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Straw Oboes and Bladder Pipes

A fun STEM Lab about science, music, & math

By Brad Fulton
Educator of the Year, 2005
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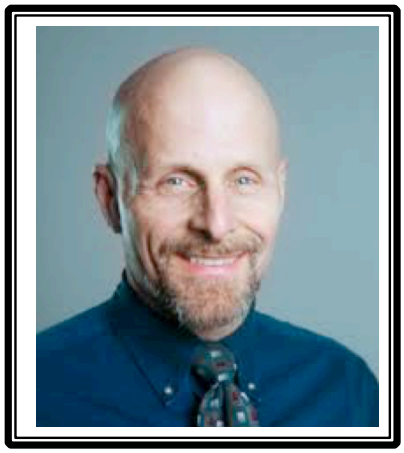

Brad Fulton

Educator of the Year

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

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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.

Brad's math activities are the best I've seen in 38 years of teaching!
Wayne Dequer, 7th grade math teacher, Arcadia, CA

"I can't begin to tell you how much you have inspired me!"
Sue Bonesteel, Math Dept. Chair, Phoenix, AZ

"Your entire audience was fully involved in math!! When they chatted, they chatted math. Real thinking!"
Brenda McGaffigan, principal, Santa Ana, CA

"Absolutely engaging. I can teach algebra to second graders!"
Lisa Fellers, teacher

References available upon request

Like my activities? How about giving me a favorable rating on the Teachers Pay Teachers website? Four stars would be much appreciated and would help me sleep better at night.

Like me even more? Then please don't make copies for your colleagues. I know it's tempting when they say, "Wow! Groovy activity! Can I have a copy?" But this is how I make my money, and why are they still saying "groovy" anyway?

If we make copies for our friends, can we honestly tell our students not to copy or take things that don't belong to them? (Ouch!)

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,

Brad

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Great DVD presentations offer quality mathematics staff development at a fraction of the cost!

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Straw Oboes and Bladder Pipes

A fun STEM Activity about Science, Music, and Math

Overview:

Students love playing with these simple musical instruments that cost a penny or so to make. They will build and design two different horns; one that is similar to an oboe and one like a medieval bladder pipe. Then they can experiment to make them play different volumes and tones as their team works with variables and controls. Students can research medieval history or the mathematics behind musical scales if they wish to refine their instruments. The vibrating parts illustrate the science of sound waves and other waves too.

Required Materials:

- ☒ Plastic straws
- ☒ Scissors
- ☒ Empty pill bottles
- ☒ Balloons
- ☒ Rubber bands
- ☒ Putty or clay (small amt.)
- ☒ Drill & bit

Optional Materials:

- ☐ Decibel meter (phone app)
- ☐ Access to the Internet
- ☐ Earplugs and aspirin for you!

Procedure: Straw Oboes

1. Each student will need only a plastic straw and scissors for the oboe. Put the students into teams of four for the upcoming challenges and to make materials easier to distribute.
2. Pinch one end of the straw to flatten it a bit.
3. Cut the flattened end to a taper as shown in the illustration.

4. Put the tapered reeds between your lips, compress them a bit and blow. As you find the "sweet spot" the reeds will vibrate against one another making a honking noise that is louder than you might expect from such a little guy. This will take some practice.
5. Now that was easy, wasn't it? Once you get the students to stop honking, you can introduce some challenges and ask some questions.
   a. Do all the straws produce exactly the same note? What may cause this variation?
   b. Can you get different notes out of a single straw?
   c. How does the force of the blowing affect the sound?
   d. What affect would be produced by straws of different types or diameters?
6. The first team challenge is to produce the *loudest* sound. I use a free phone app called Decibel 10th by Sky Paw Co. I put a meter stick on the floor so they are standing about 4 feet away from my phone and let them blow their little hearts out. My class blew 97dB. Kudos or a small prize to the loudest group!

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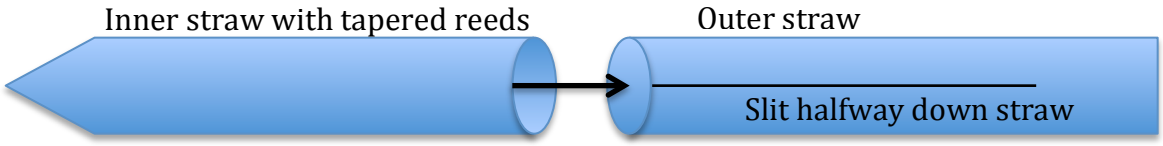
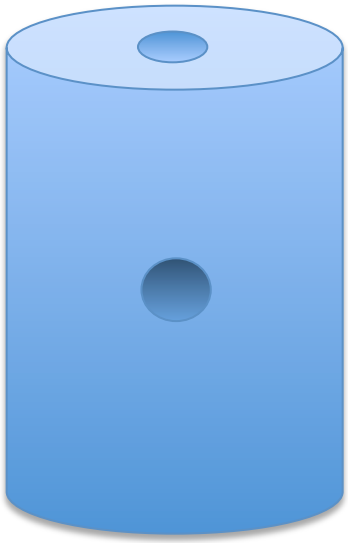
7. Students may notice that the straws produce similar but not identical sounds. This is probably due to variations in how they cut the reeds and how hard they blow. Blowing softly or more forcefully can produce different notes. These are two variables in the activity. What other variables could we introduce?
8. Have the students cut a bit off their straw and notice what happens. It now plays a higher note. They will probably keep cutting off pieces to hear the ascending tone. (I am not responsible for any student who cuts off his or her nose during this lab. My lawyers made me put that in.)
9. Now that they have mutilated their straws pass out a new one to each student and explain **the next challenge**. The first team to play *Mary Had a Little Lamb* (or a close approximation) will win. (If you ignore the high note on the third "lamb", the song only requires four notes.)
10. Many students will trim their straws too short in an attempt to get the right notes. You can increase the challenge by putting a fun or silly price on replacement straws if you wish.
11. Hmm…how could we make an *adjustable* instrument? This can be **the third challenge** for the students. One way is to take a second straw and slit it about halfway down. Then slide it over the oboe and run some tape down the slit. This outer straw can then slide a bit up and down the length of the inner straw.



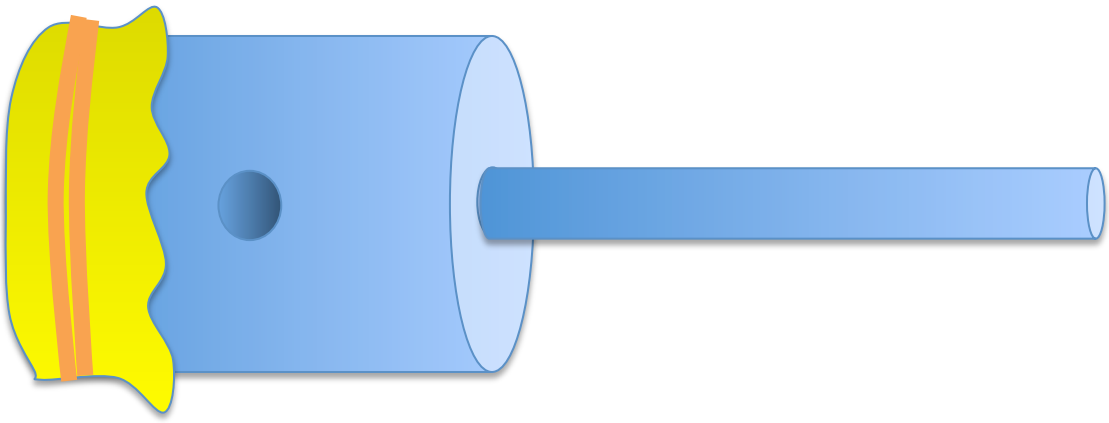
Bladder Horn



1. If time allows you to go on to this second instrument, this would be a good time to down a couple of aspirin. I don't even know what this second instrument is. It's similar to a bladder pipe or crumhorn or sacbut since it uses a bladder, but who want's to say sacbut in a middle school classroom? It's bad enough to say bladder pipe! In any case, it's probably a distant cousin of the bagpipe, and what middle school student doesn't want to play a bagpipe?
2. This will take some preparatory work unless your students have drills and drill bits…not likely. Drill a hole the size of the straw's diameter in the bottom of the pill bottle and halfway up one side. (My straws fit a ¼" hole.) If the straw is a bit loose, that's okay. The students will caulk the opening with some of the putty. You could also use hot glue if students can do that safely.
3. Cut the balloon in half. You will need the top half of it for this instrument. The bottom half can be discarded, or students can blow

through it to make an obnoxious musical note as well.

4. Stretch the balloon over the open end of the pill bottle to form a membrane and secure it with a rubber band. Teammates can help one another with this.
5. Insert the straw through the bottom of the pill bottle until it pushes against the membrane stretching it a bit. If necessary, caulk the seal with some putty.
6. Blow in the side hole and the bladder horn will produce a loud sound!
    a. Ask students what is producing this sound. As the air enters the chamber, the only way it can escape is to expand the bladder, which allows the air to exit down the straw. This lack of pressure then allows the membrane to collapse on the straw again. The process is repeated very quickly, and the students can actually see the membrane vibrate.
    b. What variables could be introduced?
        i. What happens if you blow harder?
        ii. What if you use a larger or smaller pill bottle?
        iii. What changes occur when the straw is cut?
        iv. What if you use a straw with a different diameter?
        v. What if you stretch the membrane more tightly?
7. You can challenge students to create the loudest bladder horn possible. (When they leave class, you will find that you are the most popular teacher on campus – the talk of the staff lunchroom – for better or worse.)



Taking it further:

1. If you would like students to learn even more, they can research how vibration is related to sound.
    a. What causes sound waves?
    b. How do sound waves behave similarly to light waves or waves on water?

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c. What affects do wavelength, frequency, and amplitude (height) of the wave have on sounds?

d. In what ways is the bladder horn similar to an eardrum?

2. Musical notes do not follow a linear pattern. Pluck the E string on a guitar. Then put your finger on the fret that will cut the string's length in half. This produces the E that is one octave above the previous E. Cut the length in half again and you get the E of the next octave and so on. Thus octaves are *exponential* in nature: 1, ½, ¼, …
3. What are meant by fifths, sevenths, and ninths in music?
4. Where are holes drilled on a recorder to produce the notes? Do they follow a pattern? What is the their relationship to one another?
5. What are the frequencies of the notes on a piano? If you graphed a couple of octaves, how would the graph look?

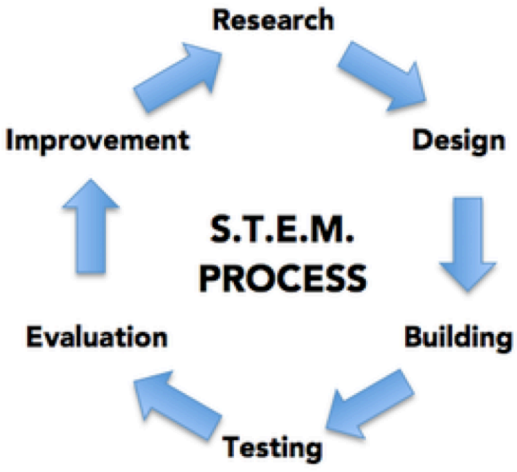
Materials List and Sources:

Straws	$1.00	for 140 at a dollar store: less than a penny each!
Pill bottles	$0.00	free from a pharmacy. They gave me 500!
Balloons	$1.00	for 25. That's 4¢ per balloon!
Rubber bands	$1.00	for a bag of a billion or so. Not a bad deal.
Putty	+ $2.00	for a 2 small tubs.
Total:	**$5.00**	**per class: Cheap!!**

Teaching S.T.E.M.

S.T.E.M. is an integration of Science, Technology, Engineering, and Math. Similarly, S.T.E.A.M. curricula introduce visual and performing art into the integration. Thus this activity incorporates all 5 content areas:

- Science: wave theory
- Technology: research on musical instruments and medieval music
- Engineering: designing the instrument to maximize the efficiency and solve the challenges
- Art: music and music theory
- Math: patterns and relationships among the notes on a scale

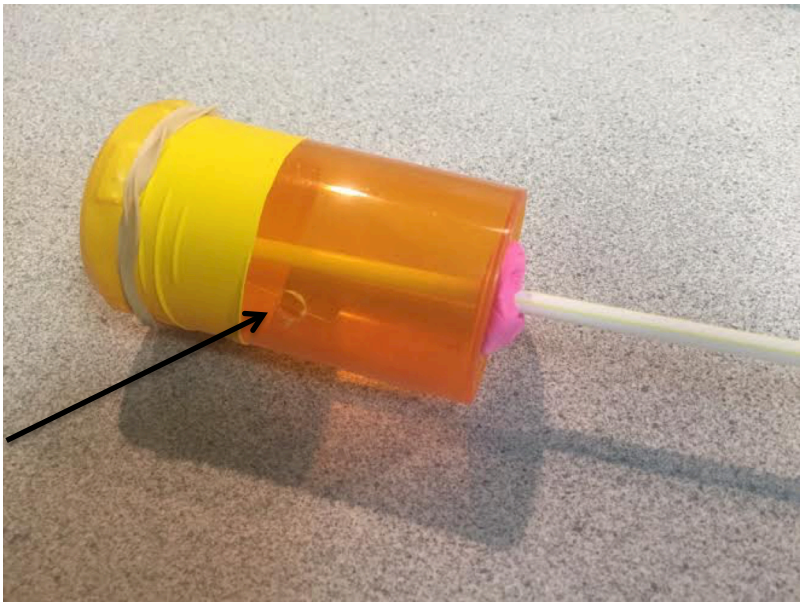


When teaching S.T.E.M. and S.T.E.A.M. lessons, students rise to the challenge. They are engaged, excited, and often self-directed.

More importantly, they redefine what failure means. Rather than seeing failure as a dead end street, they see it as a learning opportunity. They are eager to try again and again. They lose their sense of risk aversion and failure paralysis that often

plague more traditional and directed learning. I see them as involved in what I call the S.T.E.M. cycle shown above. It is no longer a one-way street but an ongoing process of discovery and learning.
For more S.T.E.M. on a Shoestring activities, be sure to visit my website. You'll find dozens of lessons under the Resources tab.

Straw Oboe



Bladder Pipe. Note the putty where the straw enters the pill bottle.

If you liked this activity, you might also like some of the other "S.T.E.M. on a Shoestring" 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 activities.

Similar activities include:

- *Invisible Ink Lab:* Your students will love using chemistry to make secret messages appear!
- *First Observation Lab:* Build their skills in observation and drawing conclusions when you appear to eat a candle
- *Milk Observation Lab:* A colorful way to see the behavior of molecules
- *Electronic Quiz Cards:* They will light up as brightly as their electric cards with this student-created assessment project.
- *Slime Time:* Study non-Newtonian fluids in this gooey lab

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

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