

# Sound Waves in Different Mediums

## Framework: Skills and Objectives

1. *Sound Wave and Vibration Patterns through Different Mediums*
  - a. Advanced Demo: Frequency generator with Water & Cornstarch (Oobleck)
  - b. Advanced Demo: Sound Waves in Perspective with Water
2. Hands-on Experiment: Telephone Game

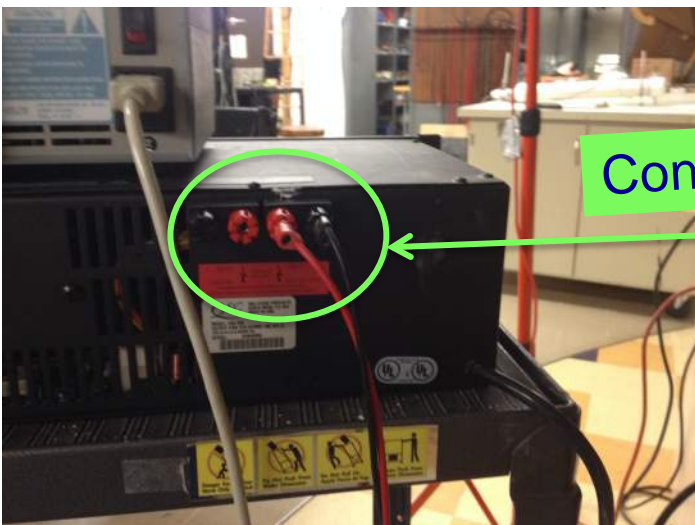
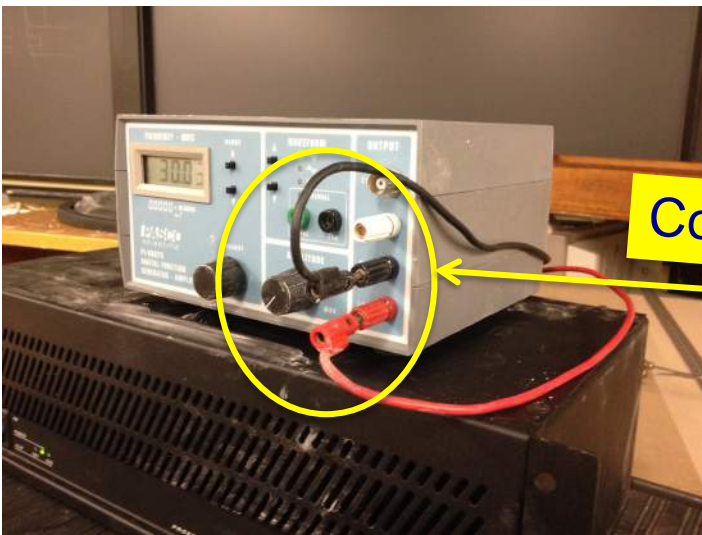
## Part 1: Sound Waves and Vibration Patterns through Oobleck

### Materials

Frequency generator, Speaker, Amplifier, Cornstarch, Water

### Procedure

1. Hook the frequency/tone generator up to a speaker and amplifier. See the pictures below for reference. Connect the wires that are connected by the arrows below. Color matters! So, connect red to red, and black to black.



2. Pour cornstarch into cup and add water while stirring until you obtain oobleck consistency (when you stir slowly, oobleck behaves like water; when you move quickly, behaves like solid).
3. Turn on machine.
4. The frequency is preset to 1000Hz, so immediately dial down to ~6 Hz.
5. Turn amplitude dial to the 10 o'clock position. The speaker should be moving up and down.
6. Pour the oobleck onto the plastic-covered speaker.
7. Slowly turn the frequency up from 6 Hz up to 45 Hz. You should see standing wave patterns forming.
8. At this point, feel free to play around with the frequency and amplitude dials to best visualize their impact on the oobleck. The frequency should not exceed 45 Hz and the amplitude should be somewhere between the 10 o'clock and 12 o'clock range. NOTE: This could largely vary depending on your mixture and amount of oobleck used, so use your best judgment.
9. To create cool climbing features, drive the speaker to ~30 Hz with a fair bit of power. The amplitude would be at around the 12 o'clock position.
10. Run your index finger into the oobleck with an upward motion as many times as necessary to stimulate the climbing motion. If done correctly, the oobleck should start twisting, twirling, and "climb" across the speaker.
11. Allow kids to poke at oobleck.

Example video:

<http://physicsdemos.site.wesleyan.edu/home/fluidmechanics/2c/2c60-32-corn-starch-and-water-on-a-speaker/>

### Discussion

- The reason sound waves forms patterns are due to something called Chladni's Law, which can be used to describe vibrations, and relate sounds and waves. However, start the following conversation with the kids:
  - (1) How do you describe sound? Students may respond by saying that sound can be unpleasant, like noise, or beautiful, like music. They also may mention that sound may be loud or soft, high or low.)
  - (2) Point to and talk about standing wave patterns that form at the varying frequencies.
  - (3) Talk about how oobleck is able to climb because of its dual and complex role as both a solid and a liquid. Talk about states of matter again.

## Part 2: Sound Waves Travelling Through a Liquid (Hydrophone)

### Materials

2L Plastic Bottle, Bucket, Water, Rocks, Scissors

### Procedure

1. Cut off the base of the plastic bottle
2. Fill the bucket halfway with water

3. Place the plastic bottle in the water upright
4. Put your ear to the top of the bottle
5. Get a partner to bang two stones together under the water near the bottle
6. Repeat experiment in the air and compare the two sounds

### **Discussion**

- Compared to air, the water is much more dense, so the sound you hear in each medium will differ greatly.
- This alters the intensity and wavelength of the sound waves, but not the frequency.

## Part 3: Sound Waves Travelling Through a Solid (Telephone Game)

### **Materials:**

Paper Cups  
String  
Paper Clips

### **Procedure**

1. Poke a hole through the bottom of two paper cups
2. Attach a paper clip to both ends of a length of string (longer the better)
3. Loop the paper clip through the hole so it won't move
4. Have the kids try to talk through the cups- one talks while one listens

### **Discussion**

- Talk about how sound can move through different mediums, not just air like we are used to
- Sound waves are converted to vibrations while travelling through the string, then converted back to sound waves when reaching the next cup
- Sound travels even faster through solids (like the string) than gases (air), so you would be able to hear some sounds at a farther distance than you would through air
- Could also mention how sound always needs a medium to travel through- no sound travels in space