

Visual Soundwaves

We hear sound through vibrations in the air, but have you seen these soundwaves move? Engineer a laser visualizer that recreates the different movements of sound as you talk into a vibration chamber!

TEKS:

SCI 2.6A: The student is expected to investigate the effects on objects by increasing or decreasing amounts of light, heat, and sound energy such as how the color of an object appears different in dimmer light or how heat melts butter.

SCI 3.6A: The student is expected to explore different forms of energy, including mechanical, light, sound, and thermal in everyday life.

SCI 4.6A: The student is expected to differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.

Materials:

- 11-inch balloon
- Double-sided tape
- Empty Pringles can
- Hacksaw
- Masking Tape
- Measuring tape (with both English and metric units)
- Paper
- Permanent marker
- Pliers
- 6 feet of PVC pipe (0.5-inch diameter)
- 2 PVC pipe elbows (0.5-inch diameter)
- 3 PVC pipe T-joints (0.5-inch diameter)
- Red laser pointer with low power output (0.6-inch diameter) – can be purchased [here](#)
- 2 rubber bands (size #64)
- Safety goggles
- Scissors
- Small plastic mirror – can be purchased [here](#)
- Optional: PVC cutter

31 Days of STEM FUN!

www.destember.org | [#deSTEMber](https://twitter.com/deSTEMber) | © 2018 by Girlstart www.girlstart.org

DeSTEMber is a trademark of Girlstart

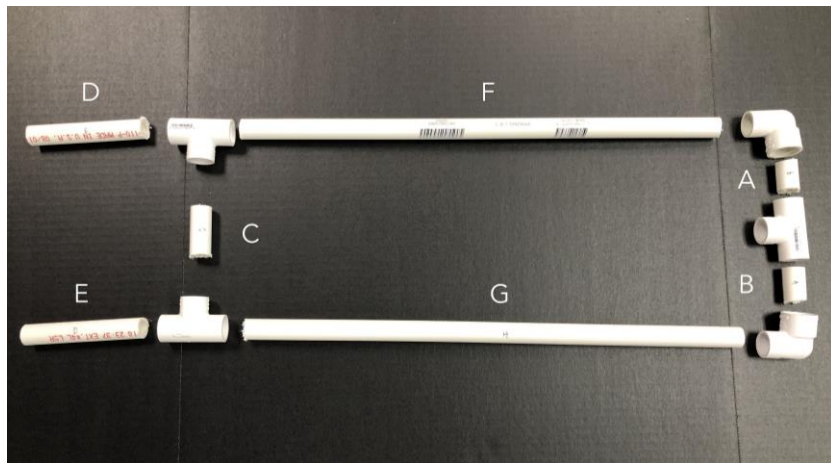
How To:

Preparation

1. Using a PVC cutter or hacksaw, cut the PVC piping into the following pieces. **Safety: An adult should assist when using a PVC cutter or hacksaw.**
 - Piece A – 1.25 inches
 - Piece B – 1.25 inches
 - Piece C – 2 inches
 - Piece D – 4.75 inches
 - Piece E – 4.75 inches
 - Piece F – 20 inches
 - Piece G – 20 inches
2. Using the hacksaw, cut the empty Pringles can to a length of 4 inches. **Safety: An adult should assist when using a PVC cutter or hacksaw.**

Making the frame

1. Arrange your cut pieces of 0.5-inch PVC piping, T joints, and elbows on a large flat surface. Follow the image guideline below to connect the pieces.



2. Fit the pieces of PVC together snugly. When completed, the frame should make an elongated trapezoid shape.

Making the vibration chamber

1. Stretch out your balloon by pulling the elastic material apart and by blowing the balloon up and releasing the air.
2. Using scissors, remove the neck of the balloon by cutting where the balloon begins to open wider.
3. Create your balloon vibration membrane by stretching the balloon over one open end of the Pringles can.
4. **Safety: Put on safety goggles!**
5. Wrap a piece of paper over the plastic mirror to protect your hands from any small broken pieces. Grip the corner of the mirror with pliers and twist your hand towards you (thumb down) to break off a piece of the mirror. You only need a small piece of mirror broken off, approximately 0.5 x 0.5 inches. The piece of mirror can be irregularly shaped. **Safety: An adult should assist when breaking the piece of mirror.**

31 Days of STEM FUN!

www.destember.org | [#deSTEMber](https://twitter.com/deSTEMber) | © 2018 by Girlstart www.girlstart.org

DeSTEMber is a trademark of Girlstart

- Put a small amount of double-sided tape on the dull side of the mirror piece and attach the mirror, shiny side up, to the balloon membrane. Place the mirror off center of the balloon membrane closer to its outer edge.



Putting it all together

- Position the vibration chamber parallel to PVC pieces D and E. The balloon end of the chamber should face inwards towards the frame and should be positioned along the T-joints, but not past them.
- Using two rubber bands, fasten the chamber to the frame by looping the rubber bands around the chamber and PVC pipes D and E.

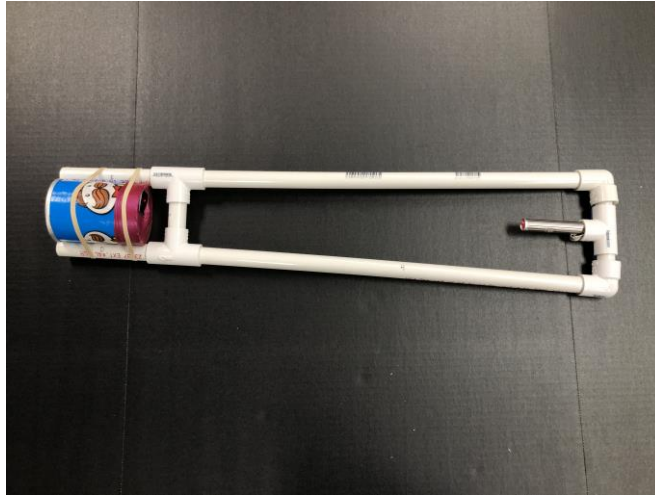


- Safety: Never point a laser at your own or anyone else's eyes!**
- Insert the laser pointer into the open end of the T-joint between PVC pipes A and B. The laser should point out towards the vibration chamber and turn on when inside the T-joint. If the laser's diameter is not thick enough, use masking tape to wrap around the laser pointer switch to thicken the diameter until it is able to stay on when put inside the T-joint.
- Aim the laser beam to hit the mirror on the vibration chamber. Turn the chamber until the mirror is positioned at the top. You can aim the laser pointer by twisting the T-joint attached below the laser pointer.

31 Days of STEM FUN!

www.destember.org | [#deSTEMber](https://twitter.com/deSTEMber) | © 2018 by Girlstart www.girlstart.org

DeSTEMber is a trademark of Girlstart



6. Once the laser is hitting the mirror, pick up the entire frame and aim the mirror/laser light at a large, flat surface, like a wall.
7. Hold the vibration chamber close to your mouth and begin speaking, humming, singing, and making different noises!
8. Discover how the laser moves as you create different sound vibrations!



STEM Explanation:

Have you ever wondered how you hear different sounds or how you make noise when you talk? It is all about the sound vibrations! Vocal cords in your throat vibrate as you talk or sing to create waves that can travel through air to your ears. Sound vibrations are invisible waves that move quickly up and down to travel as sound. When a sound motion occurs, like speaking or clapping, the molecules around the origin of the sound vibrate. As the first molecules vibrate, they hit other molecules and cause them to vibrate, creating a cascade of vibrations. Finally, the vibrations get to your brain and they can be interpreted as sound.

The visual vocalizer helps you see how different sounds create different waves and vibrations. As you speak into the vibration chamber, the vibrating air molecules from your vocal cords hit the balloon. This causes the balloon membrane with the mirror to vibrate along with the soundwaves hitting it. As the laser hits the mirror, and the mirror vibrates, different patterns of reflected light are created that allow you to visualize the soundwaves.

31 Days of STEM FUN!

www.destember.org | [#deSTEMber](https://twitter.com/deSTEMber) | © 2018 by Girlstart www.girlstart.org

DeSTEMber is a trademark of Girlstart

Since the mirror is free to move both up and down and side-to-side, it can trace harmonic motions called Lissajous patterns. These patterns create chaotic shapes like circles, swirls, figure eights, etc. that are made from different frequencies of sound. Observe how the patterns change as you change your vocal sounds by speaking louder, softer, at different pitches, and more!

Career Connection:

Acoustical engineers deal with the science of sounds and vibrations. They look for ways to limit unwanted sound and maximize desired sound. Acoustical engineers are an important part of the music industry. They can also work with auto manufacturers to help design noise control devices that reduce the sound heard inside vehicles. Architectural acoustics refers to the control of sound and vibrations within buildings. Environmental acoustics are concerned with the control of sound and vibrations generated in outdoor environments such as traffic, aircraft, and industrial equipment.

Resources:

<https://www.exploratorium.edu/snacks/vocal-visualizer?media=6128>

<https://study.com/academy/lesson/sound-vibrations-lesson-for-kids.html>

https://www.amazon.com/YSAGi-Interactive-Flashlight-Scratching-Training/dp/B077JLWMD6/ref=pd_day0_199_1?encoding=UTF8&pd_rd_i=B077JLWMD6&pd_rd_r=PFN4QQQ3GQ93QZNXVZVD&pd_rd_w=7XS5l&pd_rd_wg=FTBzv&pvc=1&refRID=PFN4QQQ3GQ93QZNXVZVD

<https://www.homedepot.com/p/3-in-x-10-ft-Drain-Pipe-Solid-3550010/100185642>

31 Days of STEM FUN!

www.destember.org | [#deSTEMber](https://twitter.com/deSTEMber) | © 2018 by Girlstart www.girlstart.org

DeSTEMber is a trademark of Girlstart