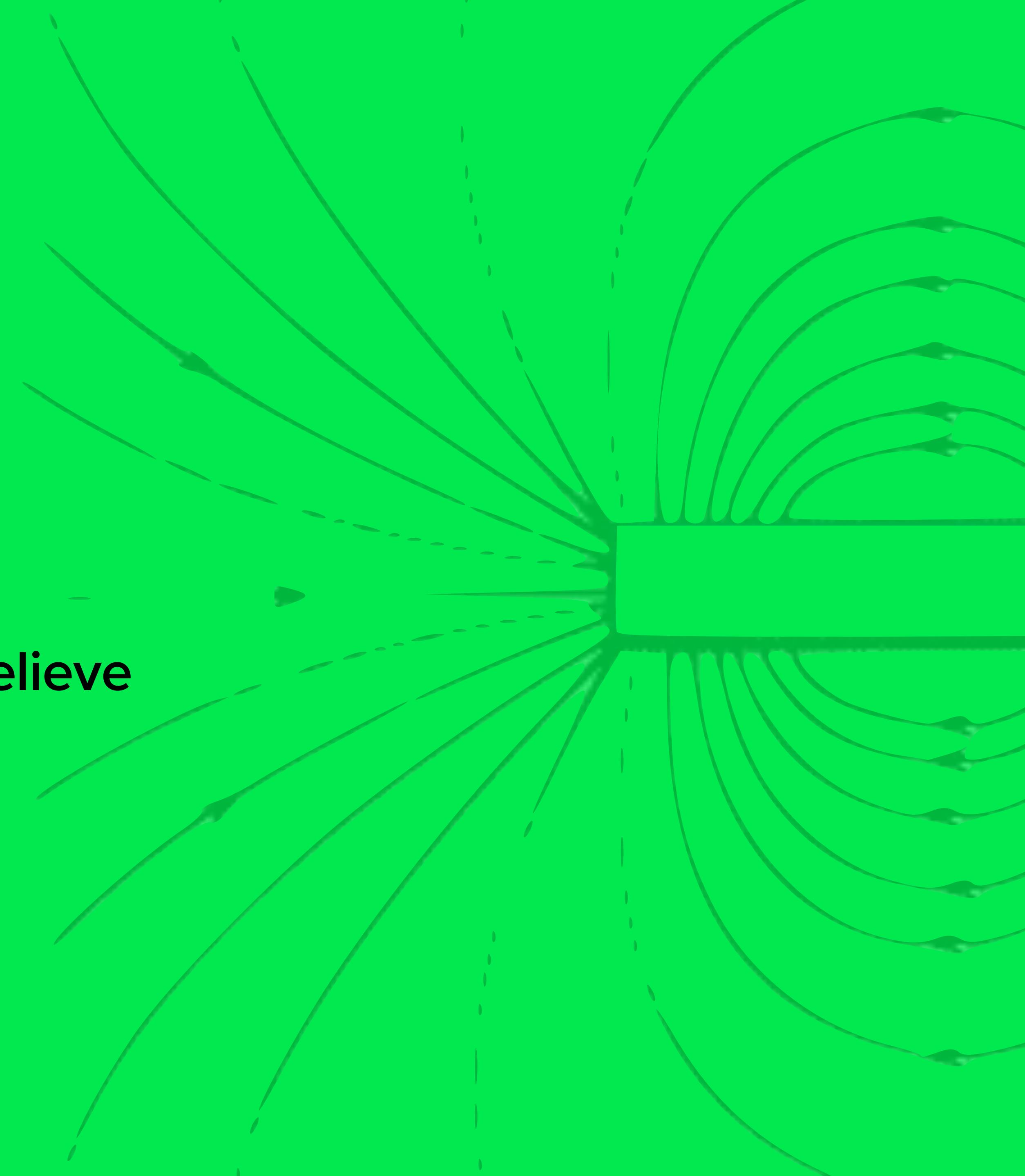


LEE WILKINS

MAGNETIC FIELDS

School of Machines, Making & Make Believe



HELLO!

HOW ARE YOU?

SHARE YOUR INVISIBLE FORCE?

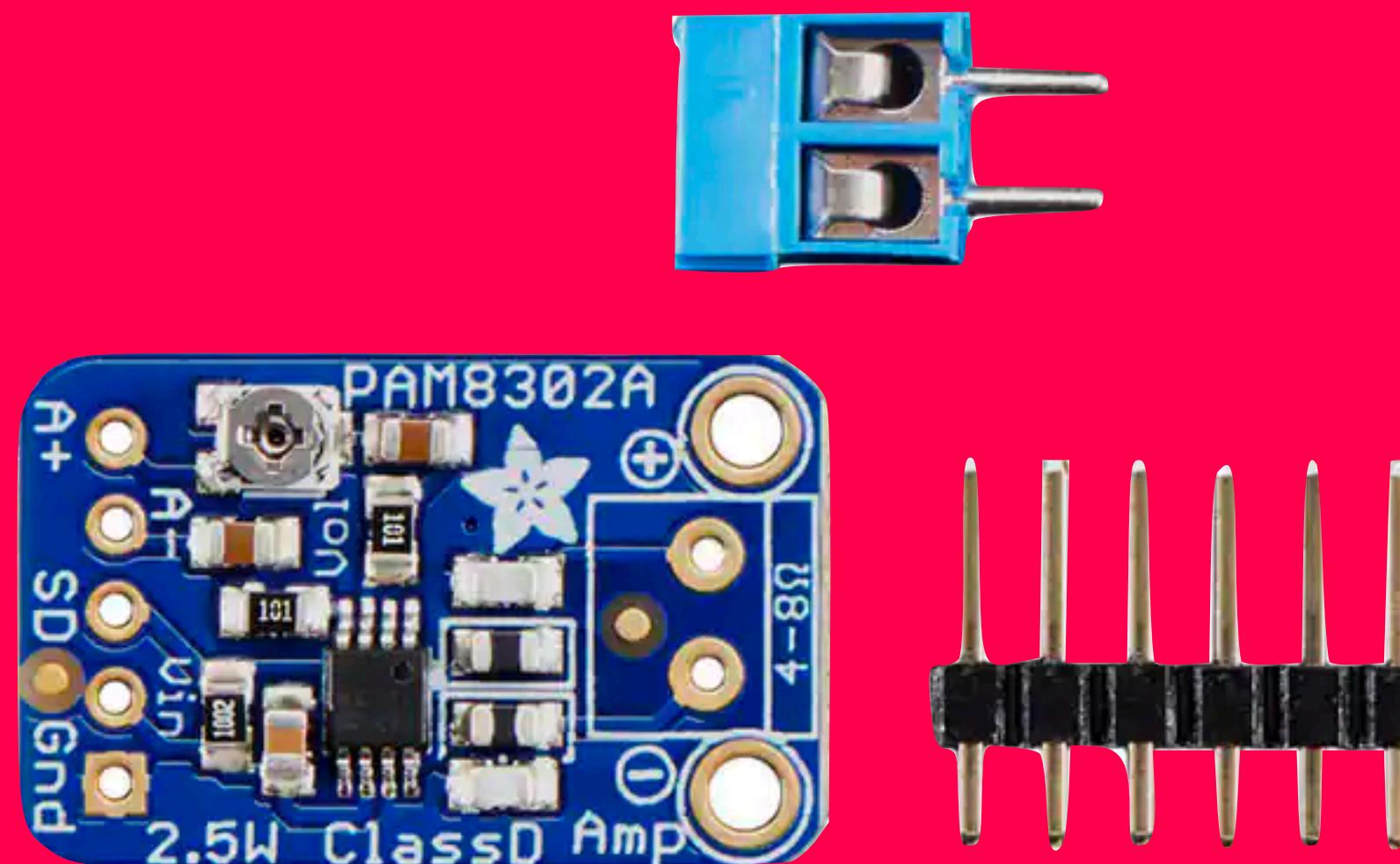
FINISHING UP LAST WEEK

HOW DO SPEAKERS WORK?

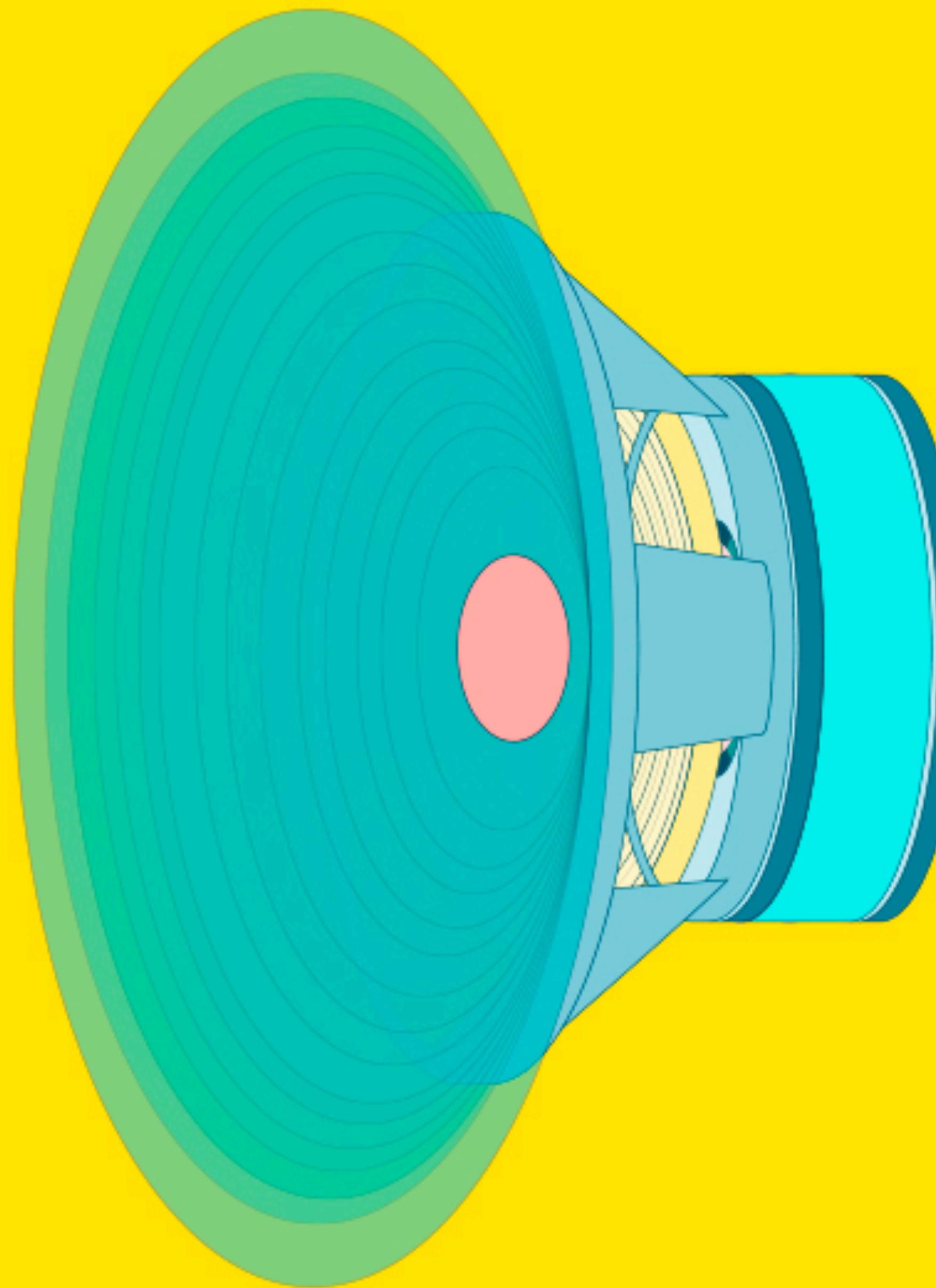


Speakers work by creating movement through the air by using a tiny coil and magnet, similar to the ones we used last week!

HOW DO AMPLIFIERS WORK?



Amplifiers make a small electrical signal bigger. Because the signal leaving our devices is weak, and our speaker will also be weak, we'll need to make the electrical signal bigger using an amplifier circuit.



An electrical signal leaves the audio device and goes into the coil, the coil creates a magnetic field based on the sound input, which interacts with the permanent magnet, moves the cone, and creates sound!

CONE

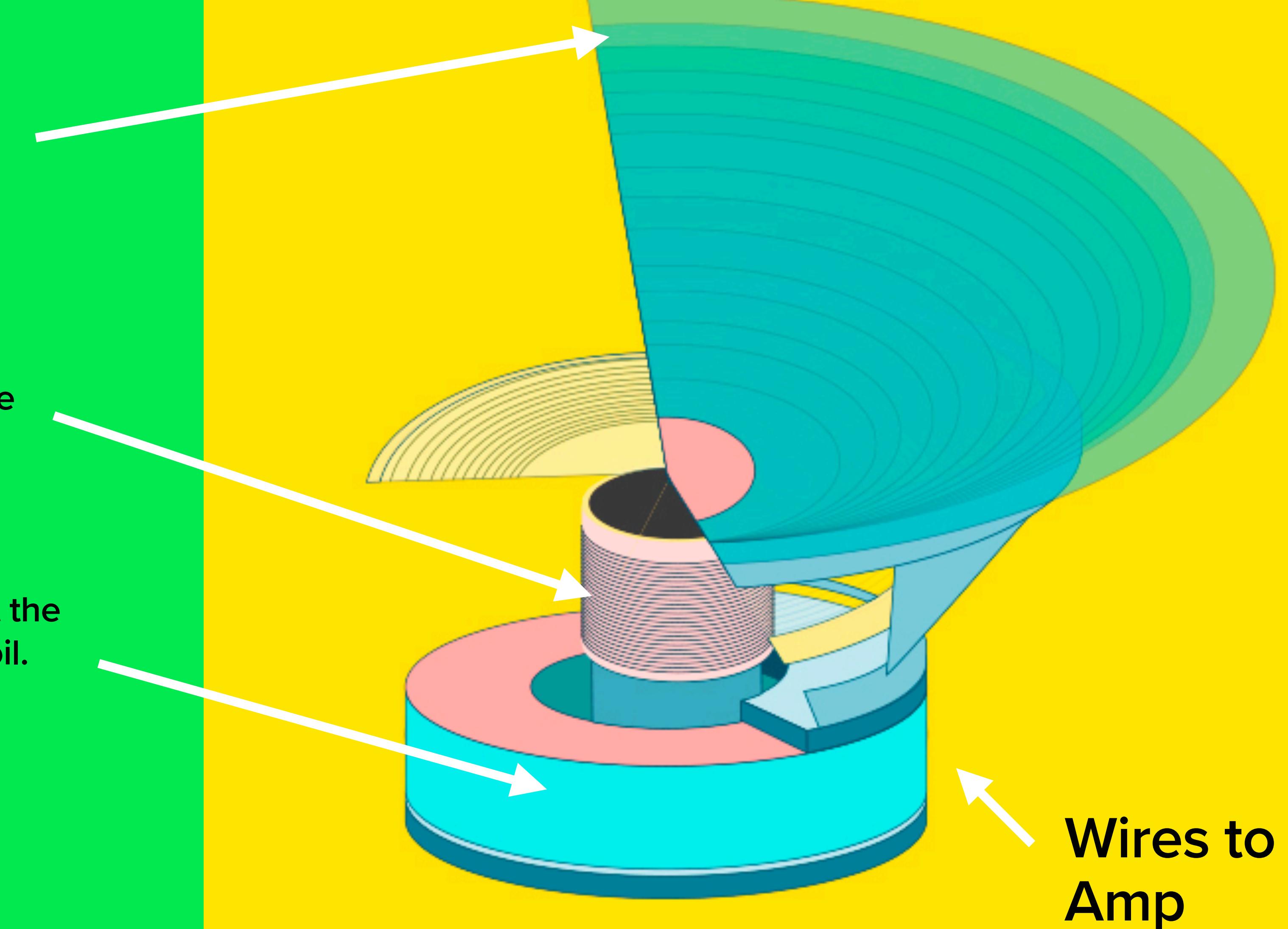
There is a cone that moves up and down with the electromagnet to create the sound waves

COIL

Much like the coil we've been using, the coil inside a speaker is made of many winds of copper wire that create a magnetic field when current is passed through them

MAGNET

There is a permanent magnet at the base of the speaker, around the coil.



BEAUTIFUL COILS

By Kobakant

[https://](https://www.kobakant.at/DIY/?p=5935)

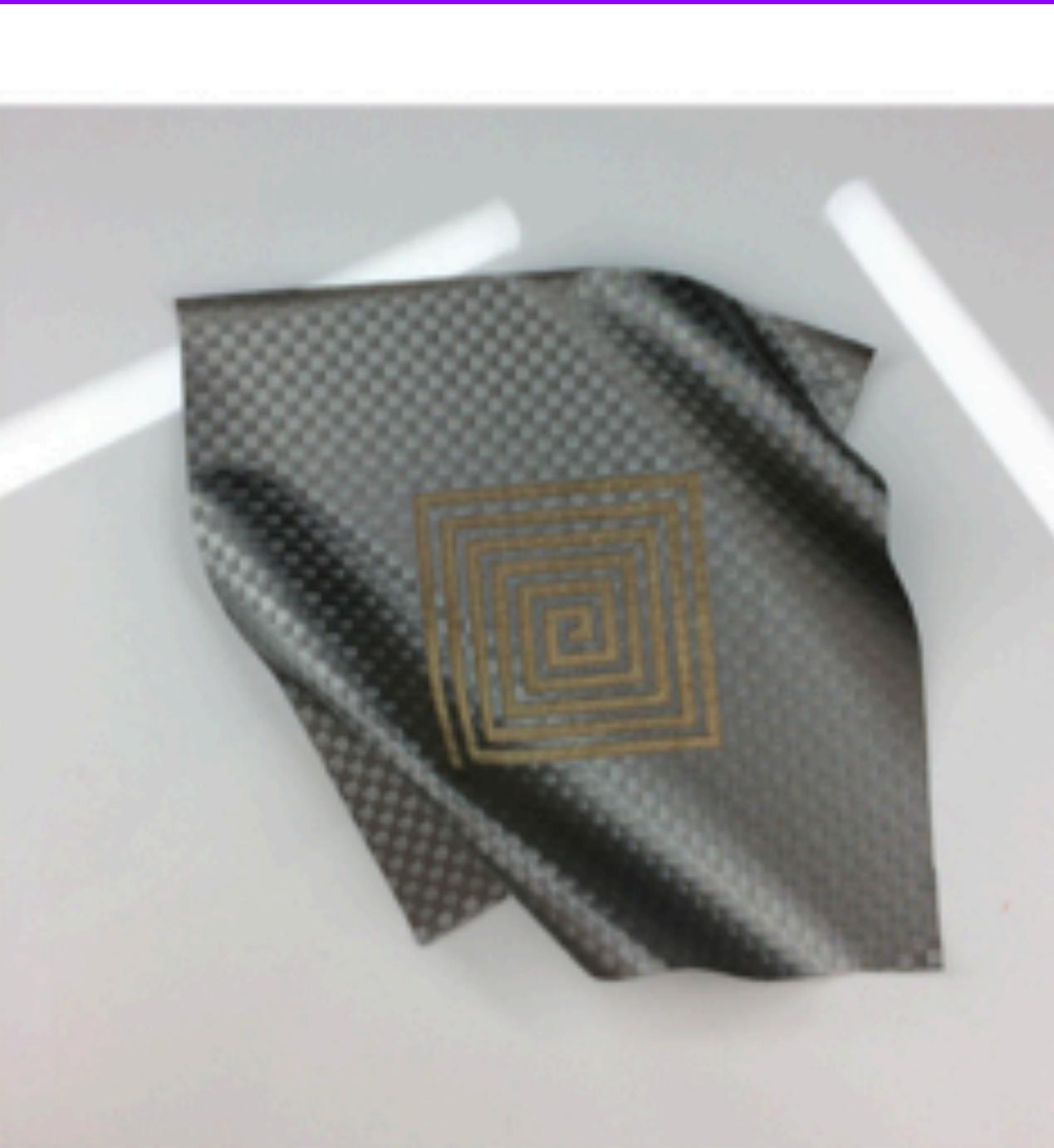
[www.kobakant.at/DIY/?](https://www.kobakant.at/DIY/?p=5935)

[p=5935](https://www.kobakant.at/DIY/?p=5935)



BEAUTIFUL COILS

Eszter Kárpáti of EJtech



BEAUTIFUL COILS

Eszter Kárpáti of EJtech

Draping Sound

[http://ejtech.cc/?
page_id=1379](http://ejtech.cc/?page_id=1379)



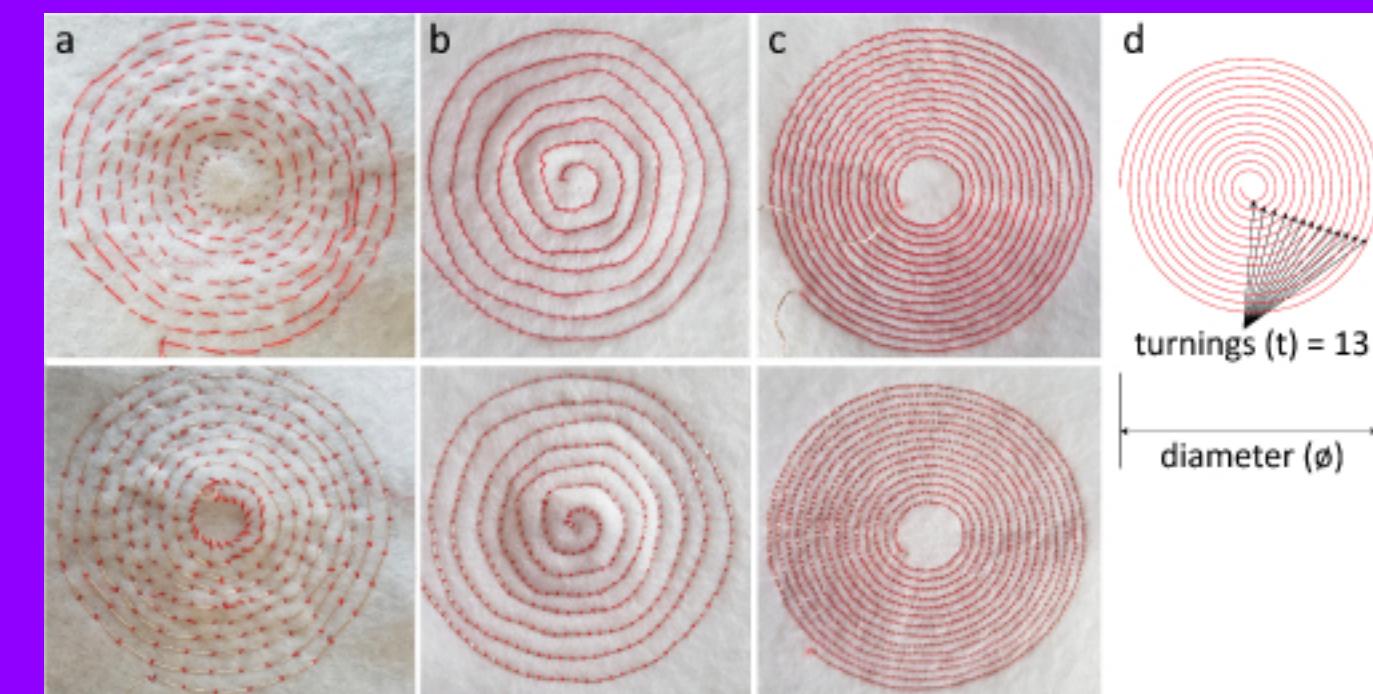
BEAUTIFUL COILS

Liza Stark



BEAUTIFUL COILS

Lee Jones https://www.youtube.com/watch?v=9s87b2cXY_k Paper on fabric speakers



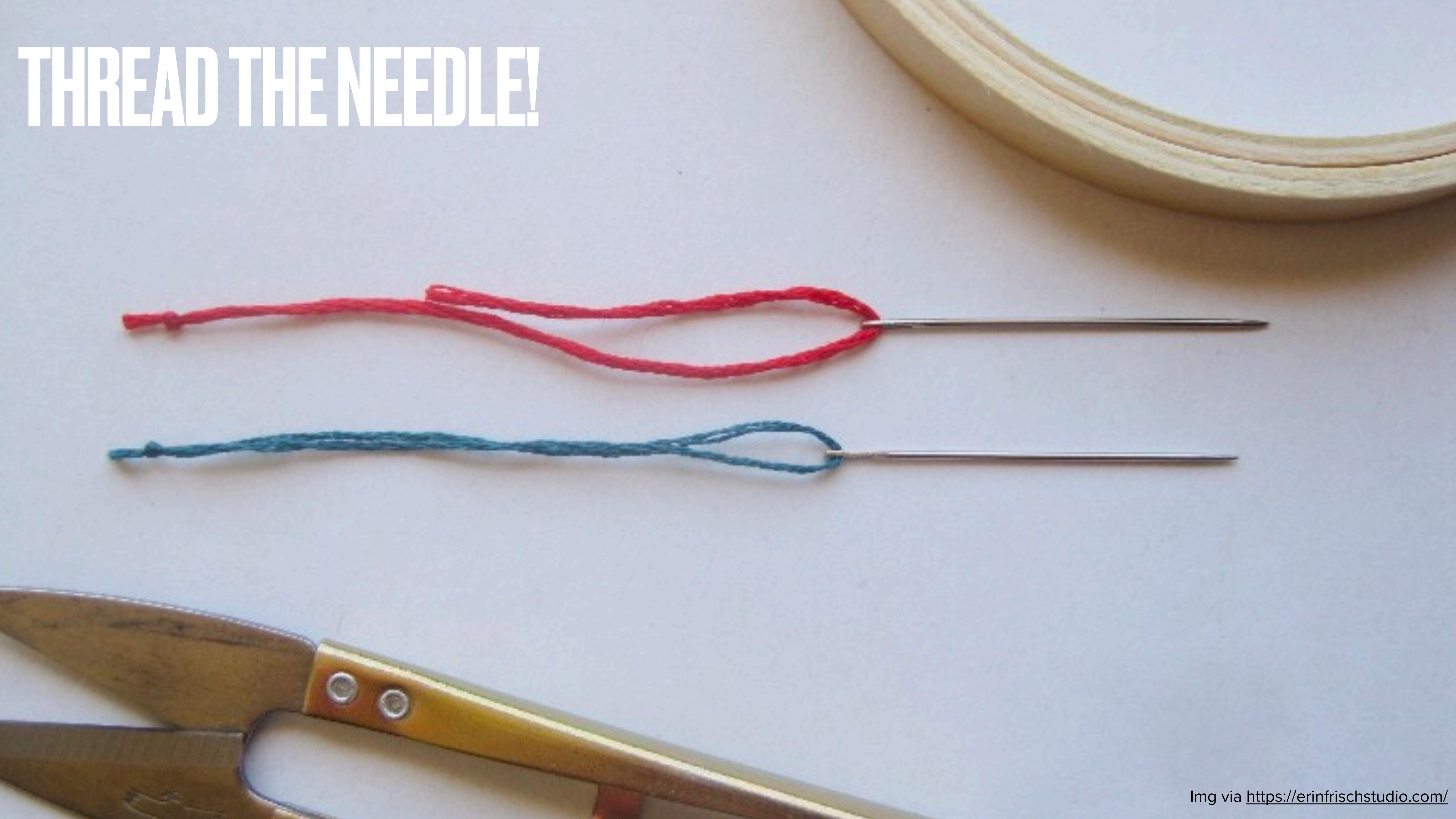
LET'S MAKE A SPEAKER!

First we will place our fabric in the embroidery hoop. Then begin sewing a spiral as big as you'd like your speaker to be. Remember that the beginning and end of the spiral will need to have an alligator clip attached to them, so leave space.

If you are using magnet wire, your coils can overlap. But you can use materials like conductive fabric, wire, conductive paint, etc.



THREAD THE NEEDLE!



1. RUNNING STITCH

Running stitch looks like this, it is a single, conductive thread. Bring the needle up through the back of the fabric, and pass it though the front. Repeat this pattern. Don't make your stitches too wide, and take your time!

2. COUCH STITCH

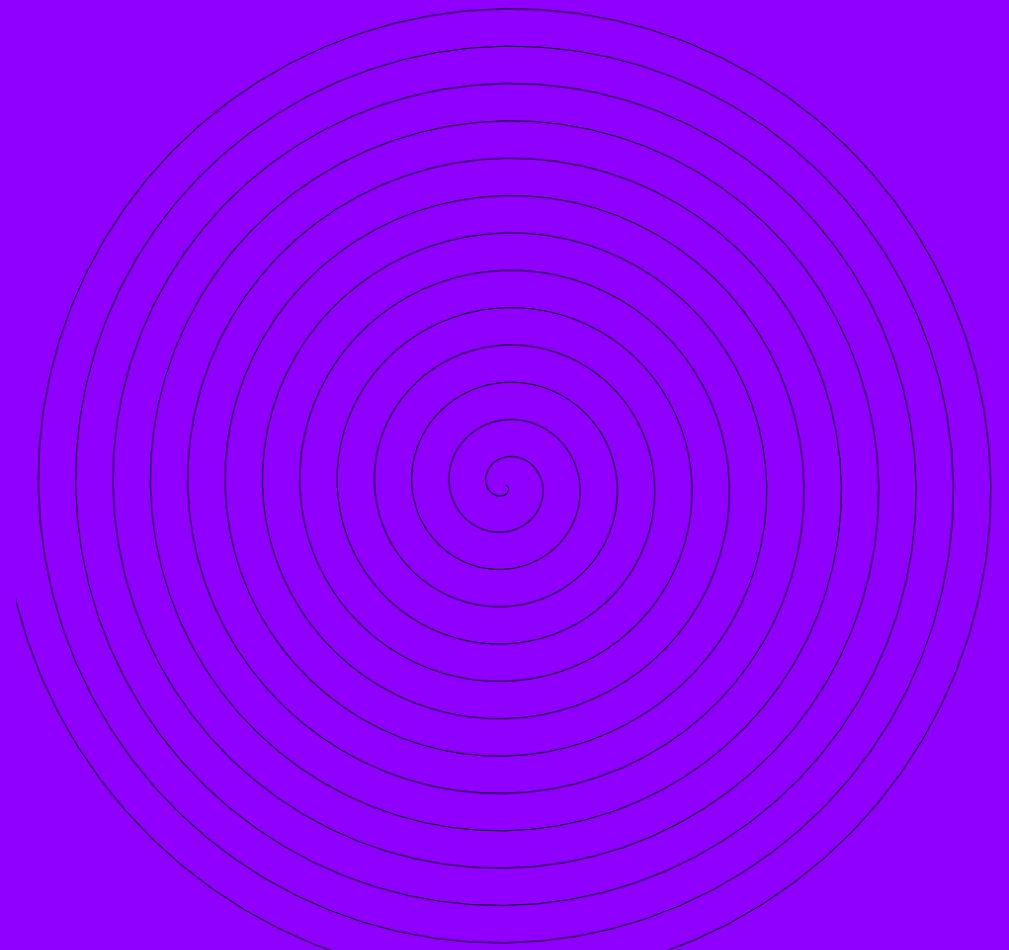
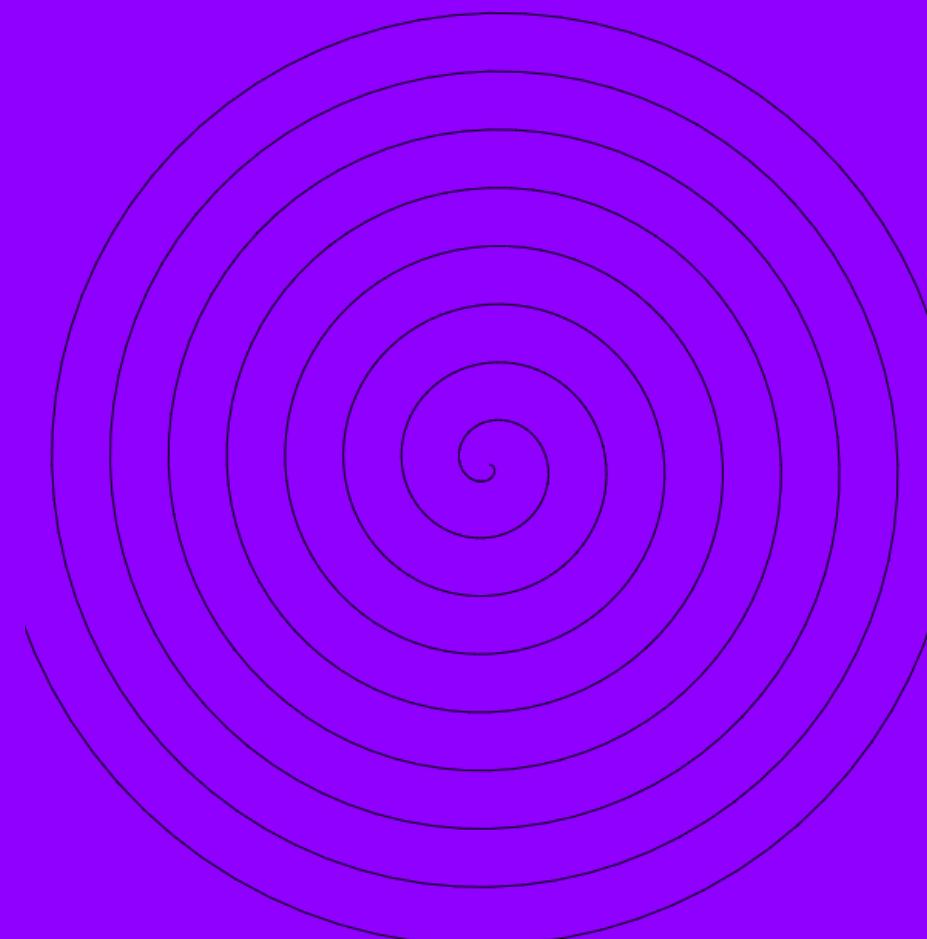
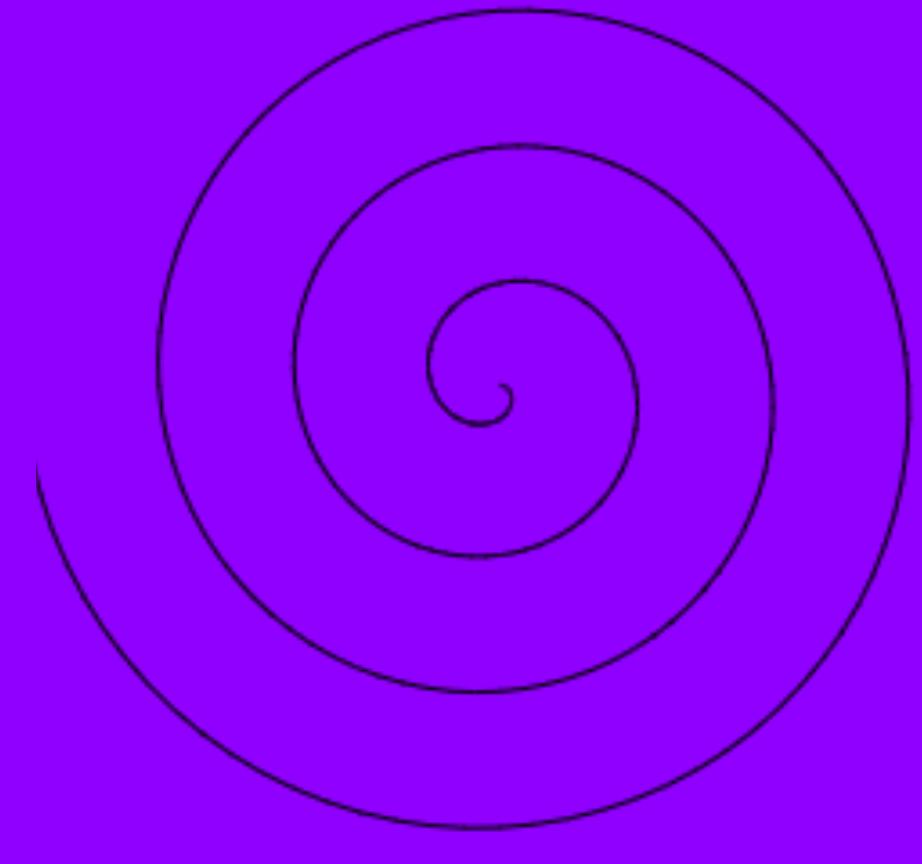


Couch stitch looks like this, it uses 2 threads. In our case, the black thread is conductive, and the green one represents a non conductive thread that is holding it down.

- 1 Lay your conductive thread down along the path you want it to go. You can mark it too!
 - 2 Bring your non conductive thread through the back of the fabric
 - 3 Bring the non conductive thread over the conductive thread, and through the front of the fabric
 - 4 Bring the non conductive thread over, on the back of the fabric, and repeat the process
-
- A diagram illustrating the couch stitch. It shows a black horizontal line representing the conductive thread. A green vertical line representing the non-conductive thread is shown crossing over the black line at two points, with its ends extending both above and below the black line, demonstrating how it holds the conductive thread in place.

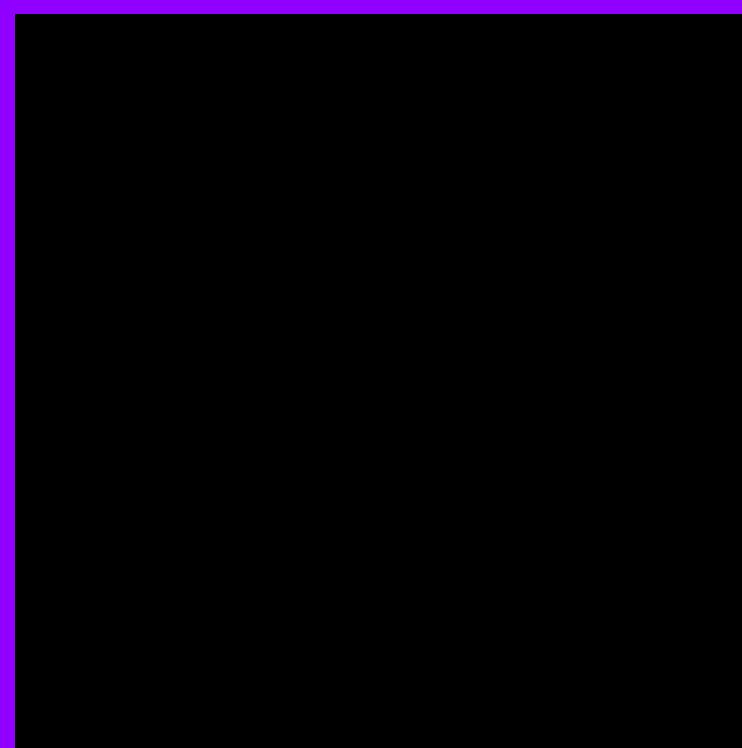
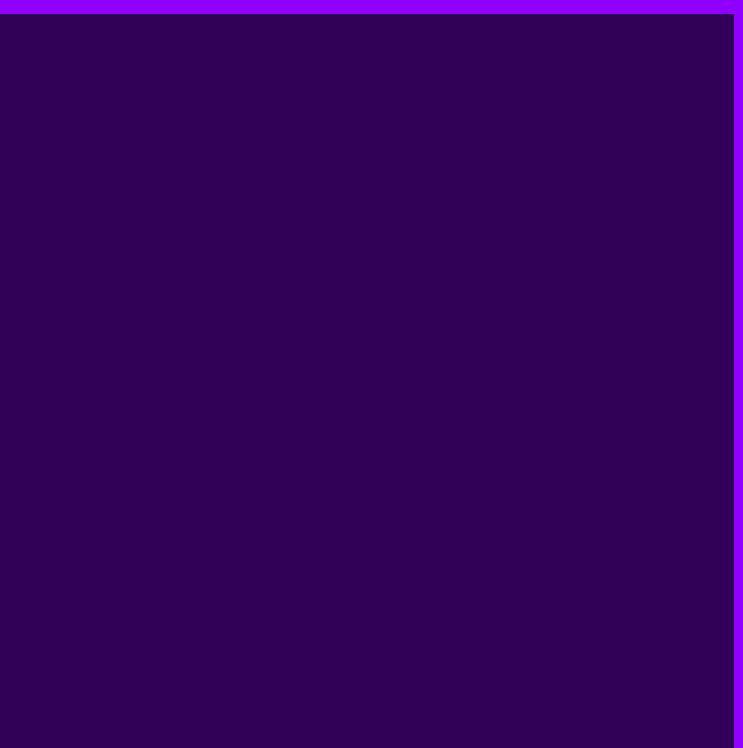
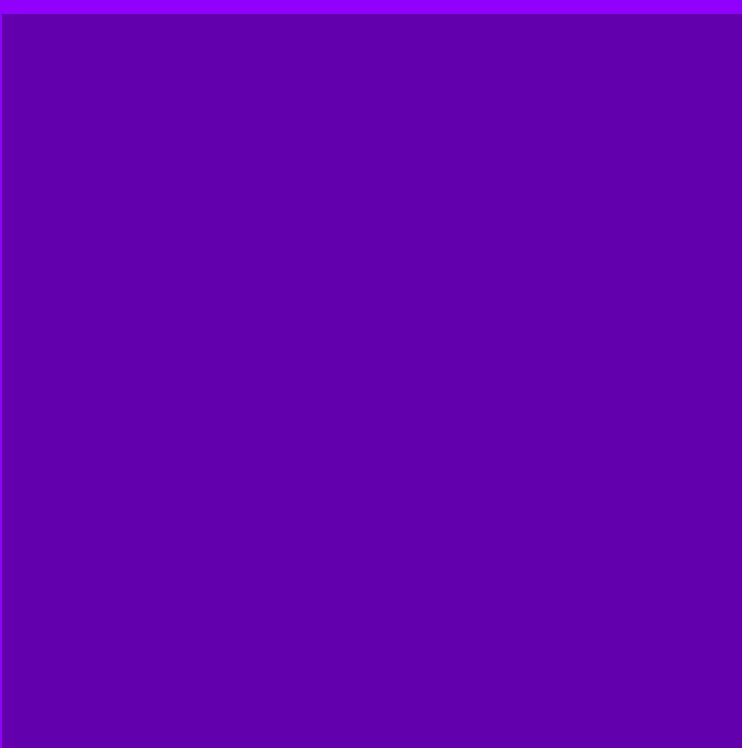
FACTOR 1: NUMBER OF TURNS

The number of turns will effect the quality of the sound because you're making a stronger magnetic field. The thickness of the trace doesn't matter, but try and get as many turns into the smallest space possible!



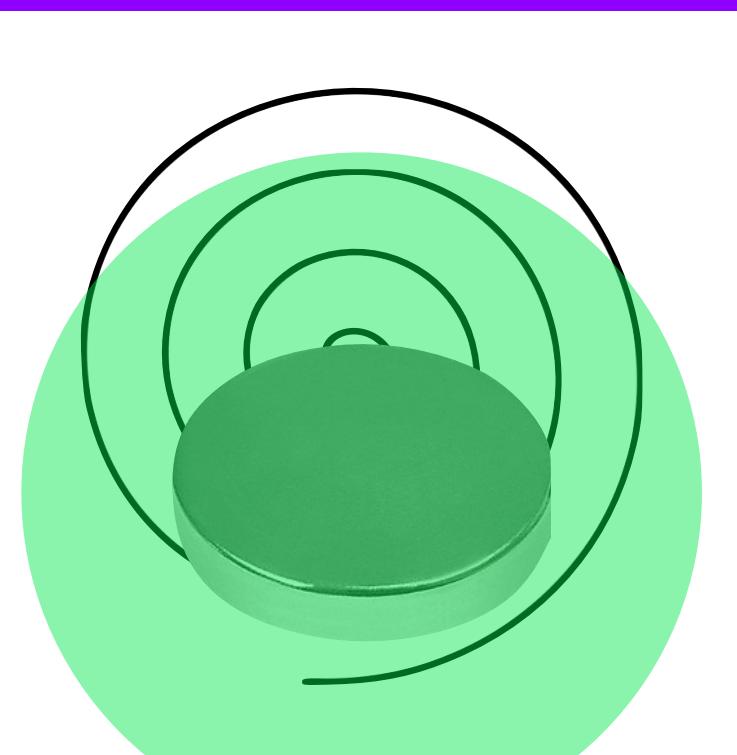
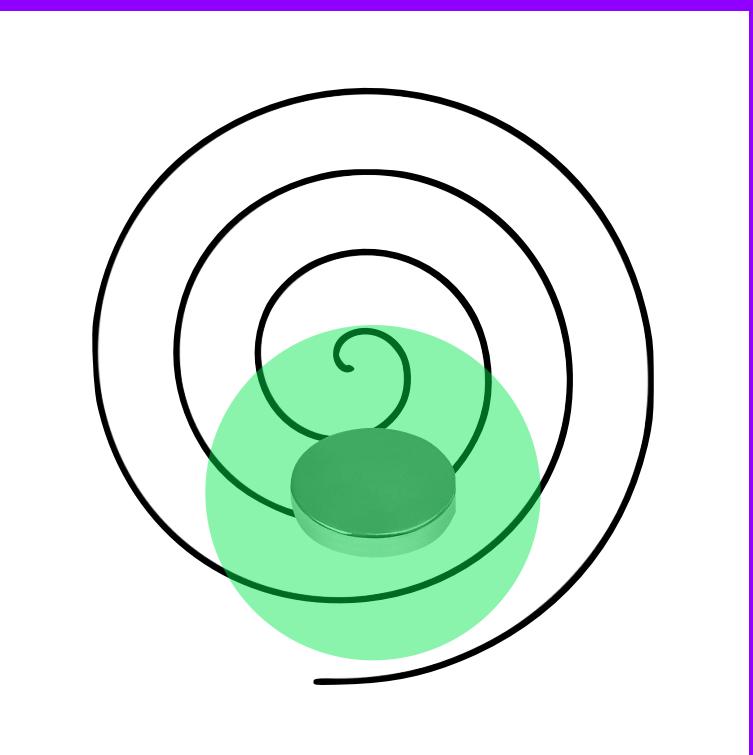
FACTOR 2: BASE MATERIAL

Basically any material will work, but if the fabric is too heavy to vibrate with the coil, the sound will be weaker.



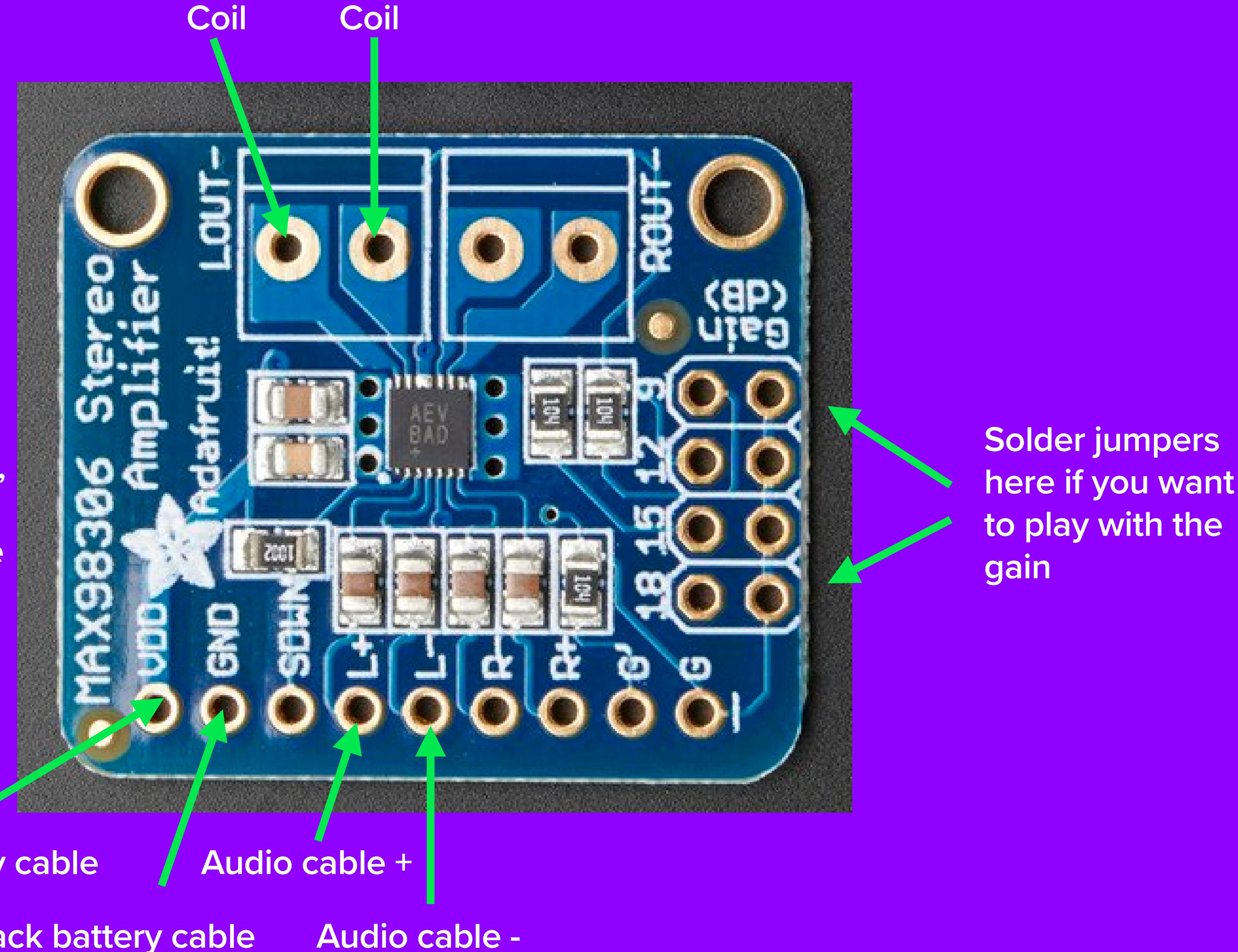
FACTOR 3: MAGNETIC STRENGTH

Make sure the magnetic field of the magnet encompasses as much of the coil as possible to get the best sound. You can stack multiple magnets too!



AMP PINOUT

You can also use the right channel, just make sure you are using the same one, or both.



CIRCUIT

Remember to make the connection you have to use alligator clips and/or make sure to remove the coating on the magnet wire where you are making a connection

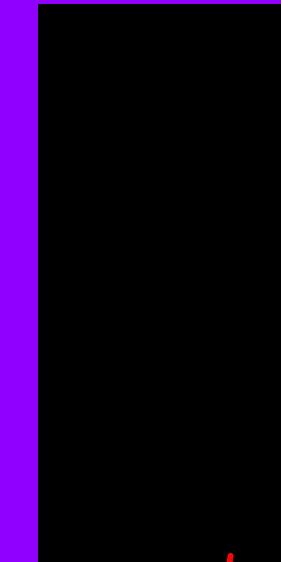
8
Play sound!



Audio cable
into device

5

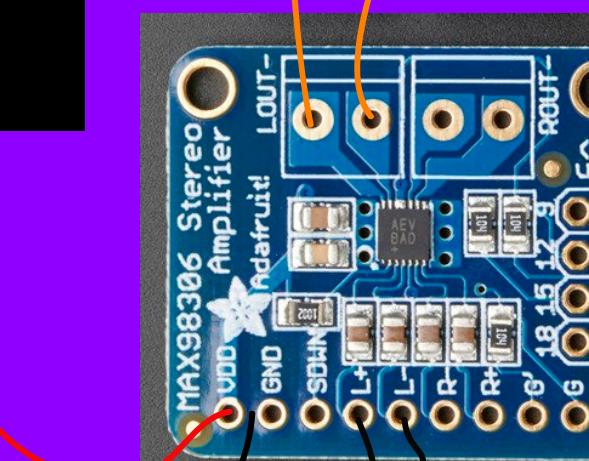
6
Make sure
battery is on!



Connect
black to
GND and
red to VDD

4

2
Connect to L
channel



BREAK

AS WE'VE SEEN, MAGNETIC FIELDS ARE EVERYWHERE. WE CAN USE THE TECHNIQUES WE'VE LEARNED TO LISTEN TO THEM USING AN ANTENNA THAT RESONATES WITH THE FREQUENCY OF CERTAIN FIELDS, ALLOWING US TO LISTEN TO DIFFERENT ELEMENTS.

AFRODITI PSARRA

<https://afroditipsarra.com/>



ANIMAL SUPERPOWERS

CHRIS WOEBKEN and KENICHI
OKADA

[https://artscy.sites.ucsc.edu/
2014/11/17/chris-woebken-and-kenichi-
okada/](https://artscy.sites.ucsc.edu/2014/11/17/chris-woebken-and-kenichi-okada/)



CLAIRE WILLIAMS

<https://xxxclairewilliamsxxx.wordpress.com/electronic-textiles/>







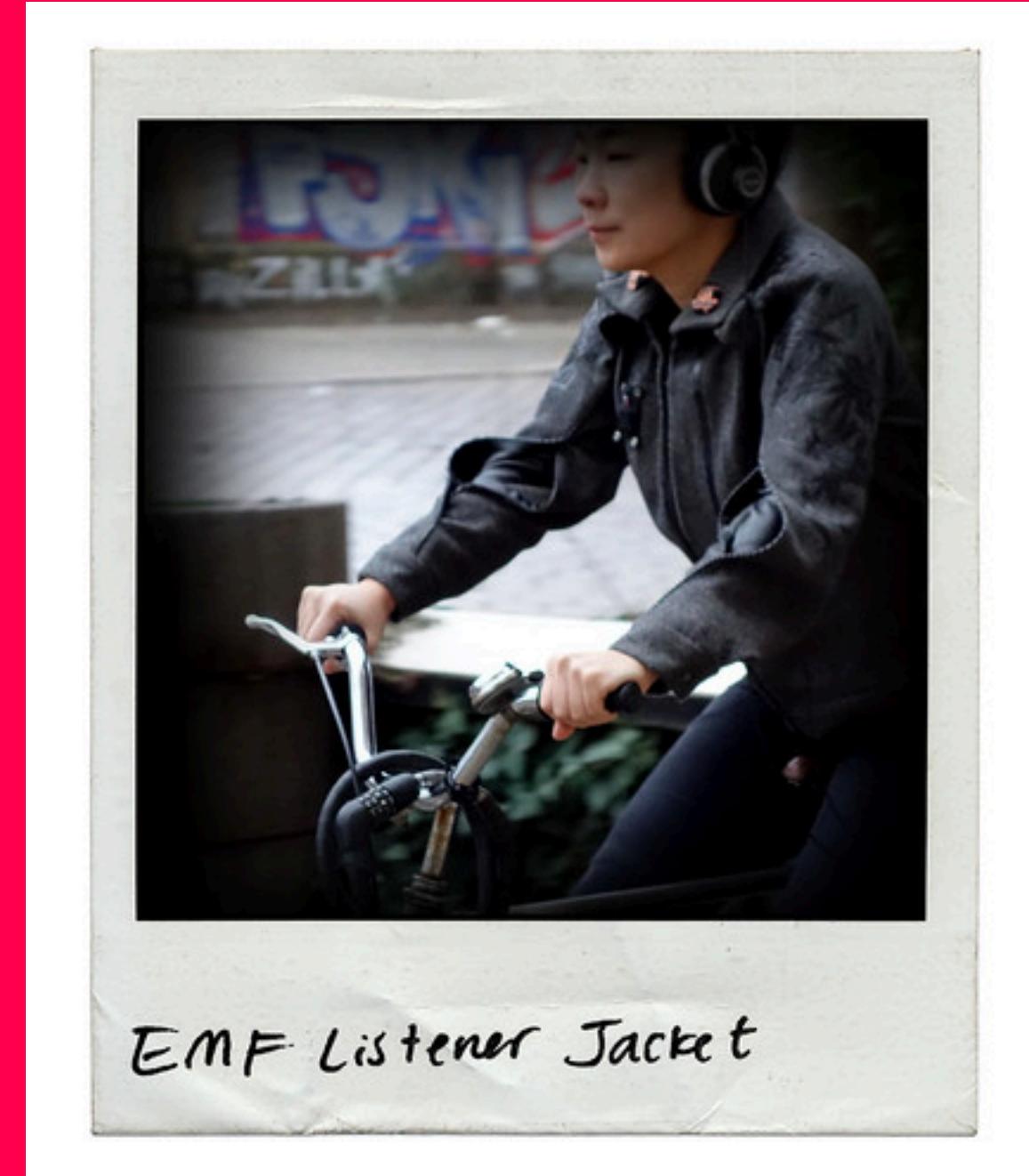
ELEKTROSLUCH 3+

<https://arstechnica.com/gadgets/2016/03/listen-to-secret-sound-of-electronics/>



EMF LISTENING JACKET

<https://www.kobakant.at/KOBA/emf-jacket/>



EMF Listener Jacket

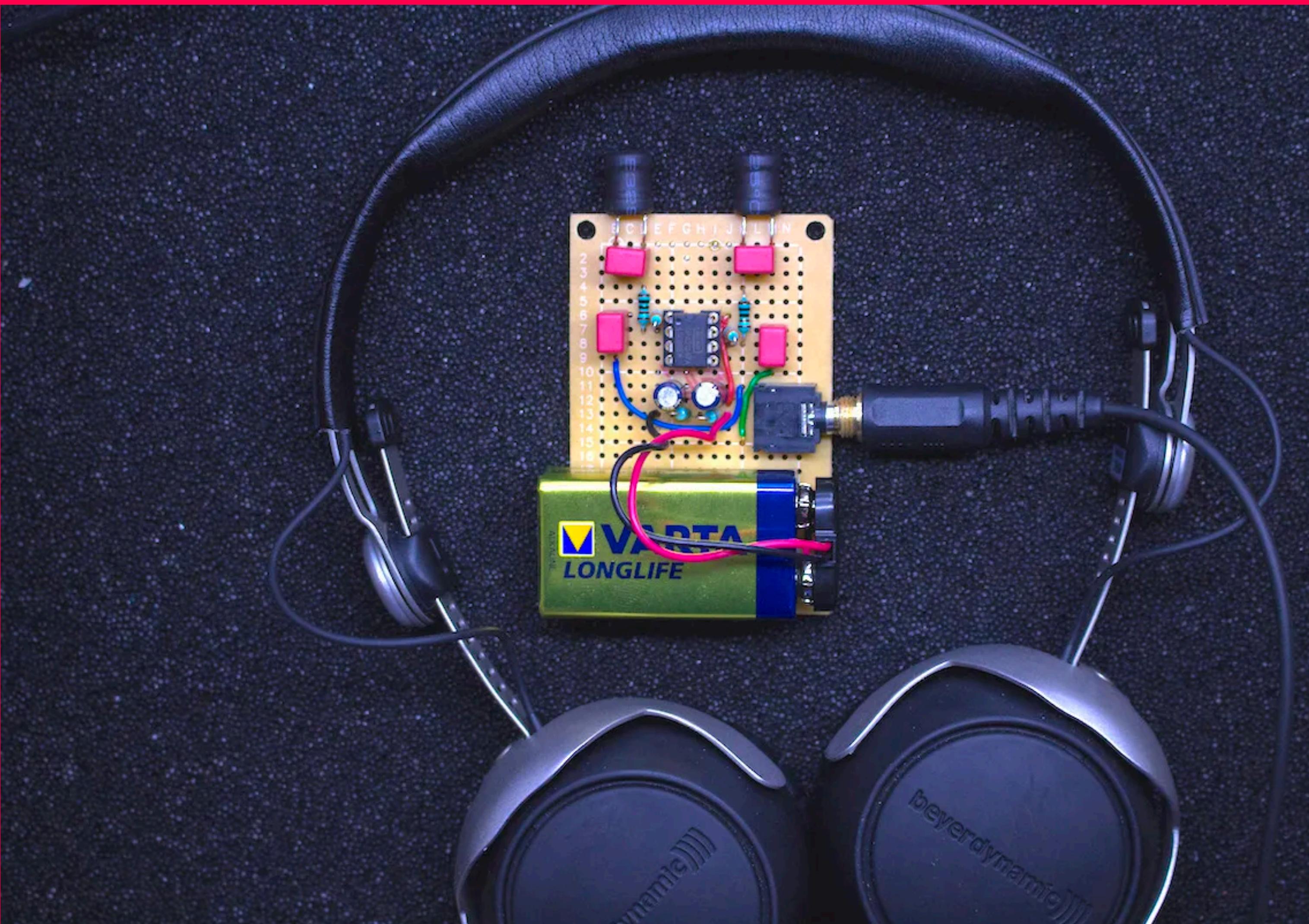
THE SCIENCE ELF INTRACTABLE

<https://www.instructables.com/Listen-to-Electromagnetic-Fields/>



JONAS GRUSKA

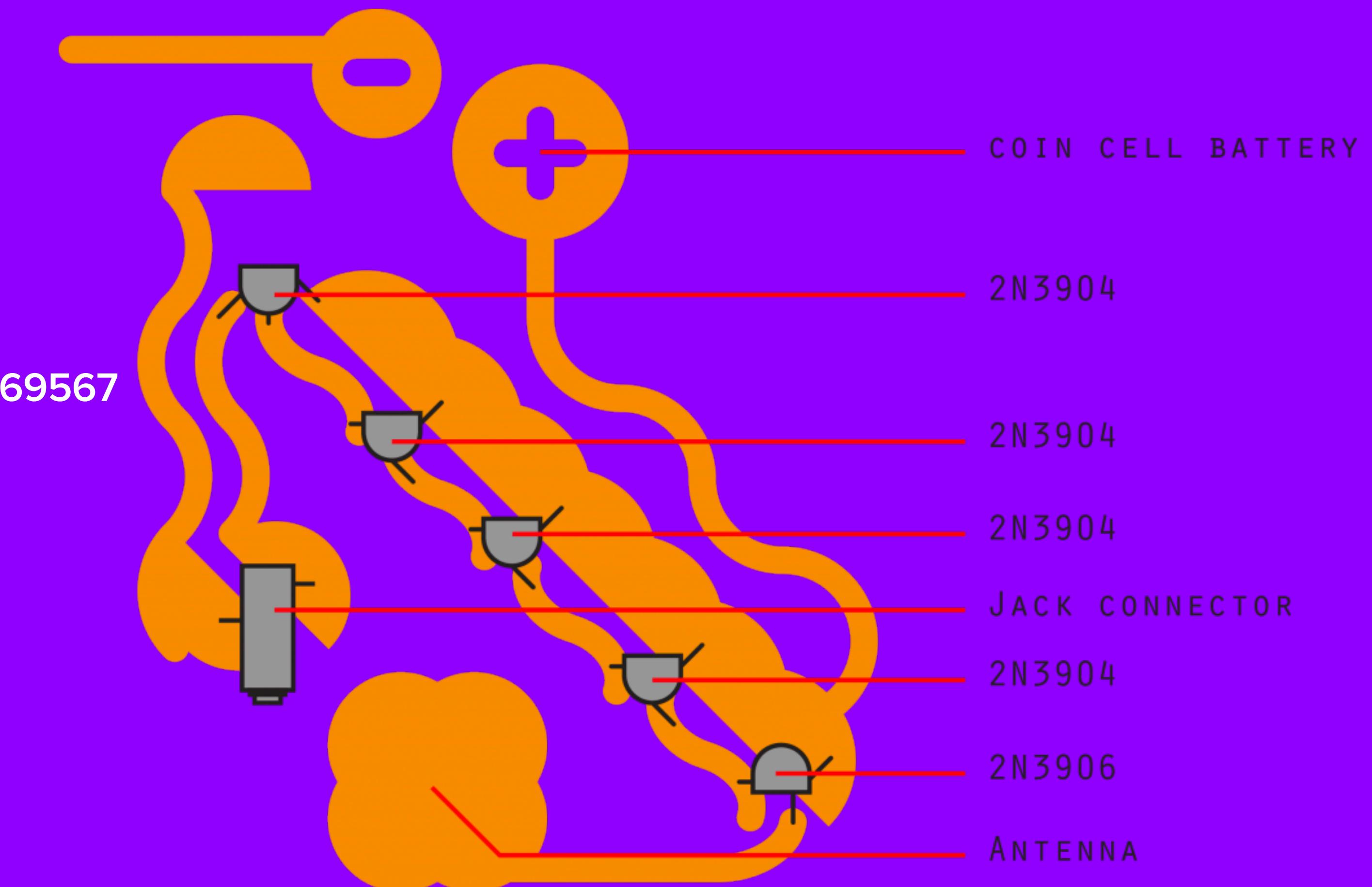
<https://makezine.com/projects/weekend-project-sample-weird-sounds-electromagnetic-fields/>



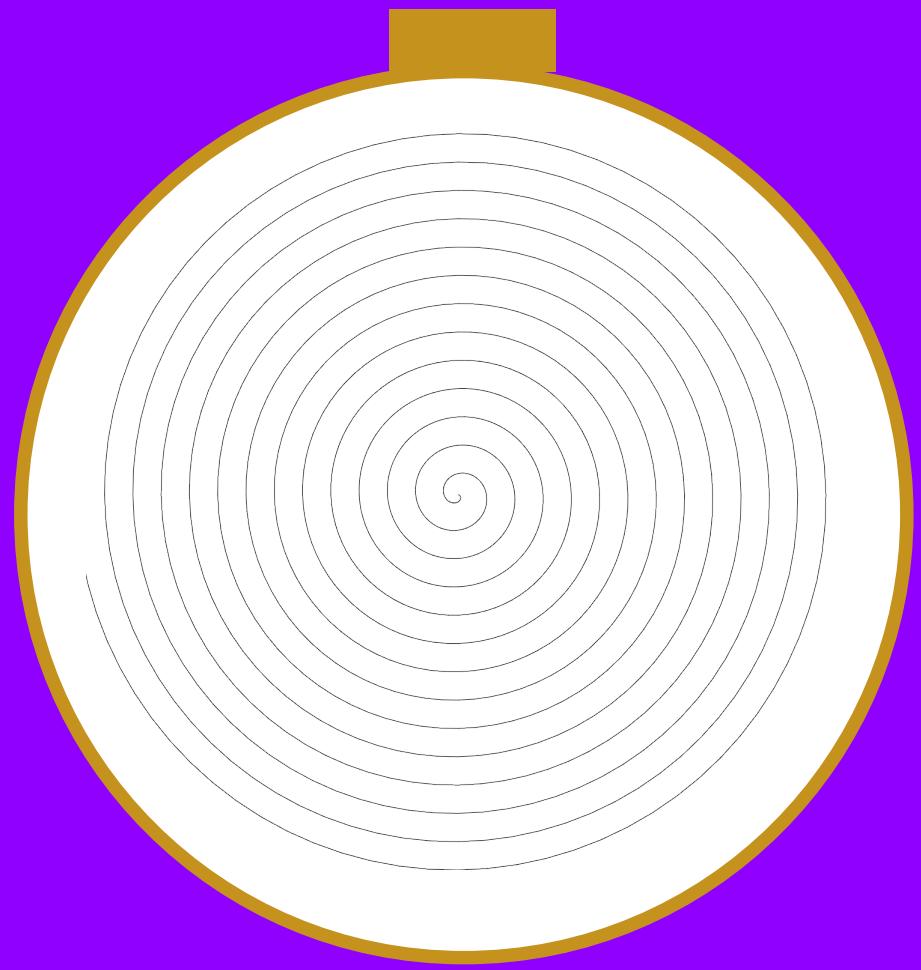
BASED ON E-TEXTILES CIRCUIT BY AFRODITI PSARRA AND MARTIN DE BIE

<http://etextile-summecamp.org/2016/emf/>

<https://www.flickr.com/photos/14412219@N04/24216769567>



ANTENNA COIL



Our speaker coil will act as an antenna, which picks up the EMF signals in the environment

DARLINGTON AMPLIFIER



We will use transistors to make an amplification circuit, that turns the weak signal into a loud signal

SPEAKER

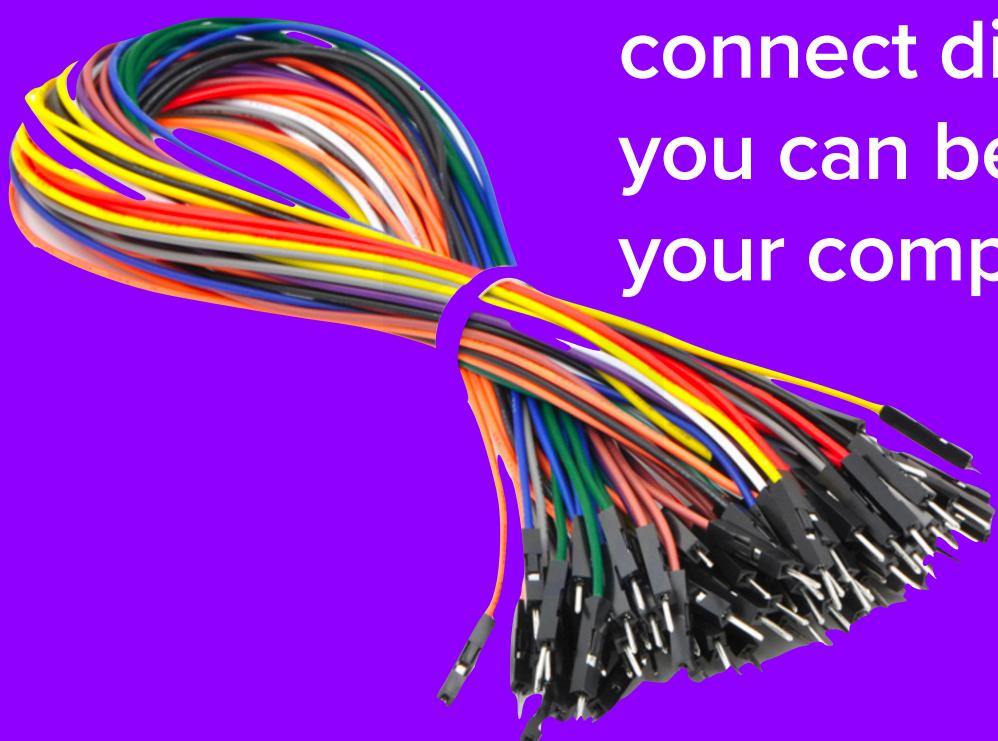


The sound will be output through your speaker or headphones!

BREADBOARDS

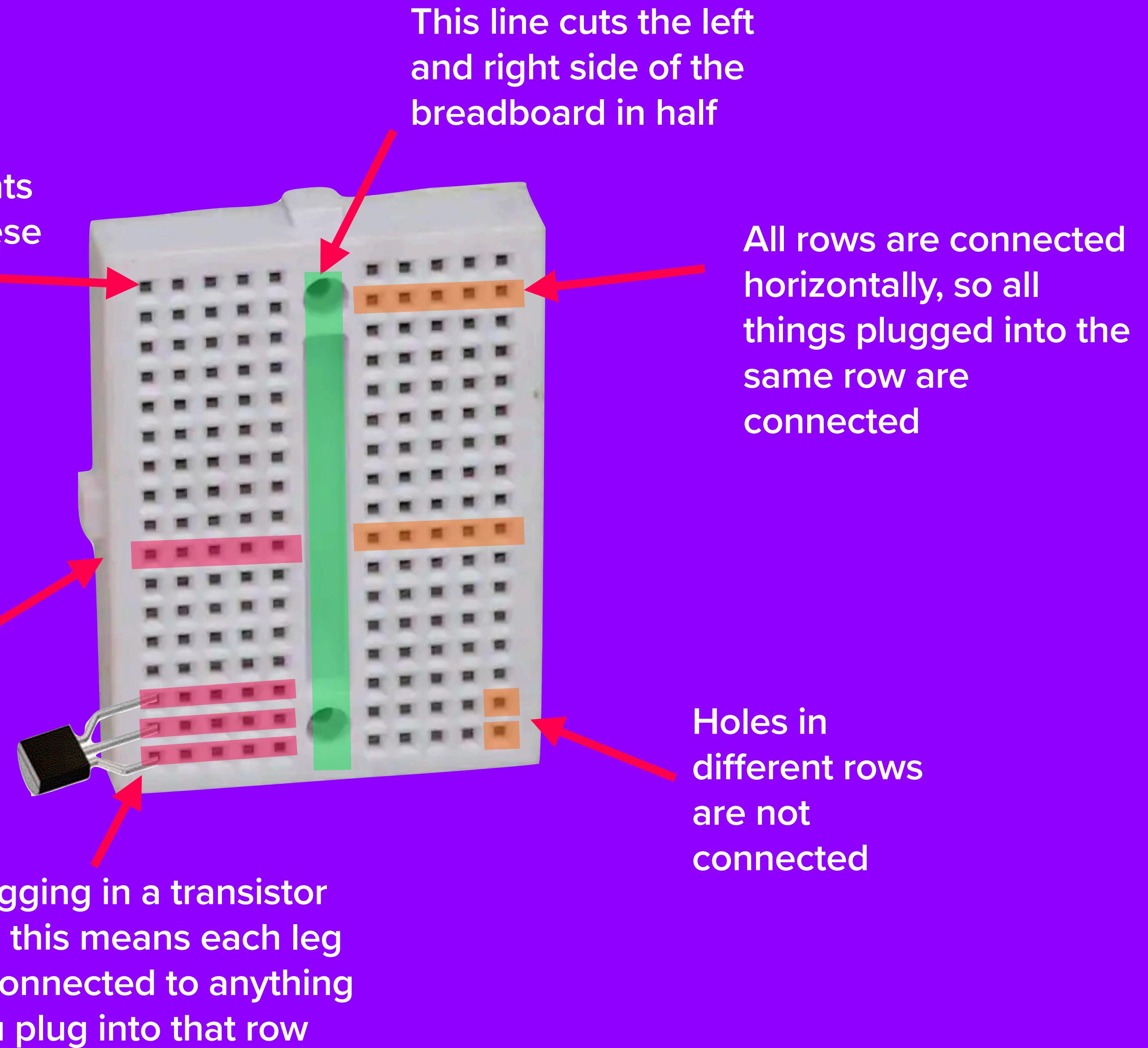
Breadboards are used to prototype circuits. You can place components on a breadboard and work with the circuit until it is finalized, then you solder or sew it down.

You can use jumper wires to connect different rows, or you can bend the legs of your components to reach.



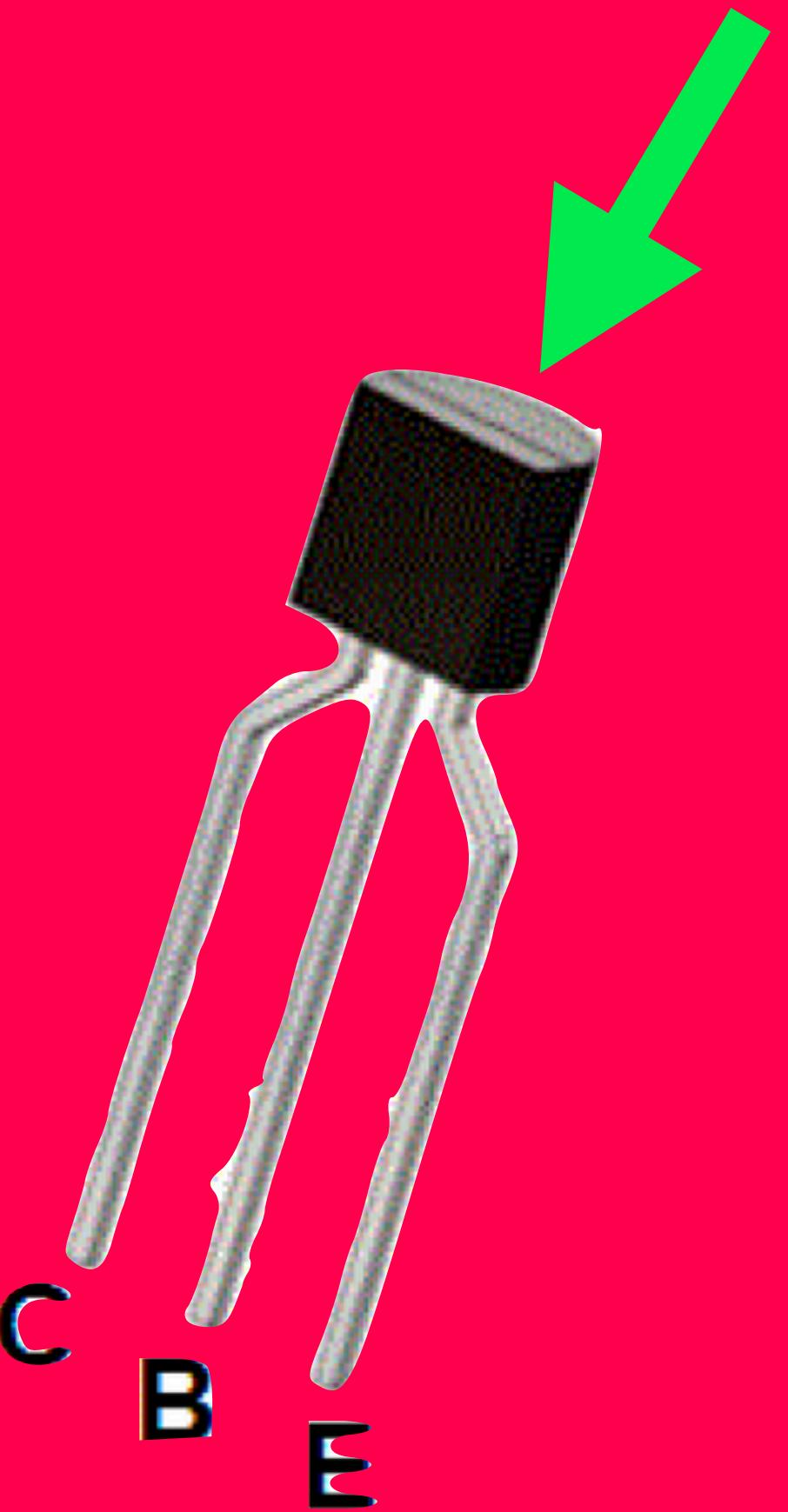
Electrical components get plugged into these holes

Only rows on the same side of the median are connected.



WHAT IS A TRANSISTOR?

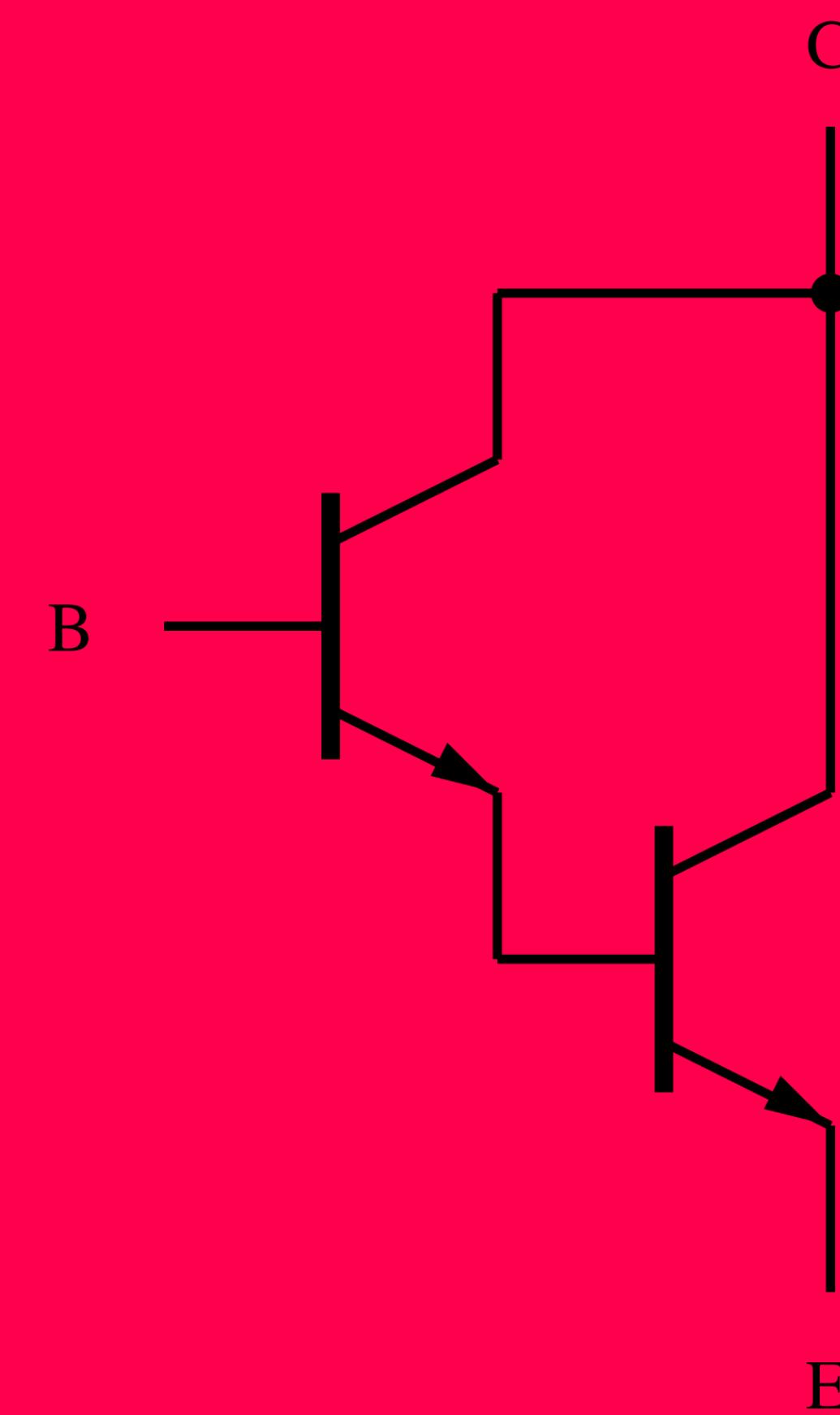
A transistor can be either a switch, or an amplifier. When it works as an amplifier, it takes in a tiny electric current at one end (an input current) and produces a much bigger electric current (an output current) at the other. In other words, it's a kind of current booster. Each leg of the transistor has a different function, so keep an eye on its orientation

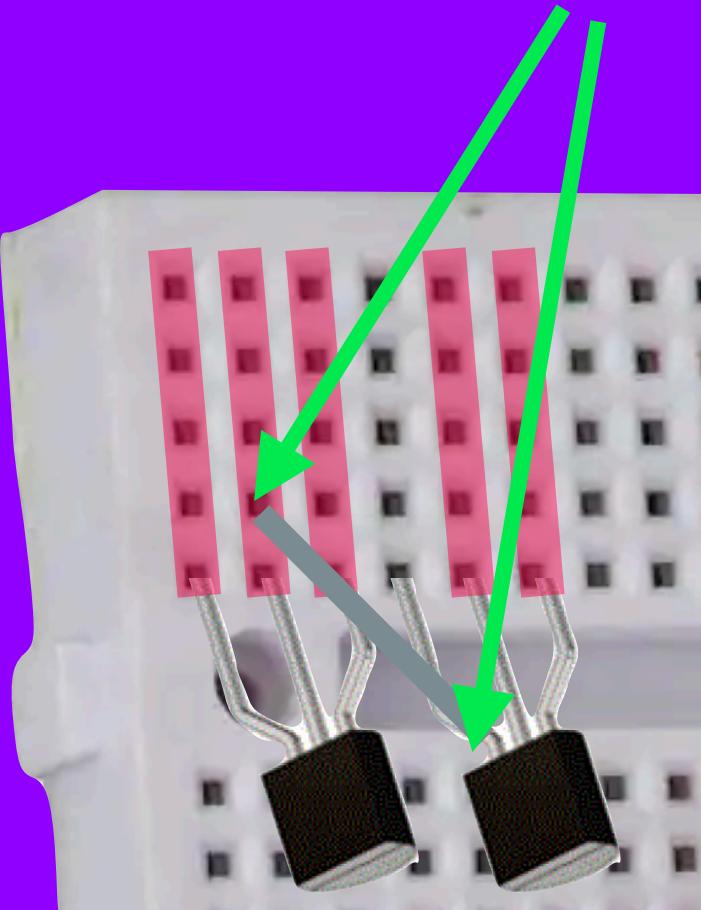


The easiest way to keep track in this tutorial is to look at the orientation of the domed side

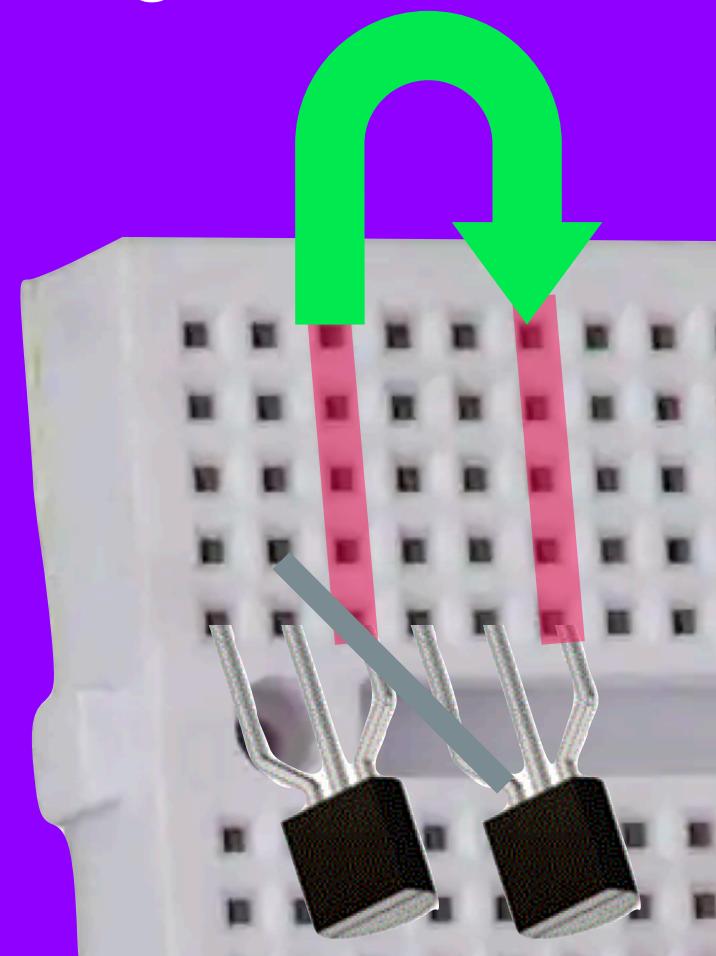
DARLINGTON TRANSISTOR AMPLIFIER

A darlington amplifier takes the higher output from the previous transistor, and amplifies it again in a chain. This doesn't work well for every type of amplifier, but its simple enough for our purposes!

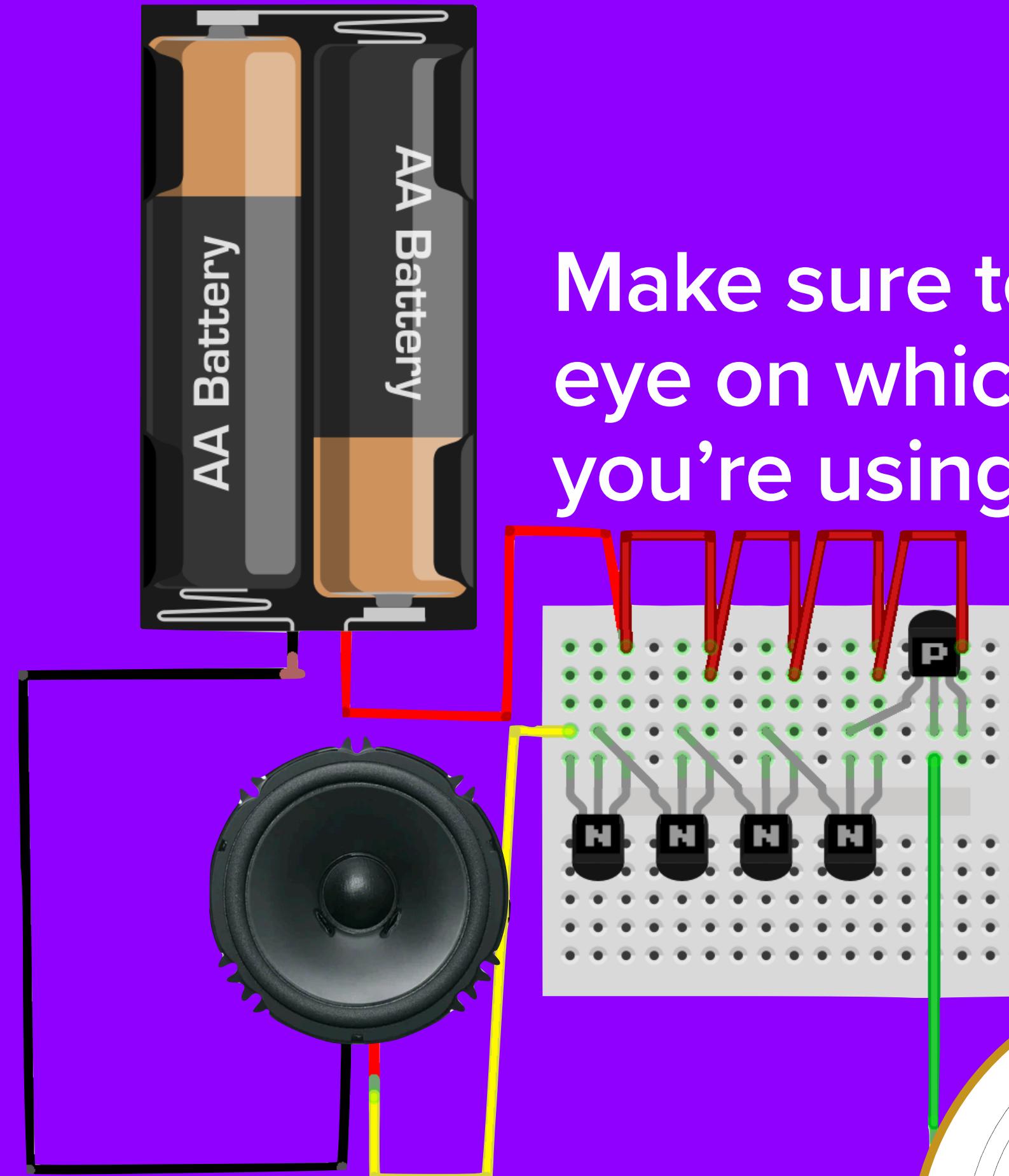




The leg of the second transistor goes in the middle row to the previous transistor

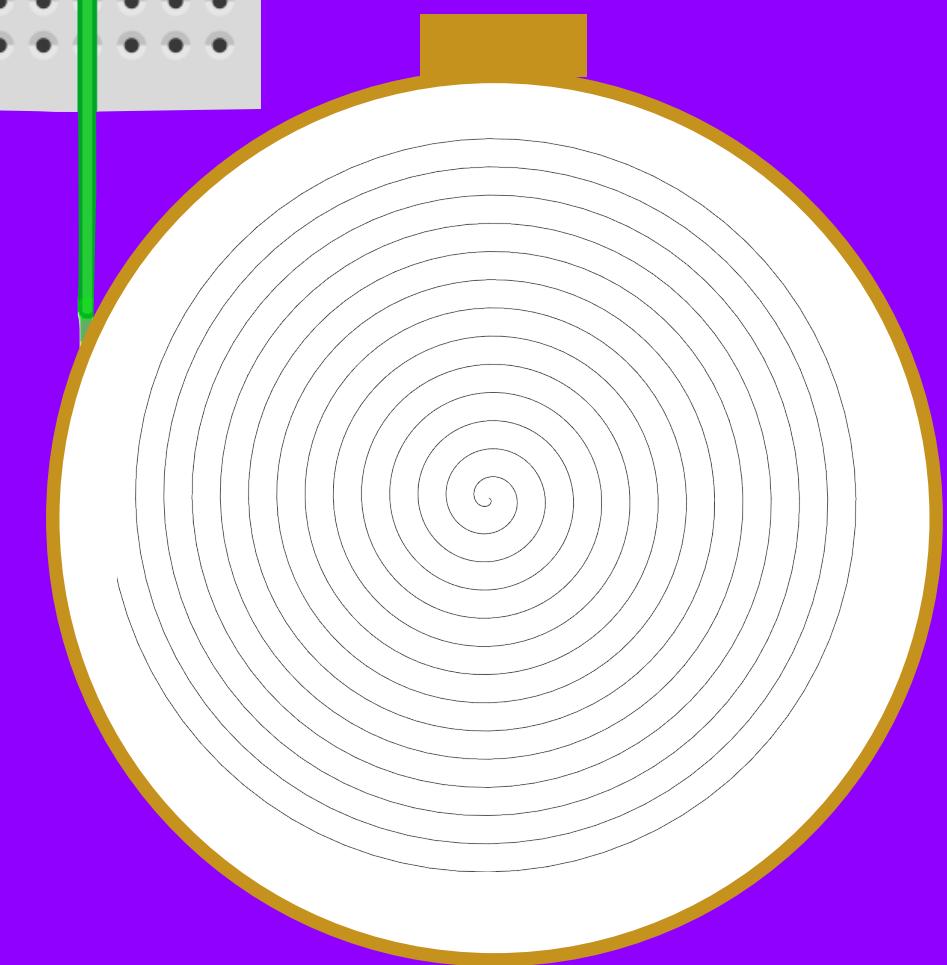


The third leg of each transistor is connected to + of the battery, use jumper wires to chain them together



Make sure to keep an eye on which transistor you're using

Speakers or headphones



Coil or other antenna

**ANTENNAS AS SPEAKERS
SPEAKERS AS ACTUATORS
ACTUATORS AS ANTENNAS**

PROJECT BREKAOUTS:

1. NEXT WEEK IS PRESENTATION WEEK

2. WHAT DO YOU WISH WE LEARNED MORE ABOUT?