The Physics of Musical Instruments / Science on Stage

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Speaker / Dynamic Microphone

Materials: Thin enameled copper wire, a magnet, banana wire, crocodile clips, guitar cable, audio interface (or an amplifier or a stereo system), paper cups (or muffin papers), scotch tape and a base made of something insulating (cardboard is fine).

1. Make a coil from the enameled wire. Ten turns is enough, but the more the better as long as the coil doesn't get too heavy.
2. Attach the coil to the bottom of the paper cup so that the ends of the wire are 5 cm long.
3. If the speaker cone can be supported from the ends of the wire, grab them with the crocodile clips and attach the clips to the cardboard base.

4. Slide your magnet beneath the speaker cone (coil + paper cup) so that the speaker cone can freely vibrate.
5. Connect the banana wires to the crocodile clips.
6. Connect the other end of the banana wires to the guitar cable via crocodile clips. So that the other wire is connected to the tip of the plug and the other to the base of the plug.
7. Connect the guitar cable to whatever sound source you have and play some music!

Further experiments

- Use the speaker as a microphone by connecting it to the input of an audio interface. It will work, but you will most likely need to shout.
- Build a box around the speaker cone to minimize acoustic shortcuts
- Record audio played through the speaker and compare its spectrum to the original audio.

Oboe

Materials: Paper or plastic straws, scissors

1. Squeeze the other end of the straw and cut that end into a triangle.


2. Make sure the cut end is still squeezed, but slightly open at the tip
3. Place the triangle end inside your mouth and blow.

Further experiments

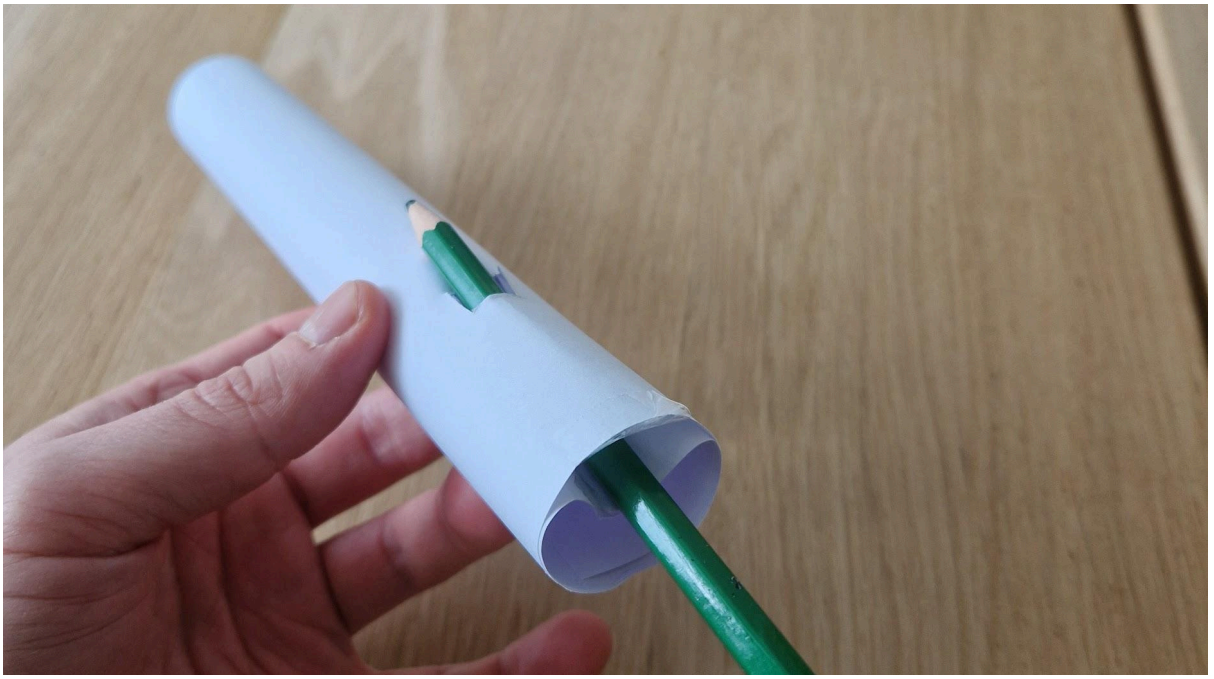
- Vary the length of the reeds by making different sized trangles?
- Cut the straw shorter while playing it or make it longer by attaching another straw.
- Analyze the spectrum of the sound. Can you see the frequency of the reed and the standing waves in the air column?
- Calculate the wavelength of the main frequency and measure the length of the straw. How are they related?
- Make flute-like holes for fingers and try to play a melody.

Paper recorder

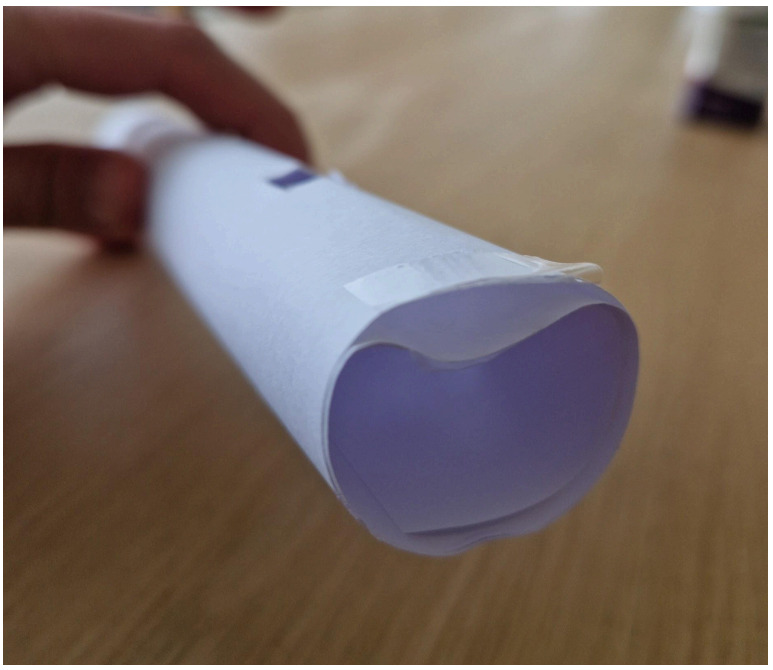
Materials: A4-size sheet of paper, scissors, scotch tape

1. Roll the sheet of paper into a pipe so that the length of the pipe is the shorter side of the sheet and the diameter of the pipe is approximately 3 centimeters.
2. Hold in shape with scotch tape.
3. Cut a square-shape tone window (1cm x 1cm) approximately 5 cm the end of the pipe so that the seam is on the opposite side of the tone window.

4. Separate the most outer layer of paper from the others from the blowing end to the tone window. A pencil is very useful for this. This airway is the blowing hole of the recorder.



5. Place a very small piece of scotch tape to fold over the top of the blowing hole and another one to fold over the bottom of the blowing hole. These pieces of tape will help hold the blowing hole open and keep the paper dry.



6. Make finger holes. Make them small enough so you can cover them fully with your fingers.

7. Play the recorder by blowing into the blowing hole while simultaneously covering the larger hole underneath it with your chin. If the recorder doesn't work (very likely!), it is most likely due to the airway not remaining open. Do the thing with the pencil again or place a piece of paper straw into the airway to keep it open.

Further experiments

- Make a bigger recorder from an A3-size paper!
- Make more recorders to experiment with the finger hole placement and size.
- Record and analyze the sound of the recorder. Calculate the wavelength of the main frequency and measure the length of the pipe. How are they related?