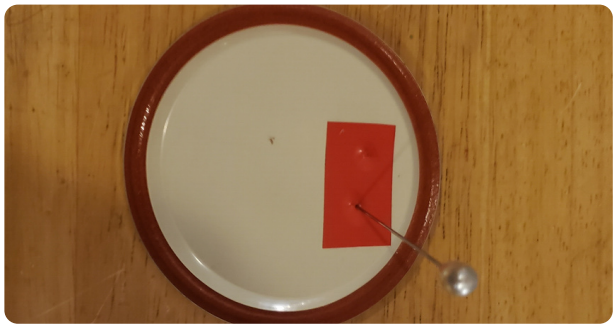
Teacher Prep

Follow the steps below to prepare buzzers for students.

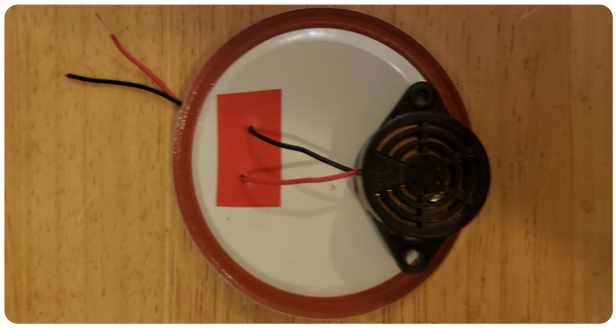
Drill two small holes off to the side but next to each other in the mason jar lid. This is where the wires from the buzzer will come out of the jar.

Place a piece of electrical tape over the two holes on the under side and the top side of the lid.

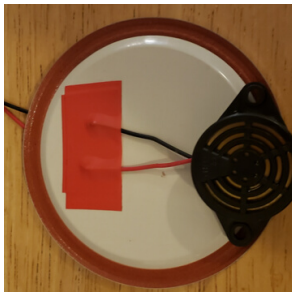
Use a pin to poke holes through the electrical tape where the holes are. This will help keep the air molecules in the jar separate from the air molecules in the room.

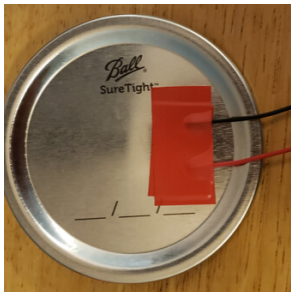


Push the wires from the buzzer through the holes in the tape and lid so that the buzzer is on the under side of the lid.



Put another piece of tape to hold the wires in place on the under side and the top side of the lid.





Sound

Sound is made up of vibrations, called sound waves. Sound is created when something vibrates and sends waves of energy into our ears. The vibrations travel through the air or into your ears. The stronger the vibrations, the louder the sound.

Because sound travels through the molecules in the air, changes in air molecules can change the way things sound. Changes in air molecules are called air pressure, which is measured in millibars (mbar).

Air pressure depends on the number of air molecules and how fast they are moving. There is more pressure when there are more air molecules, and there is more pressure when the molecules are moving faster. For example, an atmosphere that doesn't have many air molecules and the molecules are moving slow, there won't be much air pressure.

Sound on Different Planets

Sound can vary on different planets. Here are some examples:

The Moon

- The air pressure is approximately 1 mbar.
- There very few air molecules in the atmosphere of the Moon.
- If something makes a noise, the astronaut won't hear anything.
- This is because there are not enough air molecules to collide to make an audible sound.

Mars

- The air pressure is approximately 6 mbar
- There are fewer molecules than on Earth, but more molecules than on the Moon.
- Astronauts will hear a sound. The sound won't be as loud as it would be on Earth, but they will hear some noise.

Testing Sound

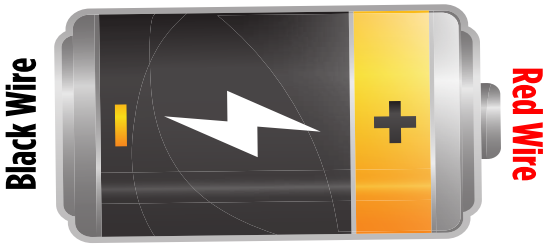
Follow the steps below to investigate how changes in air pressure affect sound.

Step One: Download Noise Meter App

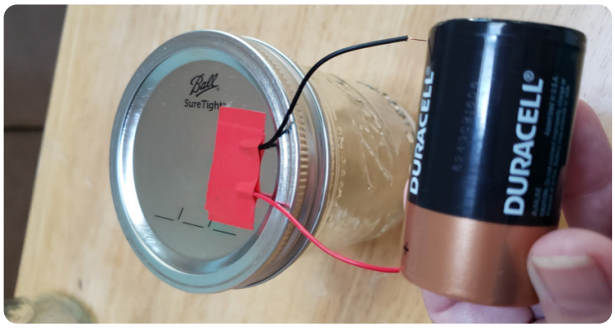
- Open your App Store on your smartphone or tablet.
- Go to the search bar and type in “noise meter."
- Download the noise meter app on your device.
- Here are links for the apps we suggest:
  - Apple https://itunes.apple.com/us/app/decibel-x-db-dba-noise-meter/id448155923?mt=8
  - Android https://play.google.com/store/apps/details?id=com.gamebasic.decibel&hl=en_US

Step Two: Test Noise Level of Buzzer

- Test the level of the noise in the room by turning on the noise meter on your smart phone. Record all noise level values in the table below.
- Acquire your prepared buzzer from your teacher.
- Test the buzzer when it is attached to the lid, but not sealed in the mason jar. To do this, hold the black to the negative (flat) end of the battery and the red wire to the positive end of the battery.



- Turn on the the noise meter app on your smart phone. Record the level of noise you hear from the buzzer when it is attached to the lid.
- Next, seal the buzzer inside the mason jar by screwing the lid onto the mason jar. Make sure the buzzer is hanging inside the mason jar without touching the sides of the mason jar.



- Test the buzzer when it is sealed inside the mason jar by holding the wires to the battery and turning on the noise meter app on your smart phone.

Testing Sound in Space

Step Three: Test Low Air Pressure

- Remove the buzzer from the jar by unscrewing the mason jar lid and removing the lid.
- Place a tea candle in the bottom of the mason jar.

- Light the tea candle and let it burn for 15-20 seconds. This will heat up the air in the mason jar.

- Seal the buzzer in the mason jar with the burning candle by screwing the lid onto the mason jar. The candle will go out within a few seconds as it burns up all of the oxygen in the mason jar. When the candle goes out, the air in the container will quickly cool off.

- Test the buzzer when it is sealed inside the mason jar by holding the wires to the battery and turning on the noise meter app on your smart phone. (The candle will probably go out before you get a chance to test the buzzer!)
- Wait 2 minutes and then test the buzzer again.
- Place the mason jar in the shallow bowl of ice water.
- This will cool the air in the mason jar even more. Wait 2 minutes and test the noise level again.

- Repeat these steps two more times for a total of 3 trials.

STEM CAREER ADVENTURES

Data Table

	Noise Level in dB		
	Trial 1	Trial 2	Trial 3
Noise in the Room			
Buzzer Attached to the Lid (Jar Open)			
Buzzer Sealed in Empty Jar			
Buzzer Sealed in Jar with Lit Candle			
Buzzer 2 Min Sealed in Jar with Lit Candle			
Buzzer in Jar in Ice Water			

Step Four: Writing a Training Video Script

You will now write a script that you will use during your astronaut training video. Plan your ideas below.

Opening:

You should introduce yourselves and explain that you are a NASA Engineer. You should also explain that you will be teaching new astronaut recruits about how sound works on other planets. Write 2 or more sentences that you will say for your opening.

Middle:

You should explain the results of your experiments and what you learned about how sound works in space. Make sure you talk about the following:

- The results of your experiment.
- The relationship between air pressure and sound.

Write 3 or more sentences that you will say in the middle of your episode.

Closing:

You should tell astronauts that your training video is over and wrap up your video. Make sure to wish astronauts luck at the end! Write 2 or more sentences that you will say for your closing.

Step Five: Record Training Video

Use a smartphone or tablet to record your training video!

STEM CAREER ADVENTURES

Teacher Key

Answers will vary greatly, but this handout helps explain why different conditions create different results.

	Noise Level in dB		
	Trial 1	**Trial 2**	**Trial 3**
Noise in the Room	This is the background noise in the room, even when its super quiet there is always some noise, like from a clock ticking or people breathing. Sound happens when energy is transfered by waves of molecules hitting each other.		
Buzzer Attached to the Lid (Jar Open)	The buzzer attached to the lid but not in the jar yet is the loudest. The buzzer is sending energy through the air molecules as sound.		
Buzzer Sealed in Empty Jar	The buzzer attached to the lid and then sealed in the jar is the second loudest. The buzzer is sending energy through the air molecules as sound, but some of the energy is absorbed by the sides of the jar so there is less sound energy outside of the jar.		
Buzzer Sealed in Jar with Lit Candle	The buzzer sealed in the jar with the lit candle is quieter than before the lit candle was added. The candle heats the air, causing the air molecules to move faster and spread out. When the buzzer attached to the lid is sealed inside the jar, there are less air molecules and they are faster and more spread out than before the candle was lit. Because the air molecules are more spread out, they don't bump into each other as often so they don't transfer the sound energy as well and the sound level goes down.		
Buzzer 2 Min Sealed in Jar with Lit Candle	As the air in the jar that was heated by the candle cools down, the air molecules are still spread out PLUS they are moving slower. Because the air molecules are moving slower, they don't transer the sound energy as well and the sound level goes down even more.		
Buzzer in Jar in Ice Water	When the jar is placed in ice water, the the air in the jar cools down even more. Now, the air molecules are still spread out and moving even slower. Because the air molecules are moving slower, they don't transfer the sound energy as well and the sound level goes down even more.		