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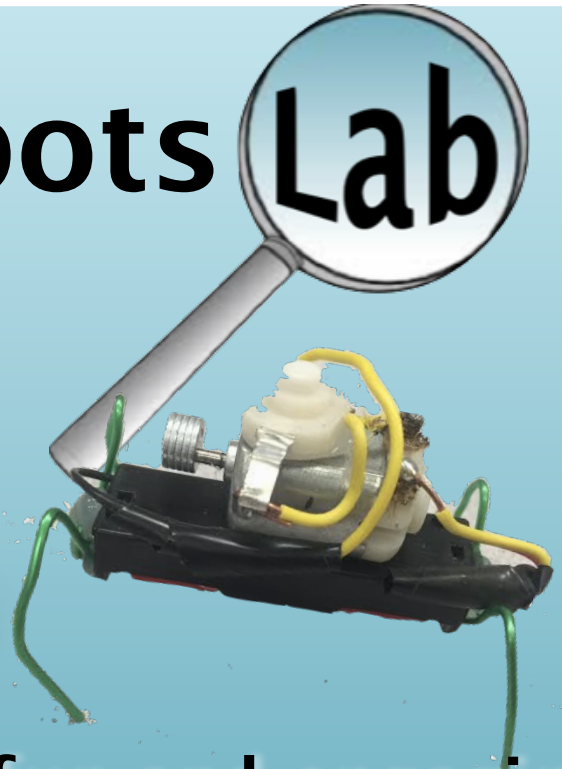
Vibrobots Lab



A fun and engaging builder's lab on electronics, art, and robotics

By Brad Fulton
Educator of the Year, 2005
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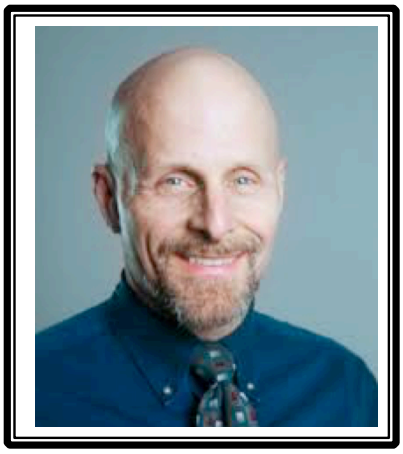
Brad Fulton

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.

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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- **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.

Vibrobots

A Fun and Engaging Builders Lab
On Electronics, Art, and Robotics

Overview:

Your students will love designing, building, and testing these inexpensive and creative robots that wiggle their way across their desks. They can compete with them in races and battles and even use them to draw artistic patterns. Using materials purchased from discount stores, each robot can be built and rebuilt for less than $2.00.

Required Materials:

- ☒ Electric toothbrush motors or pager motors
- ☒ Paperclips
- ☒ Tape or glue
- ☒ Light gauge electrical wire
- ☒ AA or AAA batteries
- ☒ Felt markers

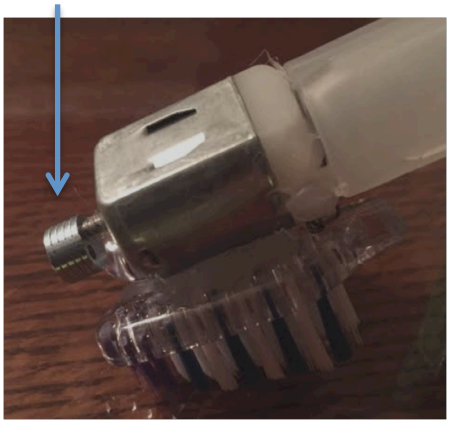
Optional Materials:

- ☐ Battery holders
- ☐ Items to decorate the robot
- ☐ Hot glue and glue gun
- ☐ Electrical tape
- ☐ Electrical solder

Procedure:

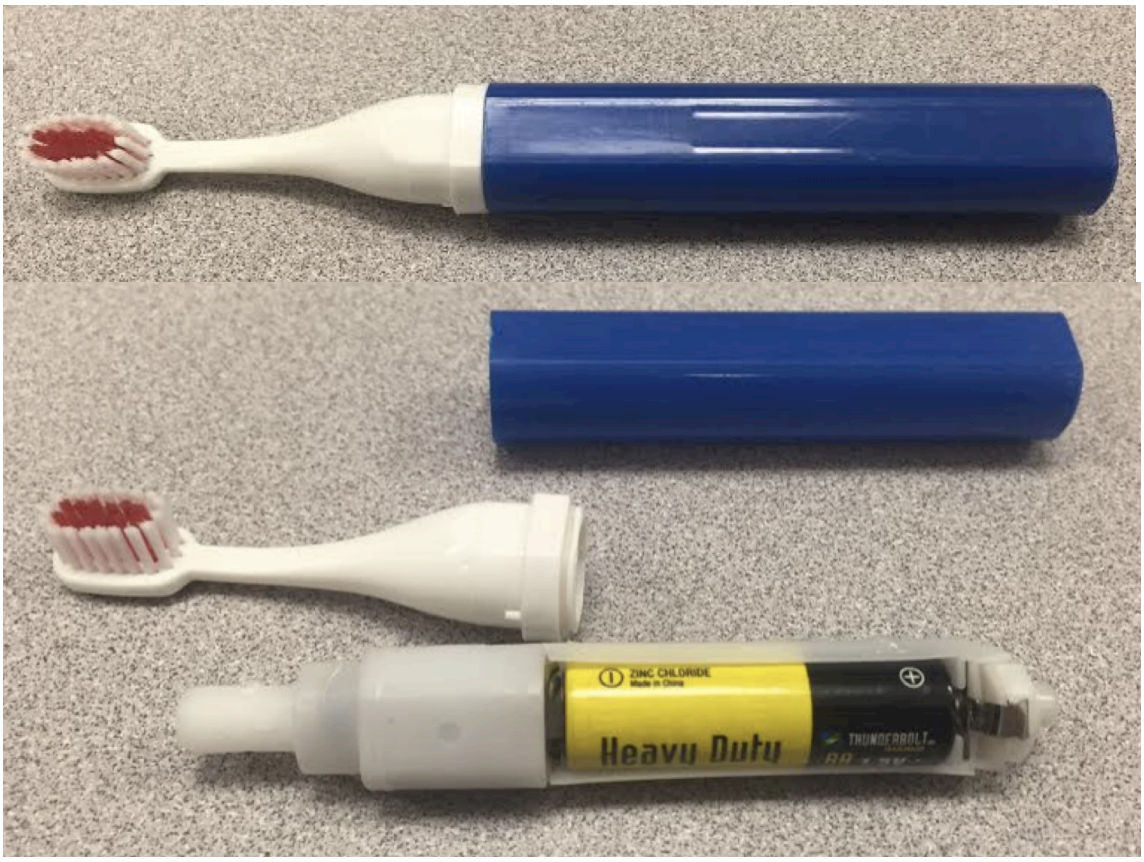
1. Prior to the activity, you will need to purchase some electric toothbrushes. I found mine at the Dollar Store for…yes, a dollar each. My students came in at lunch and removed the motor, battery holder and switch. These motors work by spinning an off-balance cam that causes the whole housing to shake and shimmy. If you want, you can simply use the motors, switches, and housing as they are – no modification is necessary. Simply drop in a battery, hit the switch, and watch it shake.
2. Students will need to tape or glue a set of paperclip legs to each end of the robot. It is important that these legs be angled back toward the rear of the bug to make it move forward. If you wish, you can attach toothbrush bristles instead of paperclip legs. This turns your bug into a millipede. Again, these bristles need to be angled toward the back as shown. I trimmed mine to create this angle as I didn't find any cheap toothbrushes with angled bristles. I used hot glue to secure them.
3. For more advanced models that can be customized, students may want to remove the individual components. This allows them to rewire the battery, switch, and motor into any configuration or design they desire. Here is a picture of the original parts and the individual

Offset cam



Angled bristles

components.



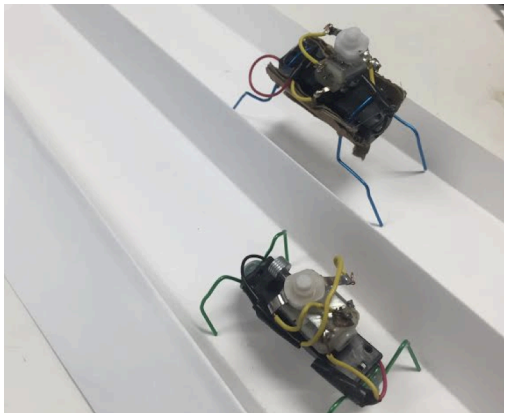
Motor housing Battery holder Switch

4. If you customize your robots, you may find that the battery holder no longer works. In the models I purchased, the switch was integrated with the battery holder, so once I removed them, there was no electrical connection between them. You can use wire to reconnect the components. In some cases, I soldered new connections, but your students may not be ready for the dangers involved in working with a hot soldering iron.
5. I found it easier to purchase AA battery holders. (AAA will also work and create a lighter robot.) These can be purchased from All Electronics (allelectronics.com) for less than a dollar each. Mine came with two lead wires that I connected to the motor and switch.
6. For a truly Spartan design, you can skip the switch. The battery can be wired directly to the motor. Once a battery is installed, away it goes. To turn it off, just remove the battery. This makes the wiring much simpler.

Catalog number: BH-311
allelectronics.com

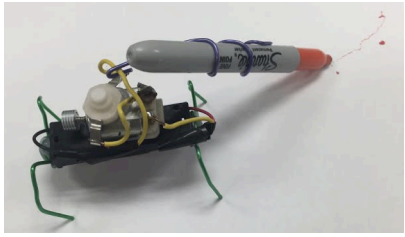
7. What makes these little critters crawl is the fact that the paperclips or toothbrush bristles point backwards. As the motor shakes, the legs push back against the ground causing the bug to creep forward, or more typically, to walk in a circle.

8. It is a challenge to get these guys to walk a straight line. By tweaking the paperclips or bristles, different movements can be achieved. If you want to race them, you can fold a track out of light cardboard like the one you see here, and the students can have races. You could also design them to fit a Hot Wheels track if you have that available.

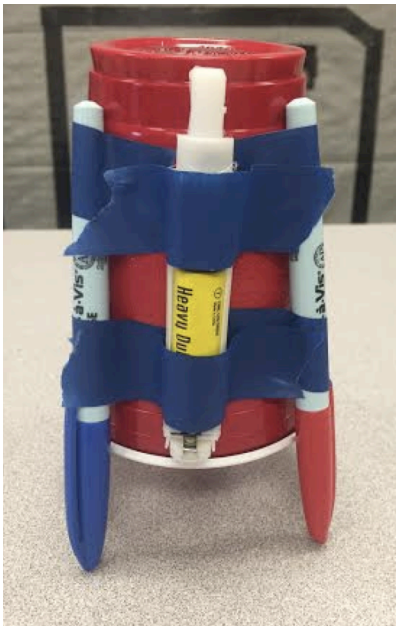


9. For an added challenge, students could try to create robots that could battle in a ring. How can they design them so that they knock over their opponents? The battle ring could be a pizza pan or anything with a border to contain the combatants.

10. If you desire a more peaceful application, attach felt markers to the vibrobots and let them create a wriggly design as shown here. A paperclip was spiraled around a pencil and then the felt marker was inserted into the clip. Here is a YouTube video of the art bots in action: https://www.youtube.com/watch?v=wWl5lH-fMAI



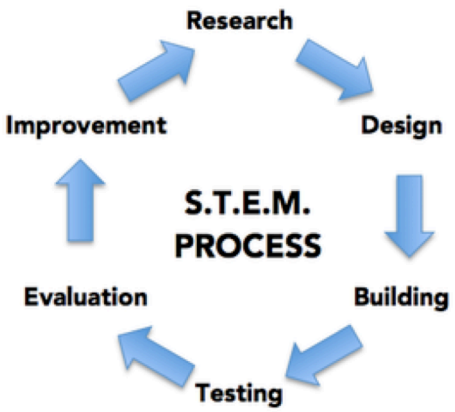
11. Attach three felt markers as legs to a lightweight plastic or foam cup using tape or rubber bands. Then attach the motor and power source in a similar way. These shaky artists will draw circular designs for you. Younger students (and my older ones too) will enjoy making these creatures more lifelike using pipe cleaners, googly eyes, and other features.



12. To get the most out of this activity, encourage your students to be creative. Let them think of their own ideas and designs. Offering a reward for the most *creative* design will often lead to some great discoveries along the way. Some suggestions are listed here.
    a. How can we make a robot that will walk straight?
    b. How can we make it faster?
    c. What if we use wheels?
    d. Can we make two of them have a tug-of-war?
    e. What other ways can we make it do art?
    f. Can it "finger paint"?

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 or performing art into the mix. Thus this activity incorporates many of these content areas:



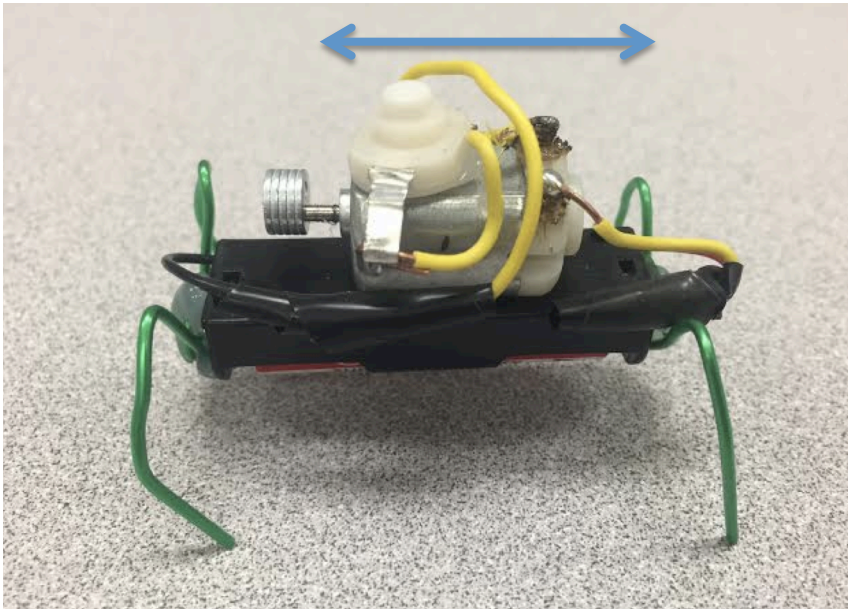
- Science: electronics and robotics
- Technology: research on robotics
- Engineering: designing the robot to maximize the efficiency and solve the challenges
- Art: abstract art
- Math: calculate speed in meters per second (mps) across a distance. This can also be converted into miles per hour if you wish.

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.

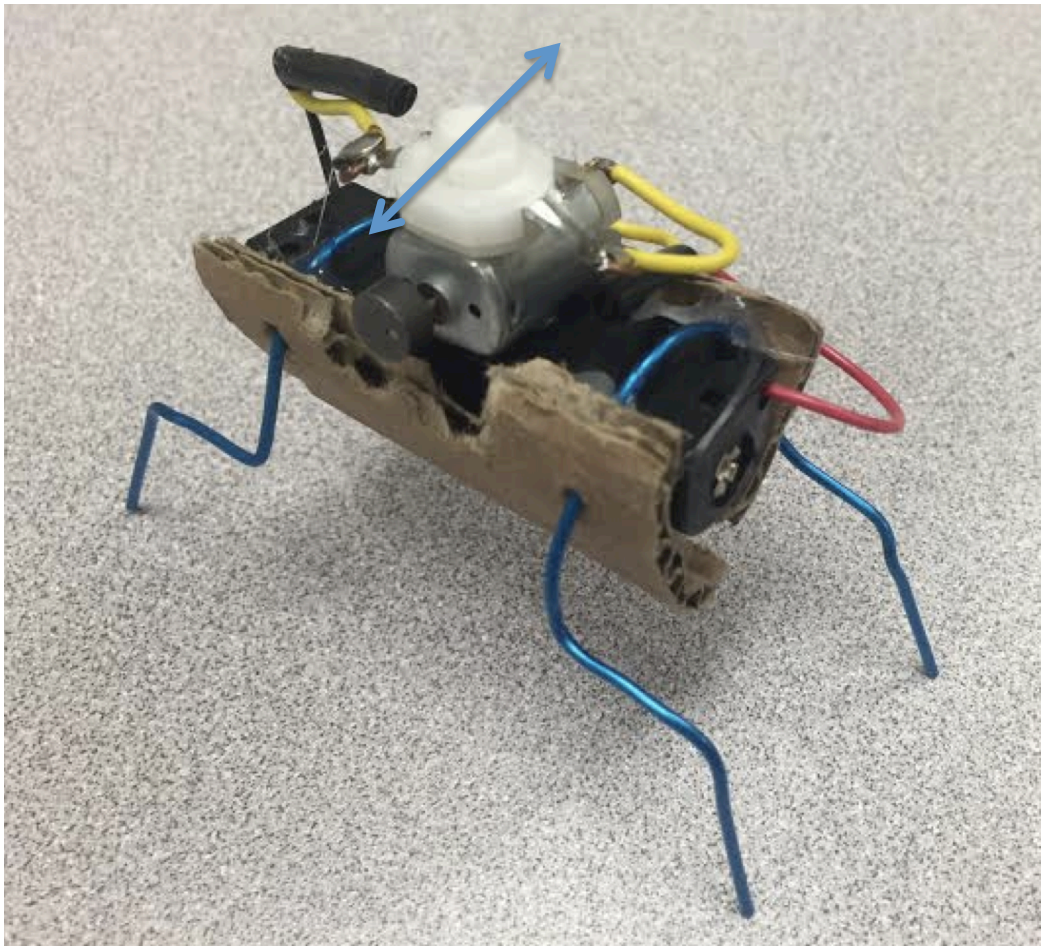
For more *S.T.E.M. on a Shoestring* activities, be sure to visit my website. You'll find dozens of lessons under the Resources tab.

In-line motor configuration

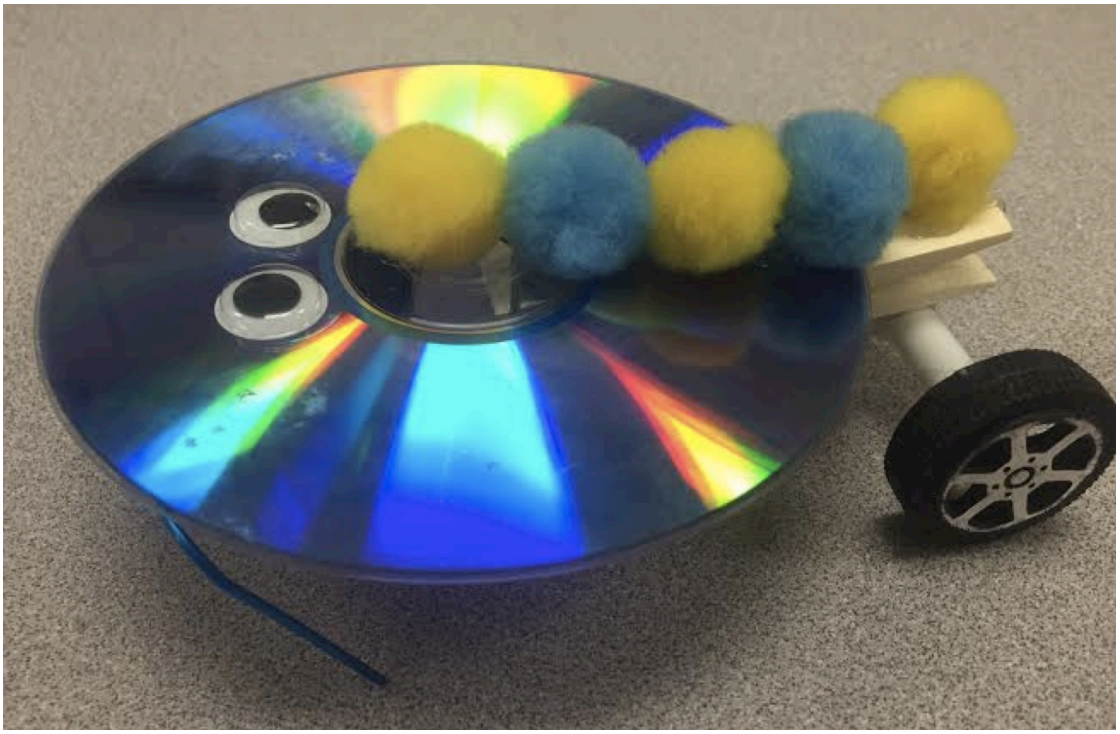


Note the rearward angle of the legs. This bot has an in-line motor mount. Electrical tape secures the connections.

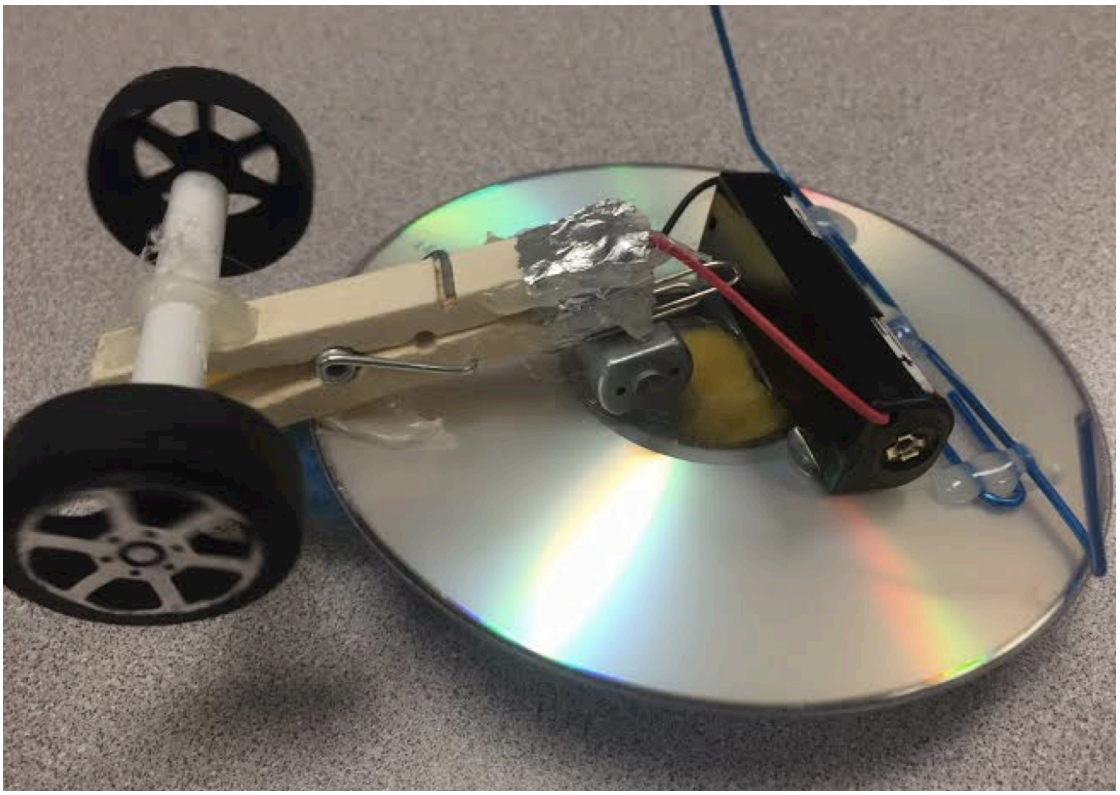
Motor is mounted transverse to the direction of the vibrobot



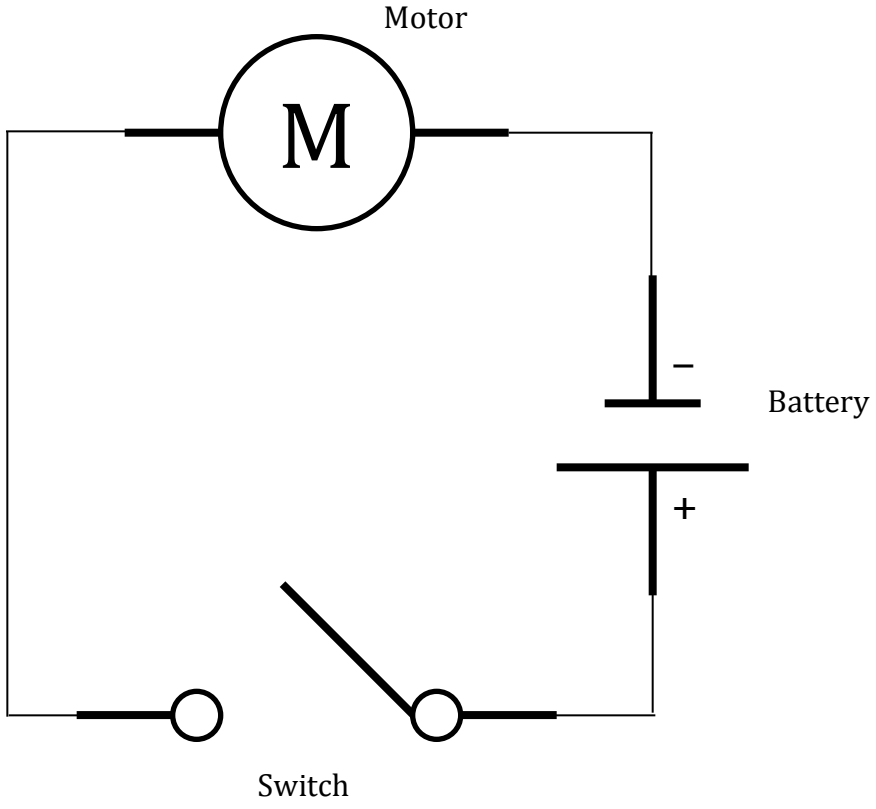
This bot has a transverse engine mount and uses a cardboard cradle for the assembly.



This bot uses a CD as a chassis and incorporates a clothespin switch and rear wheels to help it move in a straighter line. Googly eyes and pompons help of course!
The bottom view shows the battery and motor mount and the clothespin switch using aluminum foil contacts. Inserting a piece of paper between the clothespin contacts shuts off the engine.



Wiring diagram:



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:

- *Straw Oboes and Bladder Pipes:* A great way to integrate music and music theory into a S.T.E.M. lesson for pennies per student.
- *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