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Ringing Chimes And Telephone Lines

Exploring the Science of Sound Lab

By Brad Fulton
Educator of the Year, 2005
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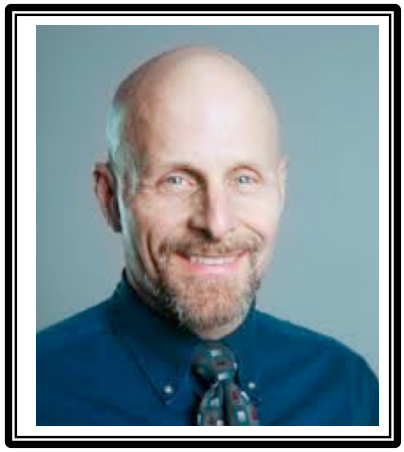
Brad Fulton

Educator of the Year



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- ♦ Consultant
- ♦ Educator
- ♦ Author
- ♦ Keynote presenter
- ♦ Teacher trainer
- ♦ Conference speaker

Known throughout the country for motivating and engaging teachers and students, Brad has co-authored over a dozen books that provide easy-to-teach yet mathematically rich activities for busy teachers while teaching full time for over 30 years. In addition, he has co-authored over 40 teacher training manuals full of activities and ideas that help teachers who believe mathematics must be both meaningful and powerful.

Seminar leader and trainer of mathematics teachers

- ♦ 2005 California League of Middle Schools Educator of the Year
- ♦ California Math Council and NCTM national featured presenter
- ♦ Lead trainer for summer teacher training institutes
- ♦ Trainer/consultant for district, county, regional, and national workshops

Author and co-author of mathematics curriculum

- ♦ Simply Great Math Activities series: six books covering all major strands
- ♦ Angle On Geometry Program: over 400 pages of research-based geometry instruction
- ♦ Math Discoveries series: bringing math alive for students in middle schools
- ♦ Teacher training seminar materials handbooks for elementary, middle, and secondary school

Available for workshops, keynote addresses, and conferences

All workshops provide participants with complete, ready-to-use activities that require minimal preparation and give clear and specific directions. Participants also receive journal prompts, homework suggestions, and ideas for extensions and assessment.

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References available upon request

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Half priced site licensed copies are available on the TPT website. Please encourage them to take advantage of this affordable option. Okay?

Thanks and happy teaching,

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Ringing Chimes and Telephone Lines

Exploring the Science of Sound Lab

Overview:

What makes sound? Your students will answer this question while unleashing their sense of wonder. They will learn how vibration is the source of all sound. In the process, they will also understand how sound vibrations can travel through a line such as a guitar string or telephone line.

You get two great activities in this handout! In the first one, students make chimes that seem to be so loud, yet they hardly make a sound. In the second, they make their very own telephone. Students can experiment with variables to find out how to change the volume and tone of sounds.

Required Materials:

- ☒ Metal kitchen utensils
- ☒ Plastic cups
- ☒ String

Optional Materials:

- ☐ Cans
- ☐ Paper clips
- ☐ Rubber bands

This activity pairs nicely with my other "S.T.E.M. on a Shoestring" sound lab, "Straw Oboes and Bladder Pipes" for a full unit on sound and its sources.

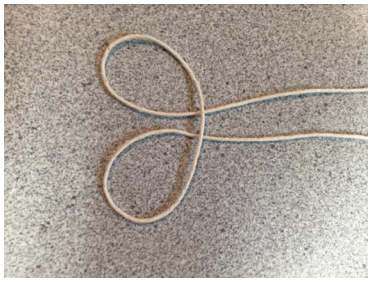
Ringing Chimes

Procedure:

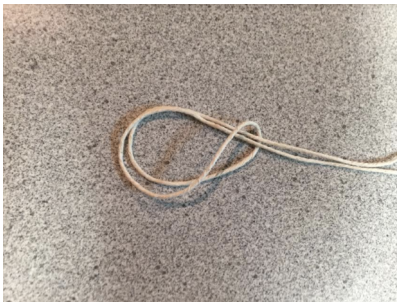
1. Prior to the activity, gather kitchen utensils such as spoons and forks. Add to this collection larger and more varied utensils such as ladles, serving spoons, tongs, baking racks, and other metal objects.
2. Set a few utensils at each station and divide your students into teams. Although this activity could be done individually, students will be so excited and engaged by the outcomes that working in groups will provide the setting for great discussions.
3. Cut one meter of string for each utensil.
4. Tie a spoon to the center of the string. If the utensil has a hole in the handle, you can simply pass the string through that hole. If not, a quick way to tie the utensil onto the center of the string is with a *lark's head* knot. Simply fold the loop over the string as shown and pass the handle of the utensil through the loops and pull tightly. On the following page you'll find illustrations for this.

Tying a lark's head knot for a utensil with no hole in the handle:

1. Bend the string in half.



2. Fold over to form 2 loops.



3. Fold one loop behind the other.

4. Insert the utensil.

5. Pull free end of the string.

Tying the larks head when there is a hole.

1. Pass the loop through the hole.

2. Pass the free end through the loop.

Or even this simple method will work:

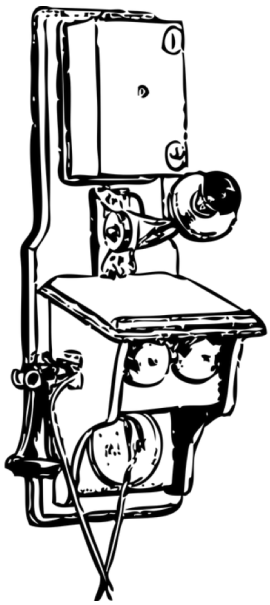
5. Press the free ends of the string against the ears as if you are trying to plug your ears with the strings.

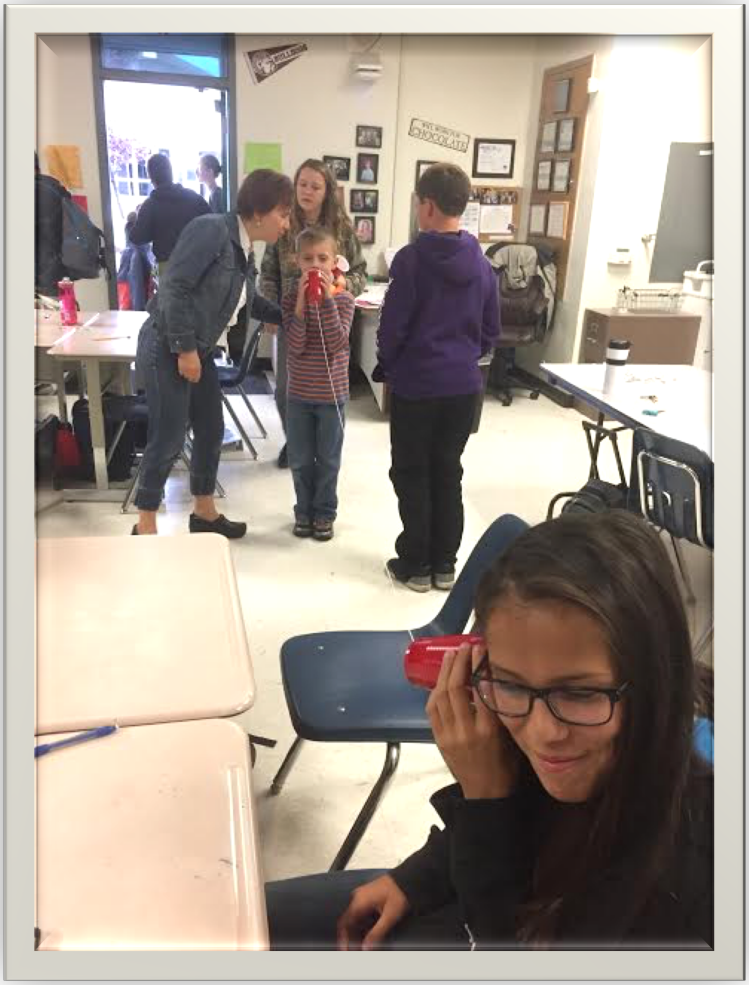
6. Bend at the waist and let the utensil hang freely.
7. Have a partner tap the utensil with a hard object such as a pencil. Although it produces a very light ring to the partner, the vibration will produce a loud ring in the subject's ears. It sounds much like being *inside* a large bell or gong!
8. Your students' eyes will light up when they hear how loudly the metal rings in their ears. They will all want to try it, and they will want to try other utensils as well. Allow them to move to each station and experiment with the various utensils.
9. Hold a class discussion afterwards. Here are some questions to ask:
    a. Which utensils seemed to produce the loudest sound? (More mass seems to be the biggest factor.)
    b. Does the length of the string affect the sound? (Your students may need to go back and test this question.)
    c. Will it make a sound if the spoon is not hanging freely or if it is touching your clothing? (No)
    d. Will it make a sound if the string is slack? (No)
10. A great option is to have the students try the experiment again but swing their head left and right when the utensil is hit. As the left and right strings alternately tighten and slacken the sound will be produced in one ear and then the other. It sounds like the ringing is running back and forth inside your head! This is called a stereo effect. Ask the students which string is producing the sound. (The tensioned one does.) This is similar to the sound a guitar string makes. What happens when a guitar string's tension is increased? (It produces a higher note.) This can be demonstrated by plucking a rubber band as it is pulled tighter and tighter.

Telephone Lines

Procedure:

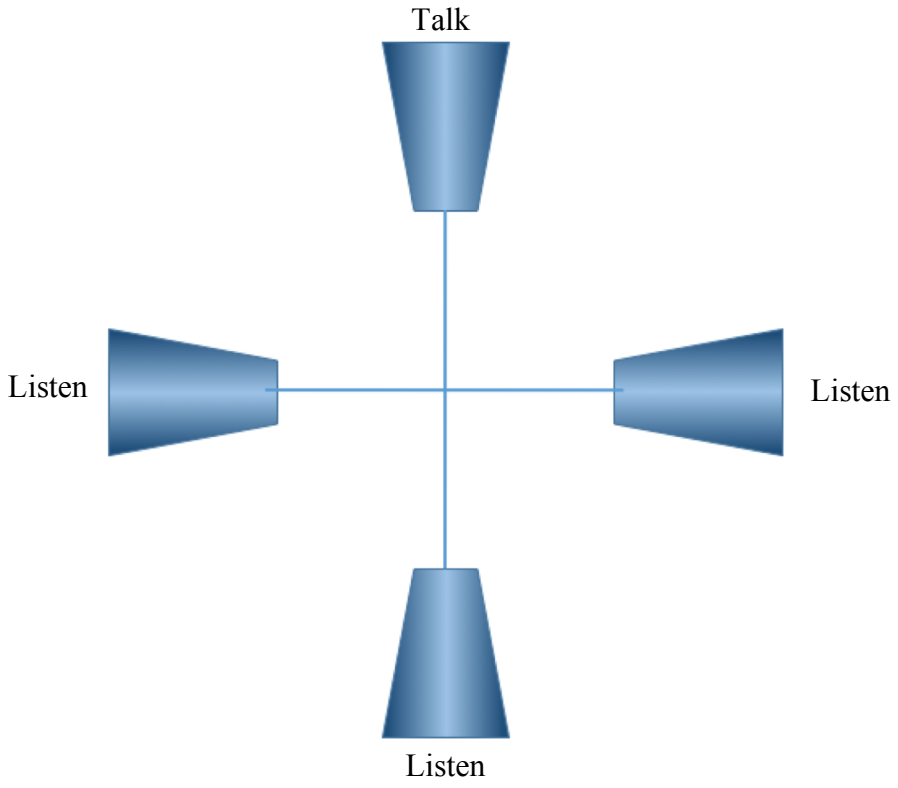
1. Each student will need two cups and about 10 feet (or three meters) of string.
2. Drill or punch a hole in the center of the bottom of each cup.
3. Thread the string through hole of one cup and tie a knot to hold it. You can also tie a paper clip onto the string if you want a more reliable stopper.
4. Do the same for the other cup.
5. Pull the cups apart so that the string is tensioned.
6. While one partner speaks into a cup, the other partner should hold their cup to their ear. They will hear their partner's voice clearly even if there are other conversations and the speaker is whispering!

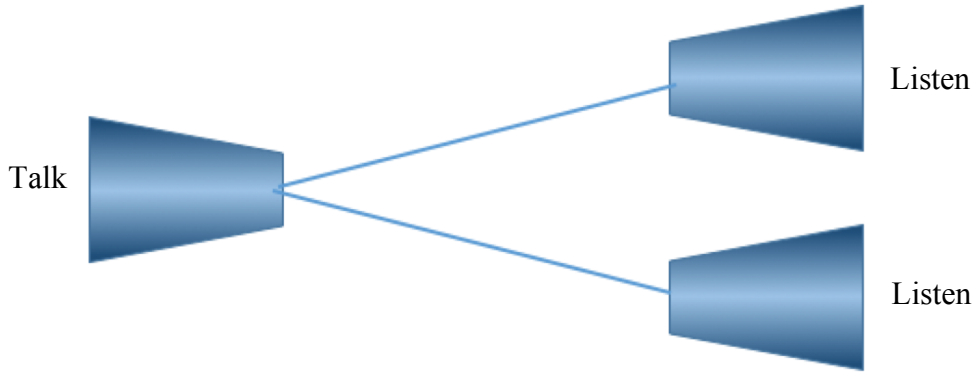




7. Ask the students what they predict will happen if the string is slack? Based on the previous activity with the dinnerware gongs, they will likely hypothesize that the sound won't travel to the second cup. Allow them to test their hypothesis.
8. Have them apply more and less tension to the string and listen to the result.
9. Can your students rig two telephone lines at the same time so that each has a mouthpiece and an earpiece allowing simultaneous conversation? Here is a picture of two students doing that.

10. What would happen if two phone lines were connected in the middle? Could three people hear one speaker's voice? What if two cups were connected to one cup? What other configurations would work?





11. My students were able to get a six-way conversation going by crossing the strings of three phone lines. They simply stretched them out and let them touch in the middle as shown in the picture keeping all lines taut; no knot was necessary. When one student spoke, the other five could hear it! How many phones can you connect at once? I told to my students about the "old days" when people had party line phones and anyone on the party line could listen to someone else's conversation.

12. While a student is talking to another student on the cup phone, have a third student pinch the middle of the string. What happens? (The sound stops.) Why does this happen? (The vibration is stopped at the fingertips.) If the person lightly pinches the string, they may even be able to feel the vibration.

Why it works:

1. Sounds works by vibration. Whether that is the membrane of a drum, the string of a guitar, or the reed of an oboe, vibration matters.
2. When a student speaks into one cup, their vocal cords vibrate. This produces a vibration in the air which is transferred to the bottom of the cup which produces a similar vibration. This in turn travels down the string much as it does in a plucked guitar string.
3. The vibrating string transfers its energy to the second cup producing the same pattern as the first. The air in the second cup vibrates against the membrane of the listener's eardrum.
4. Ask the students if they have ever noticed that their voice sounds different when they yell underwater. That is because water does not transfer vibration in the same way that air does. Similarly, when someone breathes helium, the lighter density of that gas produces a very different sound.
5. Old telephones worked in a similar fashion. A person spoke into the receiver which vibrated. This vibration was converted into an electrical signal that could be transferred over telephone wires to another phone. There it vibrated a membrane in the earpiece just like these cups. Old phones had separate mouthpieces (transmitter) and earpieces (receiver). The phones were mounted on walls, and the caller had to stand by the wall to speak.
6. Can your students identify the parts of the old phones shown in this handout? Where are the mouthpiece and earpiece? How did you dial?

7. Here are some links for further research:

   a. How sound works:

      wikipedia.org/wiki/Sound

   b. Alexander Graham Bell, inventor of the telephone:

      wikipedia.org/wiki/Alexander_Graham_Bell

      Your students may be surprised to find out that Bell's invention the telephone was the outcome of his work with helping the deaf.

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If you liked this activity, you might also like some of the other lessons available in my TeachersPayTeachers store. Simply search for "Brad Fulton".

You can also find many free and inexpensive resources on my personal website, www.tttpress.com. **Be sure to subscribe to receive monthly newsletters, blogs, and FREE activities.**

Similar ***S.T.E.M. ON A SHOESTRING*** activities include:

- *Slime Time* – A gooey lab involving Non-Newtonian fluids. Get the PowerPoint too!
- *Ramp Races* – An engaging and exciting way to teach students the principles of physics: forces, motion, speed, friction, and more!
- *Invisible Ink Lab* – Make hidden messages appear using the principles of chemistry and simple kitchen ingredients
- *Milk Lab* – Watch polar and non-polar molecules interact in this rainbow-hued lab. PowerPoint presentation available too!

Feel free to contact me if you have questions or comments or would like to discuss a staff development training or keynote address at your site.

Happy teaching,

Brad