

## Phys 221 Lab 1

### Investigating How Music is Made

Learning Goals: Students will be able to

- describe how sounds are produced with vibrations.
- describe how tones can be varied by changing the length of the resonant cavity.
- describe how string instruments require a source of vibration, a way to change pitch and use sympathetic vibration to amplify sound.
- define frequency and vibration in terms of a sound wave and what we hear.
- generalize the ideas of vocalizing and making music. Both require a source of sound (vibrations), a way to change pitch (resonance) and a way to amplify sound (resonance or sympathetic vibration).

*Predictions section – graded for completeness not correctness:*

1. What instruments, if any, have you ever played?
2. Please describe with as much detail as you can, how an instrument makes sound. Pick at least two examples to describe.
3. Please describe with as much detail as you can, how different tones are made with these instruments.

### Straw Instruments

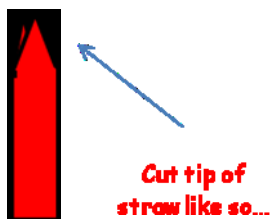
Make a new straw instrument unless you have your instrument from the previous class.

You will need:

- Straws
- Scissors

Here's what you do:

- Take the straw and the scissors, and cut off the tip of the straw to a point, like so. (Try to get both sides to be the same.)



- Now, *gently* chew on the straw to soften the tip, and to get the edges to be smooshed together. You would like the two tips to be *almost* touching each other.
- Now, put the pointy end in your mouth, and *blow really hard*. If you do it right (it might take some practice), you will get a very loud sound from the straw instrument.

4. How do you make the lowest possible pitch with your “straw trombone” (that’s when you slide a second straw over the initial straw)
  5. How do you make the highest possible pitch with your “straw trombone”?
- Make a new straw instrument with one long straw.
6. Test out how your straw instrument sounds after you cut about an inch off.
  7. Keep cutting sections off, and compare how the sound changes.
  8. Think about resonance – When one object is vibrating and it is put in contact with another object, if the frequency of the first object is at the natural frequency for the second object, the second object will start vibrating vigorously at its natural frequency. Where do you think the resonance is happening in your straw instrument? *Hint: What determines its pitch?*

### Water Bottles

9. Now use the water bottle. Blow over the top of the water bottle until you have a tone. Would you describe it as a low pitch or a high pitch?
10. What kind of instrument does the bottle remind you of?
11. Figure out how to make a new tone with the same water bottle. Describe what you did to vary the tone.
12. Where is resonance happening with the water bottle instrument?
13. Would the straw instrument and the bottle instrument be woodwinds, strings, brass or percussion? Look at [www.dsokids.com](http://www.dsokids.com) for information. Look under Listen By Instrument.

### Your Voice

Hold your fingers against the front of your throat and say *Aaaaaah*. Notice the vibration against your fingers.

14. Change the sound to an *Ooooooh*. What do you notice with your fingers as you listen? How about your mouth?
15. Change the sound to *Eeeeeee*. What do you notice with your fingers as you listen? How about your mouth?
16. Would you say the different vowels are made differently by your throat or your mouth?
17. Now try *Sssss*, not *Esssss*. Does your throat vibrate? What is vibrating?
18. How about *Fffffff*? What is vibrating?
19. Write a general description of what you found about the voice. For example, do all consonant and vowel sounds have the same source of vibration?

Hold your hand to your throat while speaking. Pitch varies with the emphasis given to different words. The last words of a question, for example are at a higher pitch.

## Stringed Instruments

You will need:

- Two 4 foot pieces of string (use different types of string)

20. Tie a 4 foot piece of string to a table leg. Pull it tight and pluck it. Does it make a sound? Would you say it is a musical sound? What does it sound like to you?
21. What if you slide the string between your thumb and index finger? Does it make a sound? Is it quiet or loud? How would you describe the sound?
22. Do these strings qualify as musical instruments? If not, what is missing?

## Cup Instrument:

You will need:

- 2 different plastic cups
- 2 large paper clips
- 2 4 foot pieces of string

Take each cup and poke a hole in the bottom. Put the loose end of your string through the hole from the bottom, tie the end of the string that is inside the cup to the paper clip and then pull all the extra string out of the cup so the paper clip is on the bottom of the cup. Work in pairs each with a cup instrument.



23. Hold the cup so the string is loose and slide the string between your thumb and index finger. How does the sound compare to what you heard with just the string and no cup?
24. Does this change in volume remind you of the *sympathetic vibration* of the table top when a vibrating tuning fork was placed on it?
25. Now attach the string of your cup instrument to a table leg. Pull the cup so that the string pulls very tightly against the table leg. Pluck the string. Can you get a musical (ish) sound from it?
26. While still pulling the cup tight against the table leg, have your partner pinch the string at different lengths from the cup while you pluck the string. How does the sound change?
27. How can you make it louder?
28. What instrument does this remind you of?

## Generalizing

29. Summarize three important features of your cup instrument that 1. makes it play sound, 2. makes it loud (amplifies the sound) and 3. changes the pitch.
30. Consider the straw instrument, summarize three important features that makes the straw instrument 1. play a sound, 2. makes it loud (amplifies the sound) and 3. changes pitch?
31. Compare and contrast your results for questions 29 and 30 above.

### **Slip Stick Vibrations**

32. Get a wet paper towel and pinch the string *very* tightly as you slide the towel down it. If you do it right, you'll get a *very loud* sound. What instrument does this remind you of?
33. What is creating the vibration in this case?
34. Did you hear any animal sounds? What sounded like what? Try to make a chicken (quick short slides), or a whale sound (long smooth slide) with the cup instrument.

### **Electric vs. Acoustic Guitars**

35. Compare the two types of guitars. Pluck a string on each one and compare the sounds.
36. Why is the acoustic guitar so much louder? What is the difference between the two that causes the acoustic guitar to be loud?
37. What happens if you press your finger on the string on one of the frets along the neck of the guitar? What happens if you hold the string down closer to the body (basically shortening the length of the string that can vibrate)?
38. Name three string instruments that are "plucked" and three that use slip stick vibrations.

### **Compare cup instruments**

39. How does the sound from different types of cups compare. Are there enough different types of cups to make any specific conclusions about cup type with sound? If so, what are they?
40. Find one other group that has the same cup but used different string than you did. How do their cup sounds compared to yours? What seems to be the cause of the differences, if any?
41. Describe what materials and tests you'd want to perform to conclusively characterize cup size, shape and material with sound characteristics.