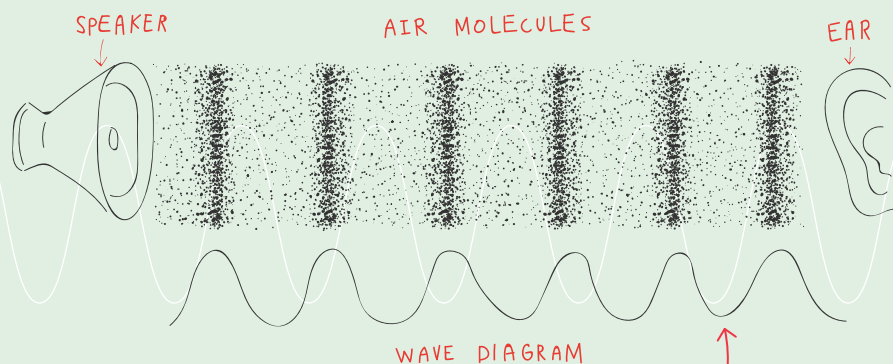


PUTTING SCIENCE TO WORK

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*).

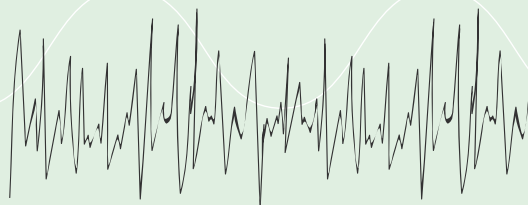


Molecules are difficult to draw, so sound waves like these are often represented with a squiggly line, like this. The peaks represent the squished-together areas, and the valleys the spaces in between.

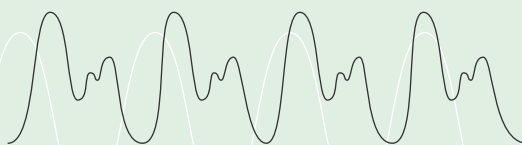


So what makes some sounds music and others just noise? It's all about the **frequency**, or distance between the areas of compression. Most sounds include many different sound waves with different, random frequencies crashing together: that's **noise**. But if a sound's frequencies are clean and regular, 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.

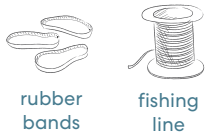
DESIGN CHALLENGE

STRINGED INSTRUMENT

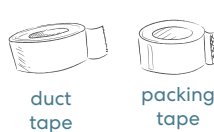
Design and build your own stringed instrument out of recycled materials, and join a long history of scrappy, low-cost instrument making.

You'll need things like...

strings,



tape,

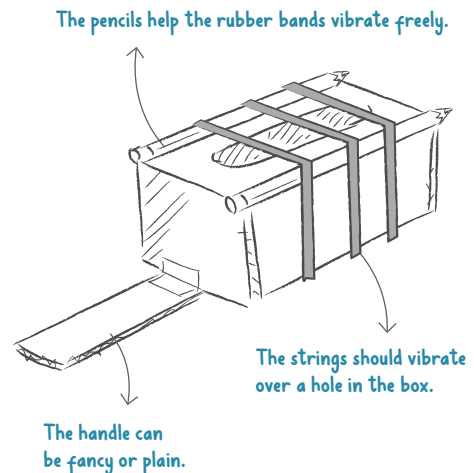


and a box!



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.





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)

girl with DIY cigar box banjo,
circa 1920



Photo by State Archives of Florida/McDonald

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