, Chris Albertine and John Van Hoesen.

Melody Bodette and I produce *But Why* here at the studios of Vermont Public Radio. And mostly we want to thank all of you for listening and for your curiosity. We love sharing this show with you. I'm Jane Lindholm. We'll be back in year two with a new episode in two weeks. Until then, stay curious!