

Sound Waves

Sound

Materials:

- Lissajous Generator
- Tripod
- P.A. speaker
- Keyboard

Key Points:

- This will soon be two separate demos.
- **Sound is made by vibrations** (things moving).
- When things vibrate, they move the air molecules.
- The vibrating molecules bump into the ones close to them, which makes them vibrate too. This keeps going until the vibrations reach your ear.
- When the air molecules bump into your eardrums you hear the sound.
- When the vibrations are fast, it sounds like a high note.
- When the vibrations are slow, it sounds like a low note.
- Inside the Lissajous generator is a laser and mirrors that can move very fast.
- When the Lissajous generator hears a sound, it makes the mirrors move and shows you what the vibrations would LOOK like, if you could see them.

Warnings:

- Again, be careful with all the equipment. The light and sound demos are the most expensive things the Physics Van owns!
- If you're using the microphone, make sure you NEVER walk near the speaker, or in front of it. The feedback from this is both unpleasant and damaging to the system.
- The Lissajous generator centers itself when powered up, but after it has modulated a few sounds the center tends to drift down. So be ready to readjust the tripod at any time.

Things to talk about:

- Start with the Lissajous laser off, and the generator's settings as follows:
 - Power switch all the way to "mono" mode.
 - Horizontal Gain at 0
 - Vertical Audio at about 50%
 - Horizontal frequency should be about 50%, or wherever the line will flicker least once you turn up the Horizontal Gain.
 - (Vertical Gain and Horizontal Audio should always be at 0.)
- Begin by asking the kids if they know what sound is, or how sound is made.
- Explain that **sound is made when things move**.
- Vibration is just a word that means moving back and forth.
- Have the kids put their hands over their throats and hum so they can feel the vibrations. Also ask them if they've ever felt a speaker vibrating, etc...
- The reason you can hear things making sound is that they are moving back and forth (vibrating). **When they vibrate, they move the air molecules** right next to them. These molecules bump into the ones next to them, and so on.
- This is how sound moves through the air. Pretty soon some of the vibrations have traveled all the way to your ear.
- The moving **air molecules bump into your eardrum, and you hear the vibrations as sound**.
- Tell the audience that we can use a laser to show them what sound vibrations look like.
- Take the laser pointer and show them how you can make a line on the screen by moving your hand back and forth quickly.
- The lights should be dimmed on stage if possible for the rest of the demo.
- Now have someone turn the Lissajous laser on. A point should be projected on the screen. Then they can turn up Horizontal Gain until a line appears.
- Tell the kids that the laser is bouncing off a mirror that's moving back and forth really fast like your hand was.
- **When the machine hears vibrations** (from the microphone or the keyboard) **it makes the mirror vibrate up and down the same way**. That makes the laser move up and down, so you can see the sound vibrations on the screen.
- Now play a note from the middle of the keyboard. Explain that the sound from the keyboard is making the sound in the speaker. The laser is vibrating the same way as the speaker. Your ears HEAR the sound vibrations, and the laser lets you SEE them.
- Ask them what they think will happen if you play a **higher note** on the keyboard.
- Play the note, and point out that **there are a lot more wiggles in the laser line**. This means the speaker is moving back and forth faster.
- Repeat the question and experiment for a **lower note**. **This time there will be fewer wiggles** because the vibrations are much slower.
- You can show what a bunch of sounds together look like by playing a preset song on the keyboard. (press song and then pick a number from the list).