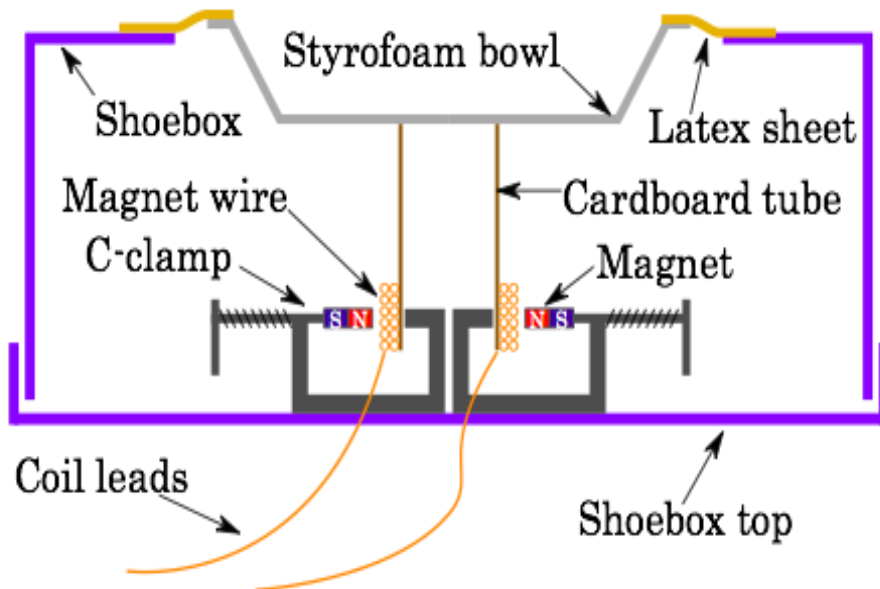


# The Singing Shoebox: A Basic Speaker

*Designed by Dr. Scott Porter*



## Necessary parts

- Shoebox with removable top (at least 16 cm long from front to back)
- Toilet paper tube (or paper towel tube cut in  $\frac{1}{2}$ )
- Latex sheet (15 cm x 15 cm)
- Styrofoam bowl (15 cm across)
- 14 neodymium disc magnets
- Two 1" c-clamps
- Magnetic wire (about 20 meters of 26 AWG)

## Instructions

1. Using the bowl as a guide, cut a circular hole with a craft knife in the bottom of the shoebox as shown in Figure 1.



- Wrap the wire around the toilet paper tube at the end, 70 times around, making sure to leave some extra on both ends. Make sure the whole coil is about 2 cm wide. Secure the coil with tape.



- Calculate the length of the toilet paper tube that you need

- $L = \text{height of the inside of the box} - 6.7 \text{ cm}$

- Example:  $L = (10.5 \text{ cm}) - 6.7 \text{ cm} = 3.8 \text{ cm}$**

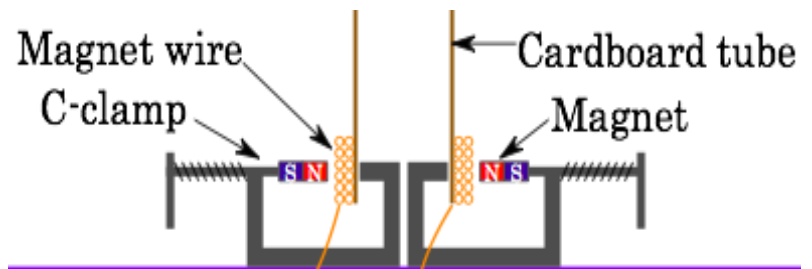
- Cut toilet paper tube to length  $L + 1 \text{ cm}$ . You need an  $L$ -length barrel that you can glue to the bowl. So, mark off  $L$  of what's left (including the coil), and make slits to that point, so that you can fold it like this.



- Cut off about half of the rim of the Styrofoam bowl all the way around
- Use hot-glue to glue the cut end of the toilet paper roll to the bottom of the Styrofoam bowl. The coil should be on the opposite end.

- Use the toilet-paper roll as a guide for where to place the clamps.

- Use hot-glue to secure the clamps to the bottom of the shoebox



- Attach 7 magnets to each side, adjusting the clamp so that there's still room for the cardboard tube and coil. Make sure either the N side of one set of magnets is facing the N side of the other, or the S side is facing the S side. This is easy to check, just by holding the magnets close to each other.

- Make sure that the magnets will be pointing towards the center of the coils, as shown in the diagram above.

- Place the bowl face-down on a 15 cm x 15 cm sheet of latex, and use hot-glue around the edge to attach the bowl to the sheet.

- Once the glue has dried, use scissors to cut the latex from in front of the bowl.

- Tape the latex (with gentle tension) to the top of the shoebox, so that the coil moves freely between the magnets and c-clamps.

- Poke 2 holes using a pencil through the shoebox, and run the ends of the wire through the holes. Use scissors to gently scrape the enamel off of the wires, so that you can see the copper wire underneath.

- Test your speaker!