

The Singing Shoebox



E/M in Action

Zachary Blackwood

<http://blackary.com/shoebox>



Why loudspeakers?

Familiar devices

Simple devices

Illustrate fundamental principles

Cross-discipline

Relatively low-cost

Many educational levels

Well understood physics



Source

Dr. Scott Porter – Penn State (now at Apple)

Published by Acoustical Society of America

Design criteria:

Inexpensive

Dissectible

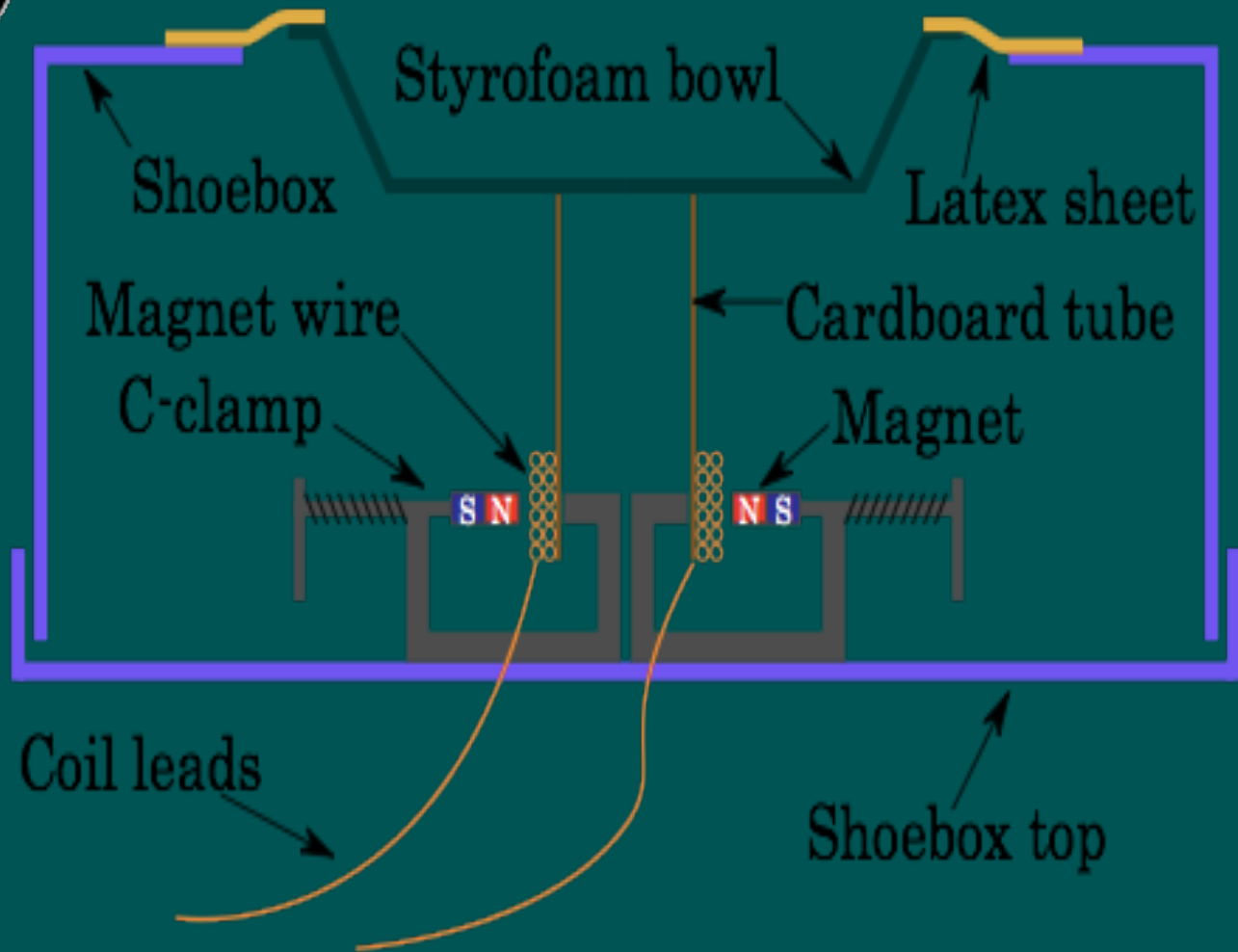
Ordinary materials

Costs & Supplies



Part	Supplier	Number	Price	Per Speaker	Notes
Shoebox	Uline	S-10586W	\$59/25	\$ -	Shoebox needs to have removable top, and be at least 6" wide. Have students provide
Cardboard Tube	??			\$ -	Have students provide
Styrofoam bowl	Grocery store	-	\$3/50	\$ 0.06	
Magnet wire	Amazon	-	\$18.09/(1 lb spool)	\$ 0.90	Good for making lots of speakers (~20)
Neodymium Magnets	Amazon	N42	\$17.29/100	\$ 2.52	Used 14 for each.
C-clamp	Hardware World	1410	\$1.54	\$ 3.08	
Latex sheet	McMaster-Carr	8611K14	\$7.32/(3.5 ft x 1 ft.)	\$ 0.73	Substitute nitrile to avoid allergy issues? Was able to make ~10 from 1' x 3.5' sheet
Total Cost per box				\$ 7.30	

Design



Design - whole



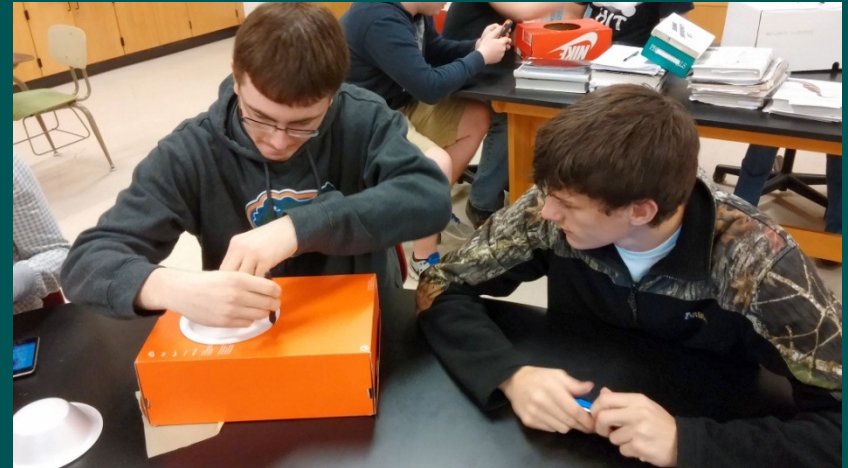
Design - parts



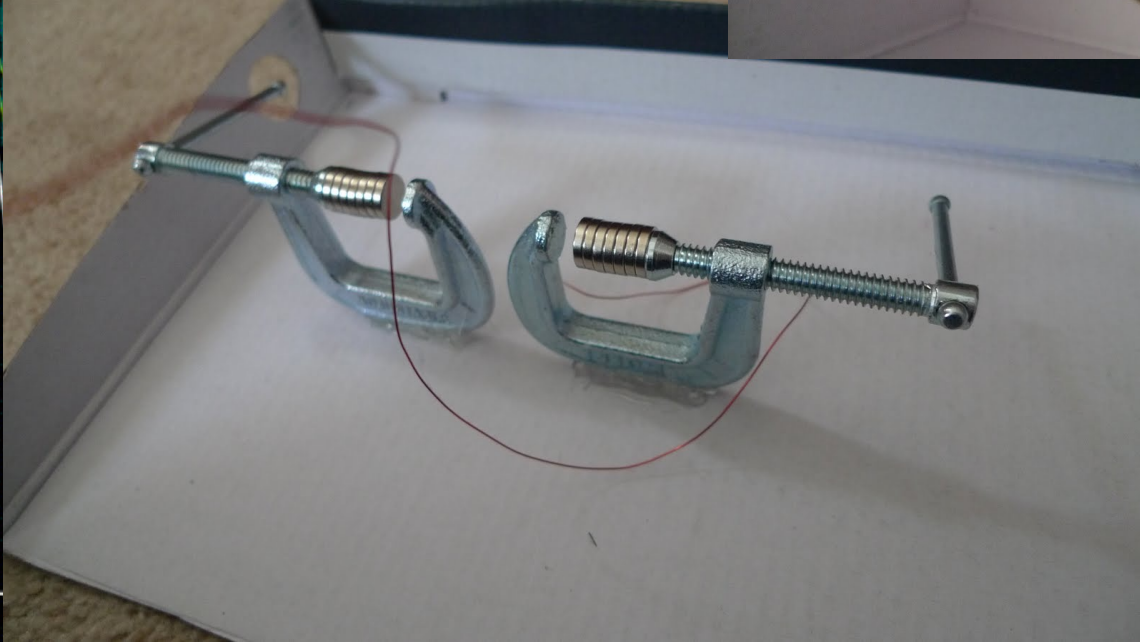
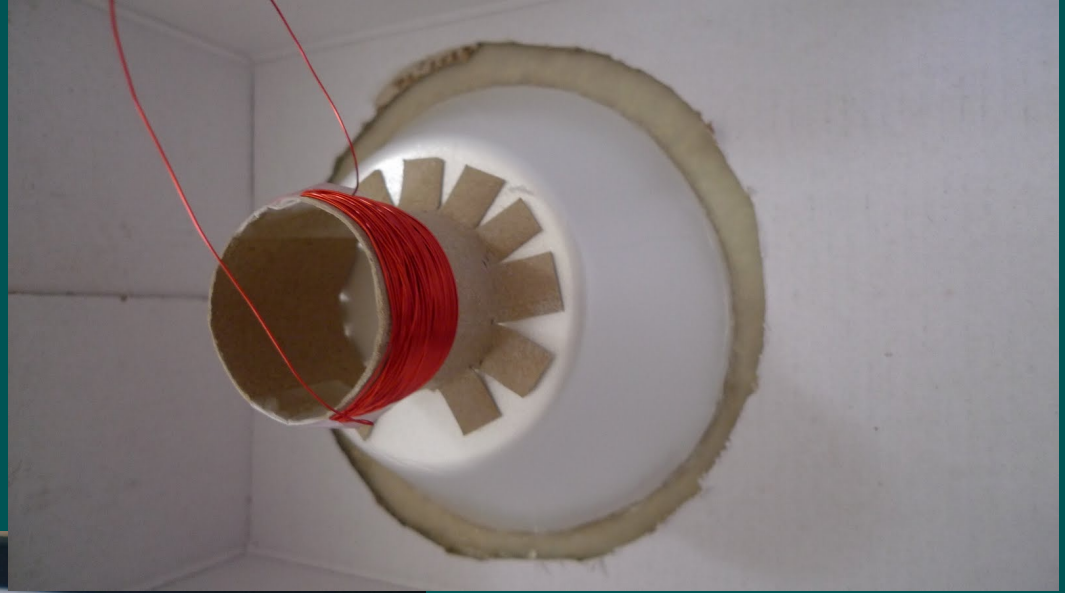
Performance



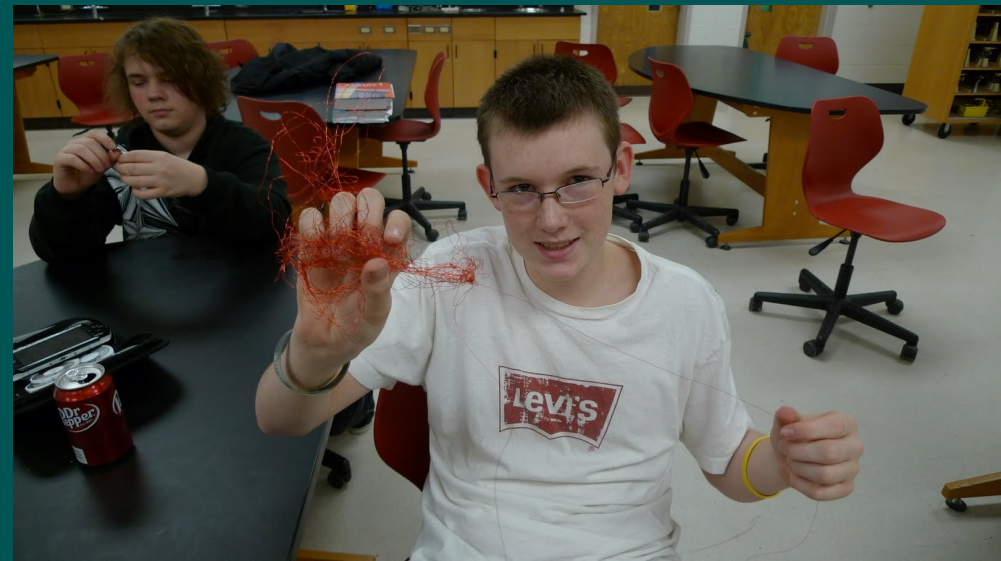
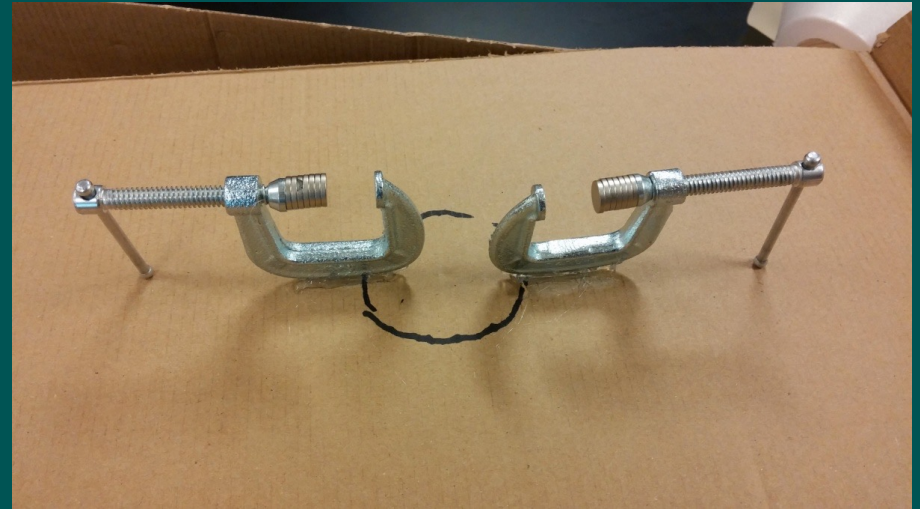
Student Engagement



Take Care



Common Mishaps





Variables

- Box size
- Number of coils
- Input impedance
- Frequency range



Questions?

- zacharyblackwood@gmail.com
- I'll be happy to forward any detailed questions to Dr. Porter
- Files are at <http://blackary.com/shoebox>