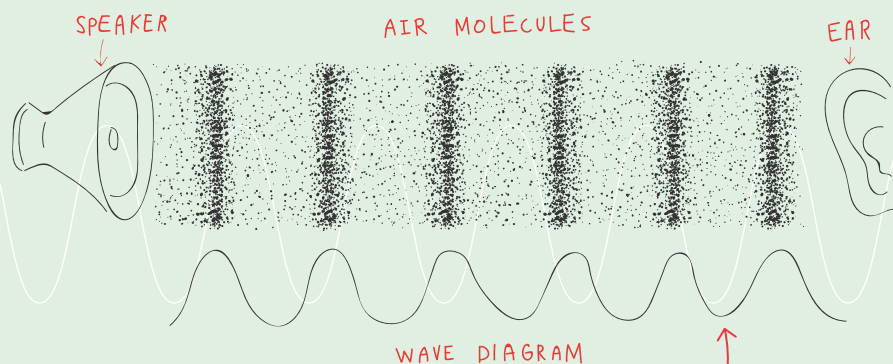


PUTTING SCIENCE TO WORK

SOUND WAVES

Just like all instruments, stringed instruments are designed to **create sound waves**. But it needs to do this in a way that creates *specific* sound waves – in other words, music.

Sound is a wave, traveling through the air (*or another medium*) like a wave travels through water. Any **vibrating** thing — like, say, a ukulele string or a speaker — will make a sound. As the string moves back and forth, it pushes the air around it. When the string moves **forward**, it pushes the air **forward**. When the string moves **backward**, it sucks air **backward**. This happens over and over, creating areas of **compression** (*where the air molecules are closer together*) and areas of **rarefaction** (*where the air molecules are farther apart*). That's a **sound wave**! Each individual molecule moves only a little bit, but the wave can travel across a room (*and into your ear*).

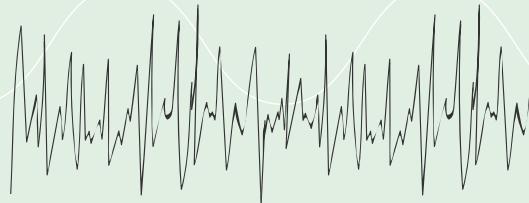


Molecules are difficult to draw, so sound waves like these are often represented with a squiggly line, like this. The peaks represent the squished-together areas, and the valleys the spaces in between.

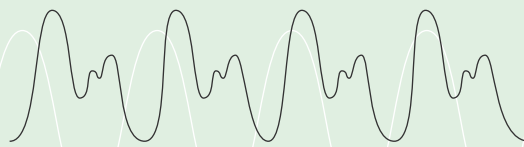


So what makes some sounds music and others just noise? It's all about the **frequency**, or distance between the areas of compression. Most sounds include many different sound waves with different, random frequencies crashing together: that's **noise**. But if a sound's frequencies are clean and regular, that's **music**. *(That's mostly true. What's music to you might be noise to someone else — and vice versa.)*

Noise sound waves



Music sound waves

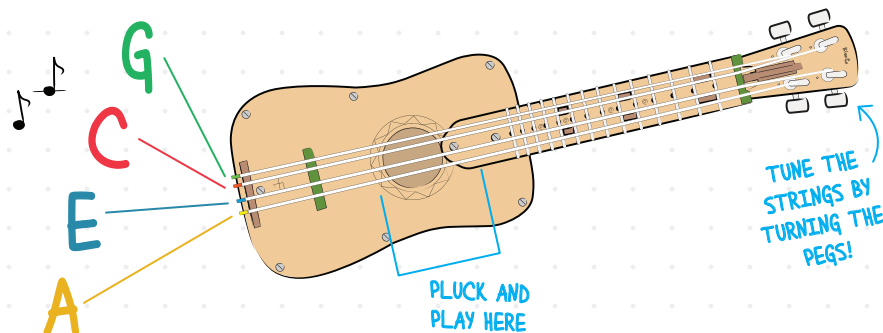


When you strum a ukulele, you're hearing a bunch of related **vibrations**: in the ukulele's wood panels, in the air inside the body, and in the string itself. These vibrations are at the same frequencies or at frequencies closely related to each other, so they work together to create the *(hopefully)* pleasing musical tone you hear. And if it still sounds like noise? Well, every musician gets better with practice.

HOW TO TUNE YOUR UKULELE

Before you play anything, you need to tune the strings!

Tuning is how you make the strings play the right notes. Each string will be tuned to a specific musical note:



Right now, though, the strings probably aren't playing those notes. That's why you need to tune!

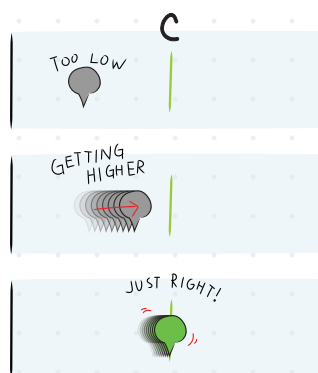
Step 1

First, download a tuner app.

A tuner is a device that tells you what note you're playing. It'll also show you if what you're playing is too low or too high, and how far you are from the right note.

If you don't know anything about music or notes, we recommend **GuitarTuna** by Yousician.

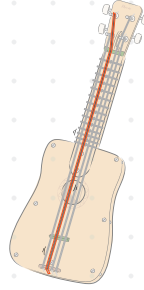
If you know more about music, like the order of notes in a scale, try **Tuner Light** by Piascore (or even a real guitar tuner).



Step 2

Next, start tuning with the red string.

You're going to tune this to the note **C**!



Why start here?

It's easiest to start tuning on the string that plays the lowest note, which for ukuleles, is this one! We have you tune from low to high rather than top to bottom.

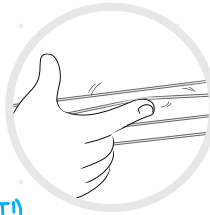
Step 3

Point the ukulele at the tuner.

Then start plucking the C string.

The tuner will show if what you're playing is higher or lower than C.

(OR JUST RIGHT!)



If you're having trouble, don't worry!

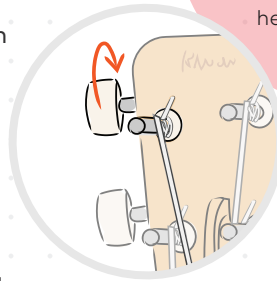
Tuning can be tricky. Check out online videos where you can hear the notes too!

Step 4

To get the string to play C, you'll need to loosen or tighten it with the tuning peg.

If it's too low, tighten the string to make it play higher.

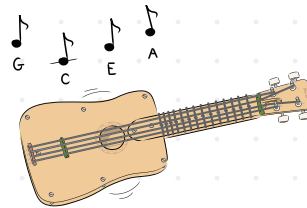
If it's too high, loosen the string to make it play lower.



This takes experimentation! Keep plucking while you turn the peg to see how the string's sound is changing.

Step 5

Once you get the **red string playing C**, repeat these steps to tune the other strings! Tune the **blue string to E**, the **green string to G**, and the **yellow string to A**.



When you finish, double-check that the strings are still in tune. All that tightening and loosening can change what note they're playing. Retune if necessary, then flip the page to learn how to play!

HOW TO PLAY YOUR UKULELE

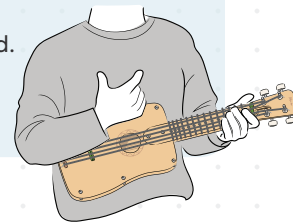
Strum

Start by practicing a **basic strum**. You'll use this to play songs next!

Playing an instrument takes practice — lots of it! Don't feel bad if it doesn't sound right at first. Keep trying and it'll get better!

To hold it:

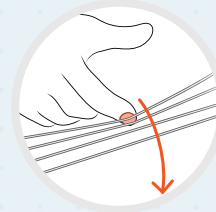
Hold the neck in your left hand, just below the head. Squeeze the ukulele against your body with your right arm.



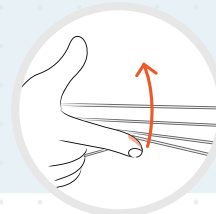
To play it:

First is the downstroke. Start with your right hand above the strings, then sweep it down so the nail on your index finger hits all four strings.

- Aim your finger just below where the neck meets the body.
- Use a fluid motion so the strings sound together instead of one at a time.
- Keep your finger stiff. For extra strength, try flicking your finger or holding your thumb against it.
- Keep your elbow and wrist relaxed and strum straight across the strings.



Next is the upstroke. Sweep your right index finger back up across the strings, hitting the strings with the side or pad of your finger.



Practice the downstroke and upstroke together until strumming feels natural. Then, keep going to try out a chord!

Chords

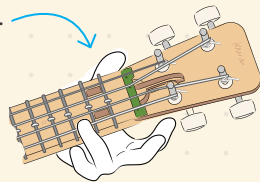
A **chord** is the harmonious sound made when you play several notes together. Strumming chords is the main way to play a ukulele!

To play different chords, you have to change the notes that the strings make. But don't touch that tuning peg; when you're playing, you change a string's note by holding it down against a **fret**!

To learn how to make a chord, musicians use a **chord diagram**. This tells you where to put your fingers to press the strings.

This diagram says to use your ring finger to push down on the A-string between the 2nd and 3rd frets. It should look something like this.

Try making this chord and strumming. How does it sound?



This is a **C major** chord! You made it by changing the note the A-string plays from an A to a C. From lowest to highest, the notes are C-E-G-C!

C major

HEAD UP HERE

LEAVE THESE STRINGS OPEN

FRETS

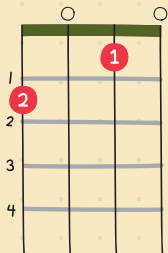
STRINGS

PRESS DOWN HERE WITH THE INDICATED FINGER

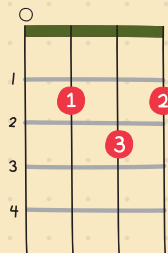
Use the tips of your fingers. If you use the pads, you might accidentally touch and mute another string.

Other chords:

F major

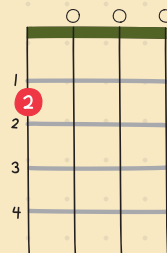


G major



Major chords sound happy.

A minor



Minor chords sound sad.

Lots of songs can be played with just these four chords!

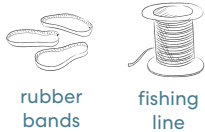
DESIGN CHALLENGE

STRINGED INSTRUMENT

Design and build your own stringed instrument out of recycled materials, and join a long history of scrappy, low-cost instrument making.

You'll need things like...

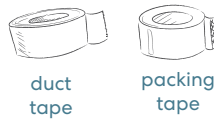
strings,



rubber bands

fishing line

tape,



duct tape

packing tape

and a box!



cardboard

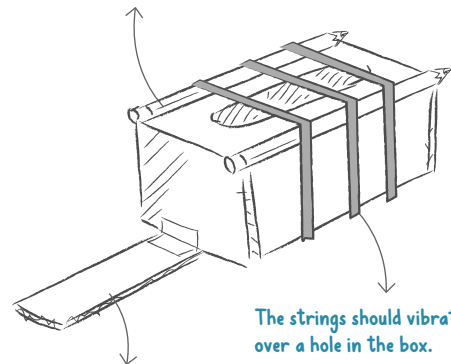
wood

metal

Design questions:

- 1. Vibration.** How will you attach your strings or rubber bands so they can vibrate freely? Where you pluck will also change the sound — *try it!*
- 2. Resonance.** Try out boxes of different sizes, shapes, and materials. Cut a hole (like your ukulele) so the sound can resonate in the box.
- 3. Handling.** Holding the box can kill some of the sound, so adding a handle is a good idea.

The pencils help the rubber bands vibrate freely.



The strings should vibrate over a hole in the box.

The handle can be fancy or plain.



Get inspired
by these designs,
or invent your own.

electric guitars made
from empty oil cans



Photo by Adam Lee (CC BY-SA 3.0)



Photo by State Archives of Florida/McDonald

girl with DIY cigar box banjo,
circa 1920

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