But Why: A Podcast for Curious Kids

How are electric guitars made?

December 1, 2023

Jane 0:20

This is But Why: A Podcast for Curious Kids, from Vermont Public. I'm Jane Lindholm. On this show, we take questions from curious kids like you, and we find experts with answers. Today we're talking about music, and primarily answering this question from Harlon.

Harlon 0:36

I'm seven years old. I'm from Buffalo, New York. And my question is, how are electric guitars made.

Jane 0:46

Luckily for you, Harlon, I happen to know someone right here in Vermont, where we're based, who makes electric guitars.

Creston Lea 0:54

I'm Creston Lea, and I'm a guitar builder. We're at my shop in the south end of Burlington. So, when I build a guitar, I start by cutting out the wood and shaping it just how I want it. And then I prepare it to spray paint on it. When the paint's all finished, it has to dry out for a while and I polish it. And then I put it together and I wire up all the electronics and then I play it, make sure it's just right, adjust anything that needs adjusting and then ship it off to somebody so they can have it for the rest of their life.

Jane 1:25

Electric guitars, the kind you might see played in a hard rock band, use electricity and an amplifier to make sound. An acoustic guitar doesn't need electricity. Acoustic guitars are usually made of thin wood that's cut and bent into a guitar shape with a thin back. They have a hollow cavity inside the body. When you strike one of the strings with your finger or a pick, the string vibrates and that sound goes into the hollow cavity, where it reverberates or echoes around and is naturally amplified. But electric guitars get amplification from an electronic amplifier, so they don't have to have a hollow body. Both electric and acoustic guitars can still use speakers to make the volume louder if the musician is playing in a big concert hall or a stadium, so both of them might be wired to make sure that everybody in a place can

hear them. But electric guitars use electric amplification and acoustic guitars use natural amplification by the way the body of the guitar is made.

Jane 2:26

Now, Harlon's question was about electric guitars. So we wanted Creston to explain his process to us. At his shop, he makes about 60 to 65 guitars each year by hand. It smells like a woodshop when you walk in; you can just smell all of that sawdust and wood, which makes sense because he makes the guitars out of wood. But he's got a room with all kinds of electronics too. And a room where he sprays color and other coatings on to the guitars. And he even has a room where he can plug the guitar in and play it to make sure it sounds cool. I don't know about you, but I love seeing and learning about how things are made. So let's go on a tour of Creston's process.

Creston Lea 3:04

The guitars that I build tend to be made of solid chunks of wood for the body with a neck attached by screws.

Jane 3:13

Even if you aren't very familiar with musical instruments, you can probably picture what the body of a guitar might be: that rounder, bigger part of the instrument. And the neck is the long thin part, kind of like the neck of a giraffe, maybe. Creston has a couple different typical shapes for his guitars.

Creston Lea 3:30

When I first got started, I would make all kinds of, you know, sort of one-off kind of shapes. And then I decided that I wanted all my guitars to be different from each other. But I I sort of work within maybe seven or eight established shapes for the bodies. So I have these plywood templates that I've made.

Jane 3:48

So your first step is to take the wood and then put the shape that you're going to cut it out onto it.

Creston Lea 3:55

So yeah, with the template I would trace the shape on there. And then, with my bandsaw, I would roughly cut it to size--maybe just like a 16th or an eighth of an inch oversized. And then using that same template taped to the wood, I would bring it over here to this router table and use this cutting bit that

has two ball bearings on top of it. So that rides along the template and the blades cut the body or the neck to shape where the plastic parts that go on top of the body.

Jane 4:31

It's kind of like using a stencil. So you're cutting out exactly the shape you want. Once Creston has the outline of the guitar, he has to use some other saws and tools to cut into the wood to cut holes and grooves into the main body. That's to make room for the electronic parts. And then he's got to make it all very very smooth.

Creston Lea 4:50

Sanding by hand, usually with sticky-back sandpaper on like a rubber block or something. And sometimes a rasp. And then I start the finishing process, which means going to my spray room and spraying sealers and color if there's color, and then clear coats of lacquer.

Jane 5:09

And lacquer is like kind of a shiny finish.

Creston Lea 5:13

That's right. And it's sort of an old fashioned, old fashioned kind of finish that you'd find on instruments or furniture or something, you know, 70 years ago. And that, you know, that takes a while, spraying a few coats a day for several days, and then it gets a little bumpy. As you apply the coats, people call that orange peel, because it's got that sort of bumpy texture of citrus skin. So when I have the right number of coats on there, I'll sand it till it's flat. And then I spray a couple more coats of lacquer that's been thinned with a lot of lacquer thinner. But it's not over yet. And you have to sand it with finer and finer sandpaper. And from there, I take it to buffing wheel with two different kinds of wax polishes. I shine it up so it's really glossy, most of the time. Right in here's the room where I polish them. Which is maybe my least favorite part of the job because it's stressful. Like you've put all this work into these guitars, you're at the very, maybe the very last day before you assemble the guitar. And then you're standing in front of this pedestal buffer with two wheels on it. And at any moment you can burn through the finish and have to start over or the wheel can catch the guitar and smash it on the floor. And you're really starting over.

Jane 6:32

How often does that happen?

Creston Lea 6:33

Well, knock on every piece of wood in here, I've burned through finishes, but I've never had one get smashed. But pretty much everybody I know who builds guitars has had that tale of woe. And it's also sort of hard on your body, you know, you're holding this thing and it's, it's either too high or it's too low. And it's it's tricky to feel like you're in a good comfortable posture. So I try and do a couple at a time and then take a break and do other steps because it's it's really the part I like the least.

Jane 7:02

You, in this workshop, also have some guitars hanging up and one of them is purple and shiny, kind of sparkly. And we're standing in front of what looks like a big container of glitter. This sounds like you're just having fun playing, making things, painting, using glitter. I mean this doesn't even sound like an adult job!

Creston Lea 7:24

Some parts of it feel like playing around in a sandbox. The glitter, I really love these metal flake finishes but it's when people order them I have this conflicting emotion of, like, I'm so excited to spray gold flake all over something but it's such a nightmare to keep that those flakes out of every other guitar's finish. So I actually now have two spray rooms and ones just for metal flake which is sort of an embarrassment of riches, but it's so nice to be able to spray and then shut the door and walk away until I'm psychically strong enough to go in there and clean up because it's really really really messy.

Jane 7:58

So what I'm hearing is, for any of the adults who are listening, what we need is not to ban glitter from our homes but just to have a separate glitter room.

Creston Lea 8:06

You need a whole separate house, and that's the glitter house, and then before you go home to your other house you need to spray yourself off of with the air hose and then vacuum your clothes and then leave all your clothes at the front door before you go in because it gets everywhere. I went to the dentist recently and she was working in my teeth and she said, "Is there a reason why you have glitter all over the back of your neck and on top of your head?" And I said, "Yes, because yesterday I was spinning a guitar with glitter."

Jane 8:49

Okay, so now we know how the woodworking part of the guitar making goes. Next up, we need the electric components. And oh yeah, strings.

BREAK 8:56

BREAK

Jane 8:58

This is But Why, and today we're learning how guitar maker Creston Lea makes his much sought-after electric guitars.

Creston Lea 9:11

[playing guitar] If I keep shaking it you can't tell if I'm out of tune or not. It's one advantage. [More guitar playing.]

Jane 9:23

We visited him in his workshop in Burlington, Vermont a few weeks ago so we could really see what the process is like. Once Creston has built the base of the guitar, there's still a long way to go before someone can play it. At this point. It's basically just a cool looking piece of furniture. But it still doesn't have any strings and it wouldn't be an electric guitar without electronics, of course. So we walked across the hall to a room that had a whole wall have shelves filled with little red labeled containers.

Creston Lea 9:52

This is where I do all the wiring and the final assembly stuff. So I have these racks over here with all the different electronic components: the potentiometers, which are the electronic part underneath the volume or tone knob on an instrument, and resistors and capacitors and switches, and all the little pieces like that. And these bins that have the name of the client on them. And those bins hold all the parts I'll need for the final assembly.

Jane 10:22

Yeah, this room kind of looks like your ultimate Lego fan's room where it has little bins and you could put all of the different Lego parts or each different color in them, or a space to put all of your crafting crafty stuff.

Creston Lea 10:37

And think I've all these...a couple of bins with lots of different plastic knobs in them. Because in many cases, I don't know what knobs will look best on the guitar until it's completely finished everything else, you know. Often the very last step in making the guitar is picking out the right knobs. So I try and keep a lot of those on hand so I have a lot to choose from.

Jane 10:56

Can you say some of the names of some of the things in here? Because I'm seeing some ones that I really liked the names of just looking at them and saying them would be fun.

Creston Lea 11:04

One of my favorites is the bin that says "Switchcraft." That's a brand that's been around for a really long time that makes switches, among other things. But I like that if you get rid of the S it's "witchcraft." And then there's three-way switches and five-way switches, there's some four-way switches. There's all the potentiometers that control the volume or the tone.

Jane 11:28

I was looking at neckplates. I like the idea of neckplates and electrosockets. And then I was amusing myself wondering whether for that bin you say MUL-tee-meters or mull-TIM-eeters, because it could go either way. And then one I saw is "Mastery." But for a minute I thought it was "mystery." And that was my favorite box.

Creston Lea 11:47

I say MULL-tee-meter. But I think maybe if you're British, you say mull-TIM-eter. Mastery is a brand that makes bridges and vibratos that I use. And a bridge is the part that the that's on the body, the string passes over that. And every guitar has a bridge. And the two contact points of the string are the nut that's out at the far end of the neck, and then the bridge, and that string rings between those two points. So Mastery makes kind of bridge that I use a lot. And the vibratos they use, that's a piece that sits behind the bridge and the strings anchor in that it has a handle that comes out from it that's attached to a spring and if you wiggle the handle and wiggles the springs and wiggles the sound.

Jane 12:32

So this is you're doing the electrics in here.

Creston Lea 12:34

Yeah, yeah, this is where I do all that all the all the wiring, all the assembly. And then once it's all put together, and I tune it all up and all the measurements are just right, then I bring it over to one of these amplifiers and I plug it in and and make sure it works and get to hear how it sounds for the first time, which is always fun. And I can sit there and play it for a while and with a screwdriver I will metal around with electronics and how close they are to the strings and get it just where I like it. And then that's finished.

Jane 13:03

What's it feel like that first moment where you plug it in to the amplifier and you get to hear what all of this physical work sounds like?

Creston Lea 13:13

It's fun. Because I you know, all the guitars I make are different. But I've used all the different components so many different times I sort of know what to expect, but it's always just a tiny bit different, you know, so it's a little bit of a surprise. Like, I just made two guitars. The necks were both cut from the same piece of wood. The two bodies maybe are from the same plank. And they're identical except for one little detail. But they sound a little different. You know, every guitar just sounds a little different than every other guitar. So it's it's always fun to see where it's going to land.

Jane 13:49

Do you have to be a guitar player to be a guitar maker?

Creston Lea 13:53

No. In fact, there's kind of a long tradition of people who don't play guitar making guitars. It's hard to explain why that is. I don't know why, why they would want to spend their lives doing something but I know a bunch of guitar builders who don't play and there's certainly a long, rich history of that too.

Jane 14:12

Did you start making guitars because you were a guitar player or a woodworker or both?

Creston Lea 14:16

I was doing both before and then the two interests merged and it never occurred to me that I could do this until I started doing it. [Plays a riff.]

Ruby 14:53

Hi, my name is Ruby. I'm six years old and I live in University Park, Maryland. And I want to know how they make guitar strings.

Creston Lea 15:05

Oh, yeah, good question. Well, I know a guy who makes strings. And the way that he does it is on the lathe, which is a tool that is most commonly used for wood or metal. And it's like a motor on one side and a, what do you say, a spindle on the other side. So in the case of strings, you're taking a long wire, long thin wire and you're stretching it between two points on a lathe, and they both spin. And then another wire is wrapped around that core wire really tightly. So it's a tight coil that goes the whole length of that core. And then it's sort of wrapped on the end so it doesn't unfurl. And one end on most guitar strings, has what they caught the ball end. It's like a, it's not actually a round ball; it's a little tiny ring that the string wraps around. And that anchors the string either on the under the you know, inside of an acoustic guitar, or in the bridge of an electric guitar.

Creston Lea 15:06

And why are the strings different...width? Different...I guess we would call them not a width, a circumference, a gauge...Yeah, it's like some of them are thicker, and they go thick to thin or thin to thick, depending on how you're looking.

Creston Lea 16:16

The thicker they are, the lower the note. So like on this guitar, that's the lowest [plays] Tha'ts the thickest string. And then the thinnest string [plays a note] is the one that's tuned to the higher pitch.

Jane 16:28

And how do you tune the strings or tune the guitar? Because you have to, some people might know or have seen somebody tuning a guitar, and their hands right up at the very top of the neck, and they're turning some knobs. So what are you doing and how does it work?

Creston Lea 16:42

Yeah, most guitars, so the ball end of the string is anchored down by the bridge. And then the other end goes around a post that's attached to a gear that's attached to a little handle. So like, if you turn that [demonstrates] you can turn that little handle, the knob, which turns the post and you get it to just the right pitch. So all the strings sound right together.

Jane 17:09

How do you do that? Some people can do it in their heads. And some people use a little pitch pipe?

Creston Lea 17:13

Yep. Well, I don't use either one. I plug mine into a little electric electric tuner that tells me if I've got it just right. But I've worked on enough guitars that I don't know that my pitch is super great, but I sort of, somehow between the feel and everything else, I usually can come pretty close before I plug it into the tuner.

Jane 17:31

Okay, so once you've got a guitar all tuned, how do you play? Because you're not just strumming those six strings?

Creston Lea 17:36

No, you have to get your fingers on just the right place. And that's the hard part of learning to play guitars, you know, feels super awkward at first. And it's frustrating because it seems like everybody you know plays guitar. So it should be easy. But it's, I mean, you can make some cool sounds pretty quickly as you're learning play guitar, but to really get comfortable with your fingers on the strings and holding them down just right, so all the notes ring out perfectly, that takes a little while. It takes a while to learn how to just hold a guitar so that's not uncomfortable. That's in some ways the hardest part, I think, for a beginner. But you can, if you hold several strings down and strum them, then you have a chord, different notes that sound good together. Or if you just play sort of one note at a time, you can play a melody that way.

Jane 18:25

So one of your hands is strum--usually--is strumming the strings. And sometimes you do that with a little device. Or sometimes you can do it with your fingers. And then your other hand is the one that is moving up and down the neck to change what notes the strings are making, right?

Creston Lea 18:43

Yeah, so the string is anchored between the bridge and the nut, those are the two points that the string, the string vibrates between those two points. But the nut is like if, [plays a note 3 times] that's just the string played open, meaning I'm not using my left hand at all to hold it down. And but then if I put my finger on there [plays several different notes in a row] my finger sort of becomes the nut. So as you

move along, and there's these little bars that go across the fretboard called frets, and each one of those, that's the point that the string then rings between the bridge and that fret, whichever fret you're pressing. So the higher up you go, the higher the the higher up the pitch and the lowest string goes is just played open, or it's ringing off the nut.

Jane 19:33

And then you can decide if your what kind of style you're playing in whether you want that to slide up and down or go note by note by note. I mean that's all part of the art of playing, right?

Creston Lea 19:44

Yeah, and that's how every player sort of expresses themselves differently and, and sounds like themselves and not like everybody else.

Jane 19:50

So that's how a string is made and how it makes noise. The thinnest strings tend to be just one bare wire and then the thicker strings are the ones that have those other wires coiled around them. So now we know a little bit about that part. And here's one more question to help us wrap it all up.

Calvin 20:08

My name is Calvin. I'm from Ireland. My ages is four. My question is how does guitars walk?

Jane 20:17

Yeah, we've spent a lot of time learning about how an electric guitar is made. But how does it actually make the sound?

Creston Lea 20:24

Well, one thing a lot of people wonder about is sort of how the sound of this plinky little string, like this is with the amplifier turned off, [plays a couple of quiet notes] isn't very loud. And then if you turn it up, [plays a few louder notes] be as loud as you want to be, you know, you can shake the house down. And that's these, these things that are called pickups that sit on the body of the guitar. And there's all kinds of different pickups, you could put a pickup in an acoustic guitar or any kind of guitar can be amplified. And it's, the pickups are magnets with wires wrapped around them. And, you know, if you've ever messed around with a magnet, you know that you can feel it pulling on something before it actually makes contact with a piece of metal. So that's a magnetic field. So the magnets have like kind of an

invisible cloud around them that's magnetized. So the strings all pass through this magnetic field. And sort of the magic of an electric guitar or any guitar with a pickup is when you pluck the string and it vibrates, it kind of disturbs that invisible cloud. And that gets, that disturbance, gets read by the, the tiny little wires that are wrapped around the magnet and that sent out to the output jack of the guitar through a cable into an amplifier which takes that tiny tiny little signal and amplifies it and blows it up. So it's a big sound.

Jane 21:46

Is there a difference between an amplifier and a speaker? Or could we kind of say an amplifier is is like a speaker?

Creston Lea 21:51

An amplifier is is the part that sort of gives power to the little electronic impulse and and then it makes it bigger and the speaker is the part that actually sends it out into the world so you can hear it. But when you see some guy like parading around on a stage in like leather pants, you know, and a giant wall of amplifiers making all this huge sound, the actual sound his guitar is making this this tiny, tiny tiny little like mousy squeak that that amplifier is turning into this, you know, thunderstorm.

Jane 22:24

Ooh, I love that idea of thinking about playing an electric guitar like a thunderstorm.

MUSIC RIFF 22:41

MUSIC RIFF

Jane 22:49

I hope you enjoyed learning a little bit about how electric guitars are made. Creston says if you want to learn how to make guitars yourself, there are lots of great books you can use and some schools you could even go to. He says the internet can be great too. But there are a lot of people who know a little bit about guitars who try to tell you they know a lot. So find someone that you trust to give you good advice. Also, if your high school has a woodshop, you might want to learn some basic woodworking skills when you get into high school. And if there are any luthiers--people who make stringed instruments--who live or work around you, see if they'll let you check out their studio like Creston did with us. Oh, and if you want to see what some of Creston's guitars look and sound like, have an adult help you check out our Instagram, TikTok, Facebook or YouTube pages.

Jane 23:37

Now, you know the drill. If you have a question about anything, send it to us. We love to help get answers to all kinds of questions. Ask an adult to help you record yourself asking your question and then have them send the audio file to questions@butwhykids.org. You can also tell them they can just go online to our website, butwhykids.org, and we have a form they can fill out and download the file right there. The But Why team includes Melody Bodette, Kianna Haskin and me, Jane Lindholm. Our show is produced at Vermont Public and we're distributed by PRX. Our theme music is by Luke Reynolds. We'll be back in two weeks with an all new episode. Until then, stay curious!