



Musical Instruments: Part II¹

Adams, W. K.

Students experiment with various sound sources, including voice, cup instruments, string and guitars, to gain an understanding of the connection between sound and vibration

Science Topics	Process Skills	Grade Level
Sound	Observing	6-12
Sound wave	Scientific inquiry	
Vibrations	Comparing	
Resonance	Measuring	
Sympathetic vibration	Predicting	
Frequency		

Time Required			
Preparation	Set-Up	Activity	Clean-Up
None	5 minutes	45-50 minutes	5 minutes

Learning Goals

Students will be able to...

- describe how string instruments require a source of vibration, a way to change pitch, and a way to amplify the sound
- define frequency and vibration in terms of a sound wave and what we hear
- describe how vocalizing and music both require a source of vibration, a way to change pitch, and a way to amplify the sounds
- describe the difference between resonance and sympathetic vibration

Materials		
In the Kit	Not in the kit	Optional
Worksheet (pg. 5-8) – 1 per student Cup instrument	3 different plastic cups – 1 per group String – 2 types* Scissors Damp paper towels ~2 per group	Acoustic & Electric Guitars**

*A smooth/shiny type of string and a rough cotton/twine make good comparisons

**Guitars can be easily accessible to teachers. Try asking the music department in your school or local music stores. Most are perfectly happy to lend instruments for learning experiences.

Advanced Preparations

Complete both the Sound and Music and Musical Instruments pt. I lessons before this activity.

Set-Up

Gather materials and arrange them so they can be easily distributed to students during class. Each student group should have:

¹ This lesson is designed for uses AFTER Musical Instruments Part I.

- A 3-foot piece of string
- 1 plastic cup
- 1 paper clip
- Scissors
- Paper towels

Introduce the Activity

1. Divide the students into groups for the activity and explain that they will be exploring musical instruments by using their voice, string and a cup instrument.
2. Begin the lesson by introducing the idea of a voice being a musical instrument. Ask the students the following question about the voice:
 - How can we feel the movement made by our voices?

If the students struggle to find an answer, ask more leading questions such as:

- Where on our bodies can we feel our voices vibrating?

3. Students should experiment with this idea for a short period of time. Have them hold their fingers against the front of their throat and say “aaaaah” to feel the vibrations against their fingers.
4. Hand out a worksheet to each student

Doing the Activity

Your Voice

1. Students will work in small groups to try out different sounds with their voice to answer questions 1-6.
2. Explain that pitch varies when you talk. For example, the last words of a question are at a high pitch than statements.

String Activity

1. To answer 7-8, students will tie a 3-foot piece of string to a table leg and pull it tight. they should try:
 - plucking it
 - sliding the string between their thumb and index fingers.

Cup Instrument

To build a cup instrument, students will need to follow these instructions:

- A. Carefully poke a small hole in the bottom of the cup with scissors.
 - B. Thread the string through the hole in the cup and tie it to the paperclip.
 - C. Pull the string so that the paper clip touches the bottom of the cup.
1. Students will hold the cup so the string is loose and slide the string between their thumb and index finger and answer questions 8-9.

2. Students will attach the string of the cup instrument to a table leg.
 - a. They will pull the cup so that the string pulls tightly against the table leg and then pluck the string.
 - b. One partner will hold the string at different lengths, while the other plucks it.
 - c. After trying a few different lengths, they will answer questions 10-15.
3. For questions 16-17, students will wet their paper towels and pinch the string very tightly as they slide the damp paper towel down the string. If they do it correctly, they'll hear a very loud sound.

Cup Comparisons

1. Student groups will find at least two other groups that used different cups, but the same string and compare and contrast them for question 18.
2. Now, student groups will find another group that used the same cup, but different string to answer questions 19-20.
3. Students should try to make a sound like a chicken (with quick short slides) and a sound like a while (with long smooth slides)

Optional: Electric vs. Acoustic Guitars

1. One group at a time should go up to the guitars to compare them and answer the last 4 questions.

Explanation

In-depth background information for teachers and interested students.

Key Lesson Terminology

- Sound wave – vibrations of air molecules that travel through air carrying energy with them
- Vibrations – a shaking back and forth movement
- Resonance – a natural frequency of vibration determined by the size and shape of an object
- Frequency (rate) – wiggles per second (moves back and forth)
- Sympathetic vibration – when a vibrating object causes another object to vibrate at the same frequency, which may or may not be a resonance frequency. For example, if you place the handle of a vibrating tuning fork onto a table it becomes a soundboard and will vibrate at the same frequency. The table top moves more air than the tuning fork so the sound is louder. A piano string causes the soundboard of a piano to vibrate at the same frequency as the string.
- Resonance Chamber – uses resonance to amplify sound
- Pitch – how high or low a tone sounds to a person. High frequency sound has a high pitch or tone (treble notes), but low frequency sound has a low/deep pitch or tone (base notes). High sounds are usually above 2000 Hz and low sounds are below 200 Hz.

Optional Extensions

- Students can keep track of terminology with a vocabulary sheet
- Students can complete the Generalizing How Instruments Work activity
- Students who play a stringed instrument can bring their instrument to class to show how the homemade instruments compare

Modifications

- Hard of hearing students can feel vibrations by touching the instruments

Supplemental Materials

Worksheet log below, pages 5-8.

Musical Instruments: Part 2

Name _____

Learning Goals:

- Students will be able to describe how string instruments require a source of vibration and a resonance chamber (or sympathetic vibration).
- Students will be able to define frequency and vibration in terms of a sound wave and what we hear.
- Vocalizing and music both take vibration and a resonance chamber.

Your Voice

Hold your fingers against the front of your throat and say “aaaaah.” Notice the vibration against your fingers.

1. Change the sound to “oooooh.” What do you notice with your fingers as you listen? What about your mouth?
2. Change the sound to “eeeeee.” What do you notice with your fingers as you listen? What about your mouth?
3. Would you say that different vowels are made differently by your throat or your mouth?
4. Not say “sssss,” NOT “Essss.” Does your throat vibrate? What is vibrating?
5. Make the sound “ffffff.” What is vibrating?

6. Hold your hand to your throat while speaking. Pitch varies with emphasis given to different words and according to what your trying to say. The last words of question, for example, are at a higher pitch than the words at the beginning of the question.

String Instrument

7. Tie a 3-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?
8. 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?

Cup Instrument

You will need:

- plastic cup
- string
- paper clip
- scissors



Take the cup and carefully poke a hole in the bottom with a pair of scissors. Put the string through the hole from the bottom of the cup and then tie the end of the string that is inside the cup to the paperclip. Pull all the extra string out of the bottom of the cup so that the paperclip touches the inside of the bottom of the cup.

9. 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?

10. Does this change in volume remind you of the *sympathetic vibration* of the table top when you placed a vibrating tuning fork on it?
11. Now attach the string of your cup 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?

12. Have your partner hold the string at different lengths from the cup (still tied to the table leg!) while you pluck it. How does the sound change?

13. How can you make it louder?

14. What instrument does this remind you of?

15. Can you summarize three important features of your cup instrument that makes it play sound, makes it loud and changes the pitch?

16. How about your straw instrument from the previous activity? What were the three important features to make it play sound, make it loud and change the pitch?

17. 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?

18. What is creating the vibration in this case?

Compare Cups

19. Find at least two other groups that have different cups that you used, but have the same string as you. How do their cup sounds compare to yours? What seems to be the cause of the difference, if there is any?

20. Find one other group that has the same cup, but has different string than you. How does their cup sound compared to yours? What seems to be the difference, if there is any?
21. When playing your cup instrument, did you hear any sounds that sounded like animals? What sound like what? Try to make a chicken noise (quick short slides) or a whale sound (long smooth slides).

Electric vs. Acoustic Guitars

22. Compare the two types of guitars. Pluck a string on each one and compare the sounds.
23. Why is the acoustic guitar so much louder? What is the difference between the two that causes the acoustic guitar to be loud?
24. 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)?
25. Name three string instruments that are “plucked” and three that use slip stick vibrations.