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# Quiz Cards Lab

***Student-made  
electrical engineering  
lights up the content areas!***



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Educator of the Year, 2005  
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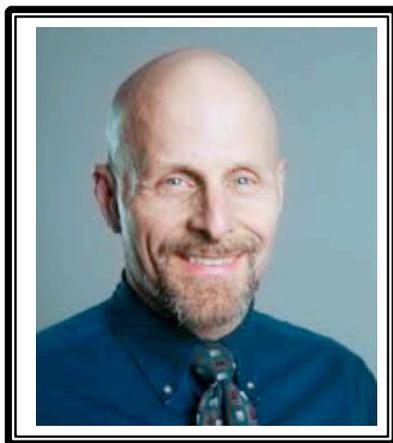
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# Brad Fulton

## Educator of the Year



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(530) 547-4687  
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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.

*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* 

# I want...

- a) Effective staff development
- b) Affordable staff development
- c) Ongoing staff development
- d) **ALL OF THE ABOVE!**

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

- ◆ **Effective because** they are classroom-tested and classroom-proven. These popular DVDs of Brad’s trainings have been utilized by teachers throughout the country for years.
- ◆ **Affordable because** they are site-licensed. Buy only one copy for your whole school, print as many copies of the handouts as you need.
- ◆ **Ongoing because** when you hire new staff, simply hit “play” and the training begins. There’s no need to bring back the consultant.

Just saying:

This project involves electricity. I am not responsible in any way for any harm that may occur to the teacher, students, or anyone else involved. I don't know how you could hurt yourself with an LED and a battery, but I have to cover my bases. 😊

As always, electricity should be approached with caution and respect. The habits students learn in this activity can carry over to work with more powerful currents later.

# Quiz Cards

## Electrical Engineering & the Content Areas

### Overview:

My students really love to create Quiz Cards with electrical circuits that light up when they get the right answer! This activity is a great way to introduce the design, building, and testing components of a S.T.E.M. lesson plan while incorporating other content areas. The cost is less than a dollar per student!

### A Word About Materials:

To keep costs down, you can substitute many of the materials. Construction paper can be used in place of the card stock. Any kind of tape will work: transparent, masking, etc. The wire can be very thin. I used #24 gauge, but even smaller would work. I even pirated some wires from a set of headphones a student threw away. The other parts I purchased from a dollar store. I found two plastic light-up rings in the toy aisle. I *reverse engineered* these and found they each contained an LED light and three batteries. I also bought some coin batteries there at two for a dollar. So each LED cost 50¢ as did each battery. You only need one electrical system per class or per group of students. Thus the only ongoing charge is for creating new cards out of the card stock. The cards only cost less than a quarter each!

You can tape the wires directly to the battery, but if you want a more reliable connection, you can hold them on with a spring clip. For a little more money you could purchase battery holders as I did. These only cost about a dollar apiece. I also pirated some battery holders from items I bought from the dollar store. These can be hard wired into the circuit or you could solder them in. Make sure that you are using the battery voltage than the LED requires (3 volts). These different configurations are shown in the pages that follow, as is a list of electronic components suppliers. I chose to keep it inexpensive. I gave students the resources from the dollar store and let them pirate parts from them to design their own configurations.

### Required Materials:

- 11" x 17" card stock
- Aluminum foil
- Tape
- Batteries
- Insulated wire
- LED lights

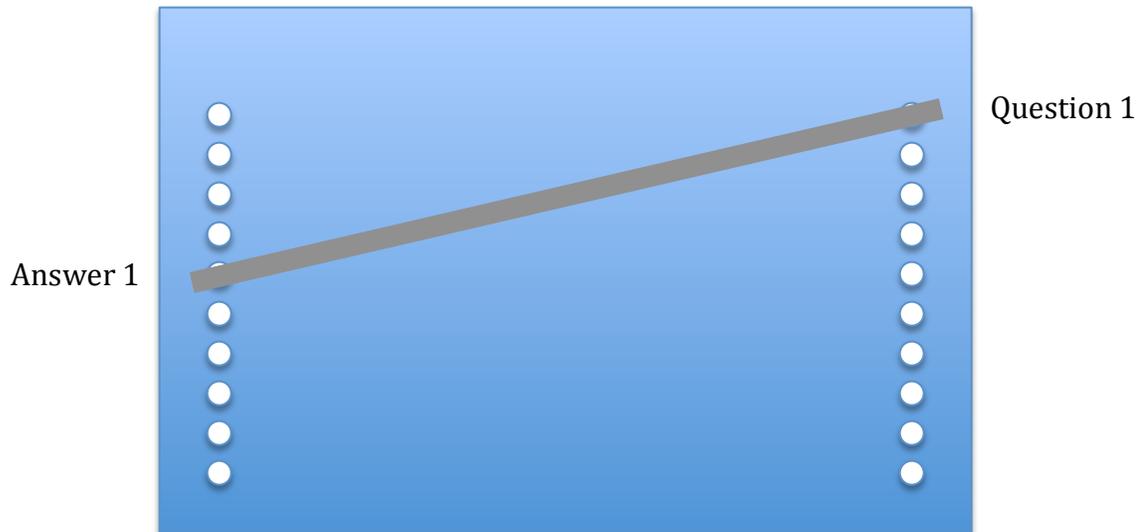
### Optional Materials:

- Markers, colored pencils, crayons
- Battery holders
- Spring clamps
- Paper clips
- Solder

***Reverse engineer*** – to take an item apart or to study it to see how it works.



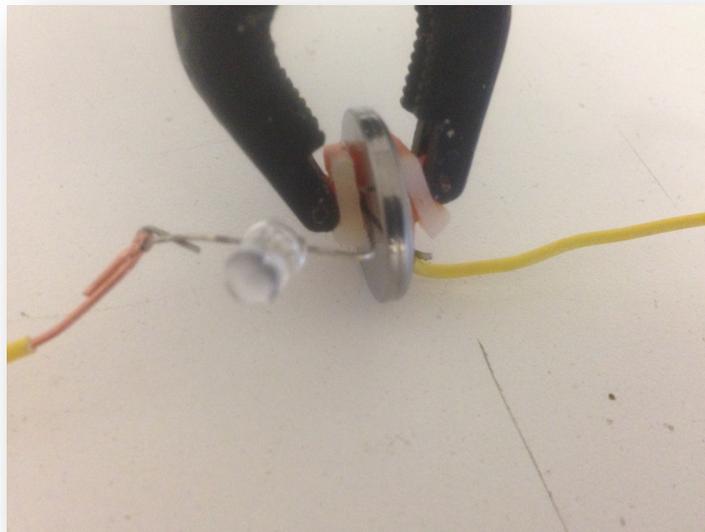
8. Students may wish to decorate their Quiz Cards. This is best done before the wiring is started when the paper is flatter.



9. Here is a picture of the completed back of a quiz card.



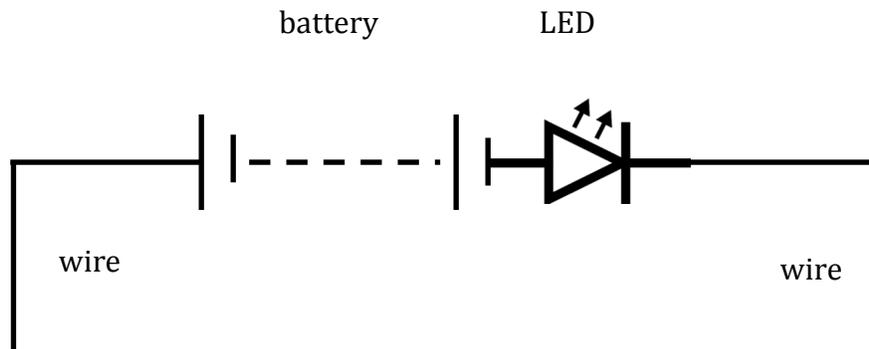
10. Next we will make the circuit tester, the electronic circuit that will light up when the correct answer is matched with a question.
11. Cut two lengths of wire about 12" each. (If your paper is not 11" by 17", make sure the wires are a bit more than half the length of your paper so they can reach the question and answers when the LED is in the middle.)
12. Strip both ends of both wires. This is best and most safely done with an inexpensive tool appropriately called a wire stripper. Set the wire stripper for the gauge of wire you are using.
13. Curl one end into a loop. This will be used as a probe and will keep the cut end from poking a student. You may wish to wrap the wire around a paper clip and use that for a probe.
14. Connect the other end of one wire to the LED. This can be done by twisting the wires together and covering them with some tape. You may wish to have older students solder them if they can do this safely. A wire nut may also be used. These are very inexpensive and effective. They twist the wires together and insulate them at the same time. Mine only cost \$.03 each. Note: An LED light has a positive and negative terminal. If these are switched, the LED will not light. On the LEDs I ordered, one wire is slightly longer than the other. This longer wire should lead to the positive battery terminal (often red). The shorter wire should lead to a negative wire (often black).
15. The free end of the other wire needs to be attached to the battery.
16. Lastly, connect the free wire of the LED to the other end of the battery using the same method as step 14 and your circuit tester is done. Here is a very simple and inexpensive way to connect the battery to the wire and LED using a spring clip.



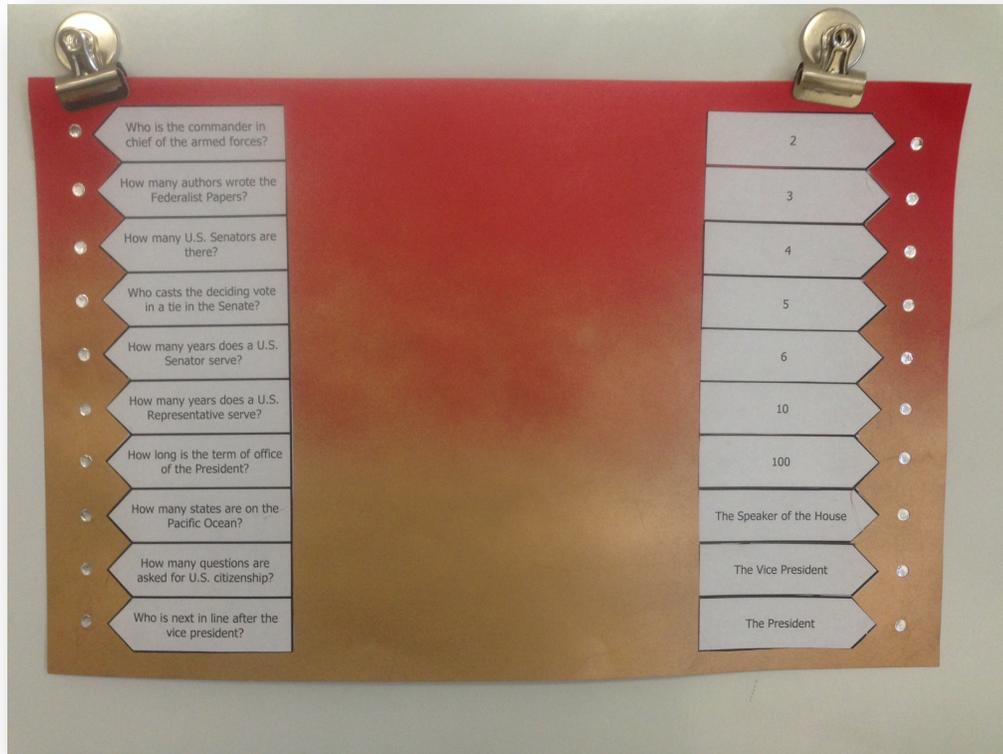
17. To test your device, touch the two looped ends together and the LED should light up!
18. Now you can use your circuit tester to play the Quiz Card. Touch one probe to the question and one to the correct answer and the LED will light as the circuit is completed. If a wrong answer is selected, the circuit is not complete and it will not light.
19. **OOPS!** Did one of the circuits not work correctly? That means there is a wiring problem. That's easy to fix. Simply cut the defective aluminum strip at some point breaking the continuity. Then run a fresh strip and piece of tape from the question to the answer.



20. Here is the wiring diagram for the circuit tester.



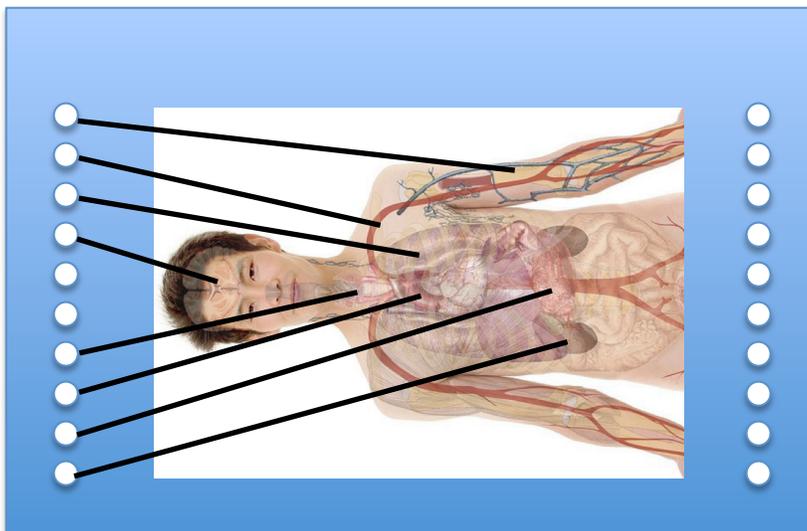
21. Here is the front of a completed Quiz Card showing questions from U.S. history.



22. And here are other ideas:



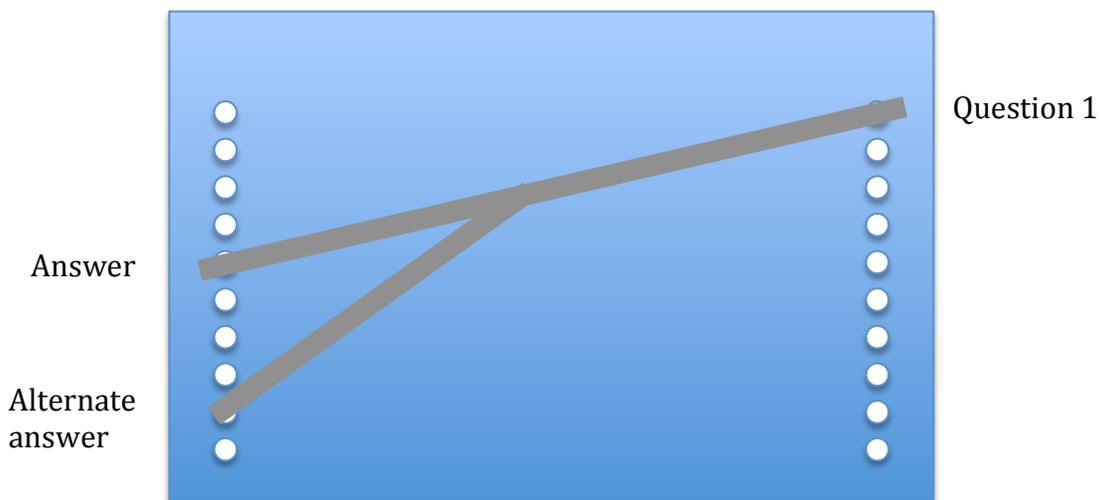
Put state names on one side and the names of their capitals on the other side.



Put names of the organs on the sides.  
 On the other side, draw arrows to the organs.  
 You could also show the parts of a cell.

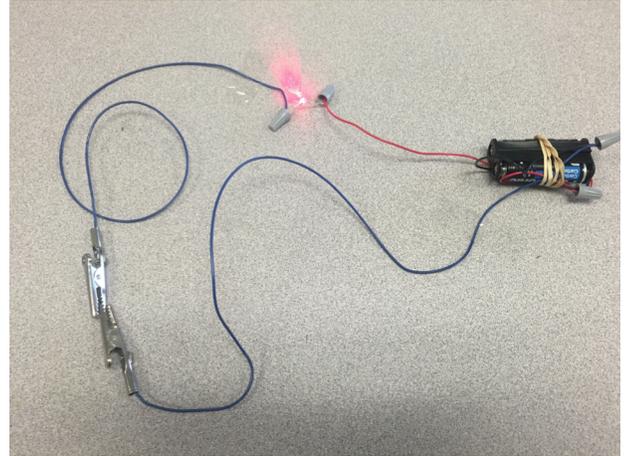
Your students will get lots of creative ideas.

- They can put vocabulary terms on one side and definitions or synonyms on the other.
- Put presidents on one side and their names, accomplishments, or years of service on the other.
- Younger students can match letters to objects: "A" – Apple.
- Put inventions on one side and their years or inventor on the other.
- Match fractional representations to decimals or percent representations.
- Match geometric shapes with their names or properties.
- Match authors to novels or artists to their pictures of their works.
- Match geographic terms to pictures of them.
- Match electronics symbols to their meanings (or use other symbols).
- Put ten events from a novel on one side and number the other side 1 through ten. Then try to put the ten events in the correct order.
- Maybe they will want to wire some dead ends: trick questions with no correct answer.
- You can also wire one question to two answers or vice versa by connecting one strip to another:

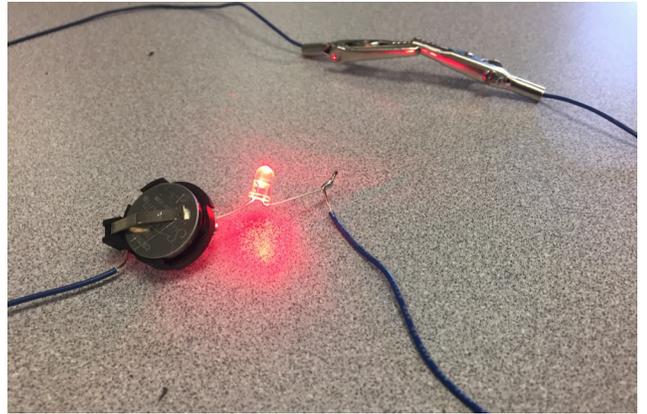


Here are two other wiring options for a cleaner, albeit slightly more costly, look.

This design uses a 3-volt LED light and AA batteries. Since a AA battery is only 1.5 volts, two are needed. I purchased battery holders, wired them together, joined wire ends with twist-on wire nuts, and used a rubber band to hold the entire assembly secure. Alligator clips on the ends complete the look. The design is rugged, easy for students to assemble, and the components are simple to replace if needed.



Here is a cleaner design in which I used a 3-volt coin battery. The pins on the battery holder were soldered to the LED and the wire leads. Alligator clips were used as the probes. This is a lightweight design, but soldering was necessary to connect the wires and LED to the pins, so this is not a student-friendly or simple design. If you can find a coin battery holder with wire leads, the assembly could use wire nuts instead of soldering.



I purchased my materials from  
All Electronics  
14928 Oxnard St.  
Van Nuys, CA 91411-2610  
888-826-5432  
[www.allelectronics.com](http://www.allelectronics.com)

Materials cost:

Wire nuts .....	\$.03 each
#24 guage wire .....	\$.06 per foot
3v LED light .....	\$.03 each
Coin battery holder .....	\$1.00 each
AA battery holder (2 required) .....	\$.50 each
Alligator clips .....	\$.25 each
AA batteries (from Dollar Tree) .....	\$.10 each
Coin batteries (from Dollar Tree) .....	\$.50 each
11" by 17" 80-pound card stock (from Office Depot) .....	\$.11 page

Wire nut:



Alligator clip:



24-gauge wire:



20 mm coin battery:



20 mm coin battery holder:



AA battery holder:



3-volt LED



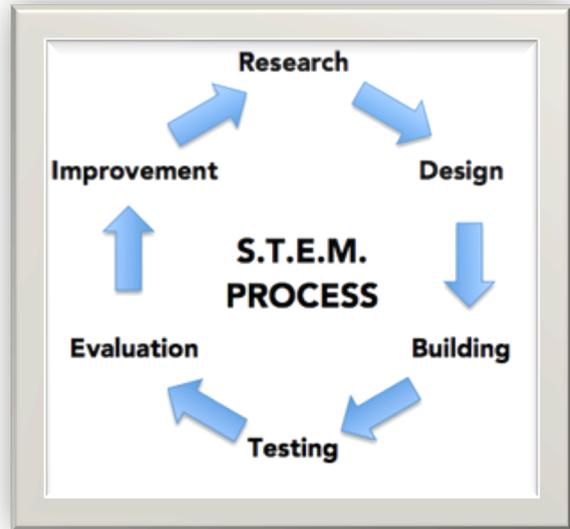
## A word about S.T.E.M. instruction:

What exactly is S.T.E.M.? Simply stated, it is an integration of science, technology, engineering, and math. However, it is more than a definition, it is a process. I view S.T.E.M. instruction as a **six-step process wheel** as shown here.

Because S.T.E.M. is a circular approach to learning, failure is not a dead end sign at the end of a road. When a student “fails”, he or she simply improves, researches, designs, and builds again. I have seen my students experience only momentary frustration when they fail to solve their problem or task. Then they jump right back in and restart with better knowledge.

We have often heard that Thomas Edison’s team of scientists made thousands of attempts to develop the filament in a light bulb. When asked, “Weren’t you discouraged from failing so many times?” it is said that he responded, “I didn’t fail. I simply learned 5,000 ways not to make a light bulb.” S.T.E.M. instruction gives students this fresh perspective on what failure really means. This is how they will work in the world beyond their school years; S.T.E.M. prepares them for that. They no longer feel failure paralysis or risk aversion.

For me, S.T.E.M. is problem-based learning in which students engineer a solution to a problem or task. The science, technology, and math are used as tools to support this search for the engineering as shown in this diagram. In each problem, the



amount by which a student incorporates these three tools can vary. Some tasks may use little math or a lot of technology. In other S.T.E.M. assignments there may be more balance among the three supporting components.

For more information about S.T.E.M. instruction and activities, I suggest taking a look at the blogs on my website: [www.tttpress.com](http://www.tttpress.com). Many of them are S.T.E.M. related and can give you ideas for implementation along with rationale for developing a S.T.E.M. program at your site.



If you liked this activity, you might also like some of the other character education 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](http://www.tttpress.com). Be sure to subscribe to receive monthly newsletters, blogs, and activities.

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

- *Slime Time* - A gooey lab involving Non-Newtonian fluids. Get the PowerPoint too!
- *Mystery Tube* - An engaging and exciting way to teach students the engineering process
- *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*