Some ideas for your brushbot from an engineer….

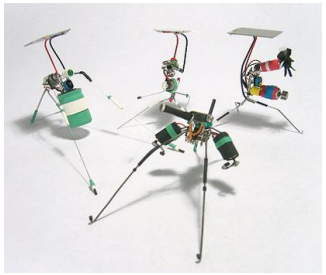
*Mount the motor on the end. This will convert as much vibration as possible into axial motion.
*Mount the motor on the rear end. This tends to lift the device off the front bristles and reduce friction.
*Mount the battery on the handle end. (Similar principle as above)
*Remove the middle bristles. This eliminates friction from unneeded center.
*Split the bristles. (Similar principle as above)
*Cut a slot in the plastic. The lightest, longest tends to move faster. (Notice how ships are designed)
*Cut the sides of the plastic. (Similar principle as above)
*Use a tail. This will tend to convert unwanted side wards movement into axial motion along the track.
*Mount the motor on the end. This will convert as much vibration as possible into axial motion.

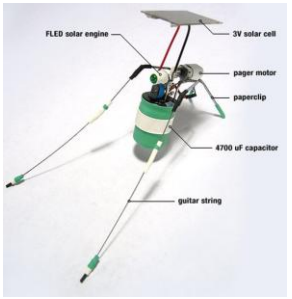
Why robotics for students?

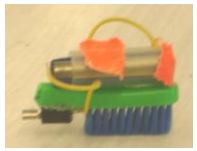
- It is not about building robots but building critical life skills….teamwork, problem solving, time management, effective communication.
- It is about raising the bar and expectations for our students through national and international competitions, and providing a measurable standard.
- It is about catalyzing interest in STEM career paths….it is about developing a work force for the 21st century.
- It is about making abstract concepts concrete, making learning relevant and engaging. It is about innovation needed to solve global issues.
- It is about "gracious professionalism," helping and collaborating on a global scale.

Try making a Vibrobot

- The key to Vibrobot movement is a motor (or motors) that employs an unbalanced weight. Pager and other motors used to create vibration alerts in consumer electronics use this technique. As the motor shaft spins, the weight on the shaft, being off-kilter, makes the motor, and therefore the entire pager, vibrate. Hook such a motor up to a little robo-critter with four fixed legs, and when the motor fires and the weight starts spinning, the bot will skitter across the floor. That's all there is to it. Since the legs don't need to be articulated or driven, there are few mechanical challenges in building a Vibrobot. The power circuit is very simple too.
- The simplicity of the mechanics and electronics frees you up to put more effort into making the bots look incredibly cool.
- The key to a good Vibrobot is to keep it as lightweight as possible so the motor can really jiggle it around when it fires.
- Play around with leg placement. Having only a couple of the legs touching the ground at the same time can create some interesting movement patterns.
- Buy a pack of jumbo- and regular-sized paperclips. For a few dollars, build a whole fleet of robots. Use paperclips and guitar strings for your creations.
- An assortment pack of heat shrink tubing goes a long way. Not only are your bots more interesting-looking, but you can use the tubing in key places to reinforce weak joints. I rarely have two strips of heat shrink on top of each other *just* for visual appeal.







What's happening? …the science behind the brushbot…..it is all about scientific inquiry….friction, center of gravity, inertia

Your brushbot should crawl erratically over any smooth, flat surface and maybe even fall over occasionally – if you're getting no movement try bending the bristles a bit or trying a different surface. To understand how it works, imagine holding a heavy bowling ball and taking a run-up as if to throw it, only to have your fingers stick in the holes at the last second. You'd probably be thrown off balance and fall flat on your face. This is called 'inertia'. An object in motion will stay in motion and an object at rest will stay at rest unless acted on by an unbalanced force

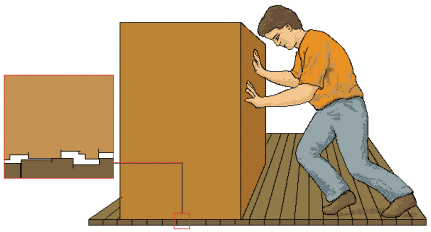
The unbalanced motor works in a similar way. Unbalanced by the weight, the motor's spinning shaft makes it vibrate rapidly, in turn making the toothbrush head shake in one direction and then back again very quickly.

So why doesn't it just sit in one place and buzz? Why does it move forward? Most toothbrush bristles are angled just like the hairs on a gecko's foot, meaning they'll slide smoothly in one direction, but not so easily in any other. The robot bug is thrown forward by the swinging weight and the bristles slide along the surface a short distance. When the weight swings back again, the bristles catch and resist moving. This way the bug creeps along the surface using friction, pushing along with its bristly feet.

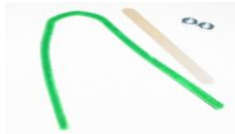
Mobile phones and pagers vibrate using a similar motor. A tiny motor thinner than a pencil with an unbalanced weight is whizzing around each time the phone rings. This vibration is transferred to the whole phone making it all vibrate and alerting you to the call. In some ways, your brushbot works a little like how a snake eats. Snakes have teeth which are angled backwards, just like the bristles on the toothbrush. Any prey they consume can move in easily.

Friction is actually a force that appears whenever two things rub against each other. Friction is a 'catch all' phrase for any force opposing the relative motion of objects in contact.

Friction releases some of the energy. This release can be in the form of noise, vibration, and energy transfer. Friction can also transfer energy into heat energy. If you rub your hands together you will notice that the skin on your hands warms up. Some of the energy of motion in your hands is transferred to heat energy through the friction process.

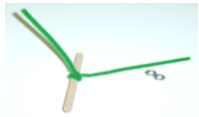


HCPS III Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process



Center of Gravity: the balance stick

1. Materials: craft stick, pipe cleaner, 2 metal washers
2. Bend the pipe cleaner in half; wrap it around the stick two times and twist to hold, ending up with two ends of the pipe cleaner about the same length.



3. Attach a metal washer to each end of the pipe cleaner.
4. Try balancing the stick on a fingertip; if it tips over and falls, move the location of the washers or the attachment location.

Center of gravity is the exact spot on an object where there is the same amount of weight on one side of the spot as there is on the opposite side. Once you change the weight anywhere on the object, the center of gravity changes too. The ease with which an object can be balanced depends greatly on the location of its center of gravity.

Which of the following did you apply in your investigation? (Circle all that you used)

Posed a question
Made a prediction (hypothesis)
Designed and conducted a simple investigation
Collected data
Analyzed the data
Identified variables (factors which could affect outcome/results)
Made a conclusion

Asked another question for further investigation: what is the question?