

STEM ACTIVITY 6 BUILD A CELL PHONE SPEAKER

BUILD AN AMPLIFICATION DEVICE FOR A CELL PHONE

REDIRECTING AND REINFORCING SOUND

Can you design a non-electrical device to amplify the sound of a cell phone?

Sounds are all around us—the quiet rustling of leaves, the whisper of a gentle breeze, the hum of a plane overhead, and the wail of a fire truck. Sometimes, we want to reduce the volume because we are trying to sleep, read, or hear something else. At other times, we want to amplify sound. Some musicians use amplifiers, police use bullhorns, and announcers use public address systems. All of these are examples of electrical amplification.

Sound can also be amplified without using electricity. If you have ever visited Washington D.C., you may have visited the US Capitol building, which houses the Whispering Hall—the National Statuary Hall. The curve of the hall's ceiling amplifies and directs sound to different spots in the room. While this may be fun for tourists visiting the Capitol, it was once a serious issue for politicians when Congress debated in that hall. Politicians thought they were privately whispering with each other, but a properly positioned opponent could easily listen to their conversation. In this activity, you are going to design a non-electrical amplification device for a cell phone.

DESIGN PARAMETERS

Note: Record all parameters, notes, designs, data, calculations, analyses, and conclusions in your project log.

- 1 Your teacher will provide a list of materials from which you may build your device. If you desire to use any other materials, you must get the approval of your teacher.
- 2 Your teacher will show you the marked locations for the tone-generating device and the sound-measuring device.
- 3 Your teacher will specify the three frequencies and the baseline (no amplification) sound level for testing.
- 4 Your amplification device must be less than 12 in. cubed.

Key Questions

- » How can shapes of containers affect sound?
- » Can sound be reinforced without using electricity?
- » How does the size of the device affect the sound?

Equipment

Tone-generating device
Sound-measuring device
Construction materials as specified by teacher

PROCEDURE

Planning the Design

- 1 Research sound conduction, reflection, and amplification.
- 2 Familiarize yourself with the available materials.
- 3 With your team, test different materials, shapes, sizes, etc.
- 4 Individually draw a design for an amplification device.
- 5 Discuss the different designs with your team members and come to a consensus on a team design.
- 6 With your team, construct your amplification device.

Testing the Device

- 1 Confirm baseline data by setting up the tone-generating device and sound-measuring device. Turn on the tone-generating device and adjust the volume until the desired decibel reading registers. When you have recorded the baseline data, turn off the tone-generating device.
- 2 Install your amplification device, turn on the tone-generating device, and record the measurement on the sound-measuring device.
- 3 Repeat Steps 1 and 2 for the other two frequencies.
- 4 Calculate the effectiveness of the device. As a team, decide what calculation would demonstrate the effectiveness of the amplification device.
- 5 Calculate the average effectiveness from the three trials.
- 6 Discuss your device's performance with your team members, update the plan drawing, and make modifications as needed.
- 7 Retest the device by repeating Steps 1–5.
- 8 Share your data with the other teams. Compare the different teams' results, analyze your designs, and suggest reasons for the differences.

Data Table

Trial	Frequency	Baseline decibel level without device (dB)	Decibel level with device (dB)	Calculated effectiveness	Given that an increase of 10 dB is 10x more intense, how much more intense is the sound?
1					
2					
1					
2					
1					
2					
1					
2					
1					
2					
1					
2					