

BRISTLE BOTS

Goal: To introduce students to basic circuitry and the design process while fostering problem solving and critical thinking skills

Scientific Significance

Understand concepts related to circuits, energy, and Newton's laws. Explore the conversion of chemical to kinetic energy.

Key Terms

- ◆ Circuit: a closed path through which an electric current may flow.
- ◆ Battery: an electrical component that creates the driving force for the circuit
- ◆ Motor: an electrical component that converts electrical energy to kinetic energy (motion)
- ◆ Wires: electrical components that pass current easily from one part of a circuit to another



What are Bristle Bots?

Bristlebots are simple-to-assemble robots where the motion is caused by the transfer of kinetic energy from the motor, vibration, through the robot to the ground. The bristles rapid motion, from the vibration, enables the robots locomotion.

Directions:

- 1) Describe Bristlebots and show examples to the students.
- 2) Students will need a toothbrush head, motor, battery, mounting tape, and electrical tape. (Rubber bands are also helpful for securing the motor to the toothbrush).
- 3) Instruct students to apply the mounting (foam tape) to the back of the toothbrush head.
- 4) Place the *motor* on the top of the tape, using rubber bands if needed to secure the motor. (The placement does not matter, but it will determine which part of the toothbrush is the front, or which way the bot will move, so encourage the students to experiment if there is time.)
- 5) Shorten the *wires* of the motor, and strip the wires of their



Supplies

- ✦ Toothbrush heads
- ✦ Rubber bands
- ✦ Tape
- ✦ Double-sided foam (mounting) tape
- ✦ 1.5-3v motors
- ✦ 1.5-3v coin batteries
- ✦ Weights (coins, paper clips)
- ✦ Meter sticks
- ✦ Wire strippers
- ✦ Scissors
- ✦ Decorative materials

Facilitator Tips

- ✦ Engage students by asking about different robots they have seen or know of
- ✦ Describe bristle bots as a type of pogo-stick. The motor causes the bouncing up and down, and the tilted bristles from the toothbrushes cause the locomotion
- ✦ Suggest a competition or game to showcase their bristlebots such as a race with other bots, or bowling where they knock down small items

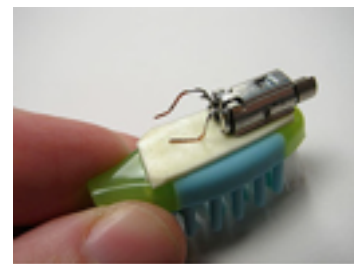
References:

<http://www.makereeducation.com/bristlebots.html>

<http://www.instructables.com/id/Bristlebot-1/>

<http://www.evilmadscientist.com/2007/bristlebot-a-tiny-directional-vibrobot/>

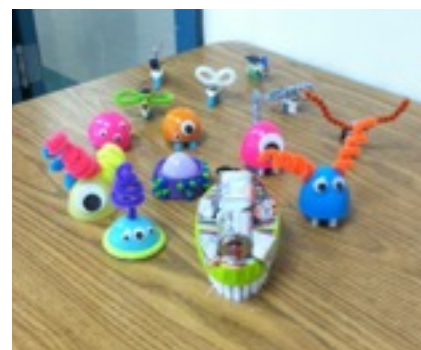
insulation, leaving enough wire to touch the *battery*. Place the negative side of the battery on top of the negative wire, securing it to the mounting tape.



6) At this point, the bristlebot should be functional, and will start moving. Ask the students what they notice about how their bristlebot moves and what would make the bots go straighter or faster. (Allow the students to modify the bristles by adding weights or adjusting the balance and seeing what helps. Don't suggest it right away to encourage experimentation.)

7) Have the students compare their bristlebots with others (usually in a race is most fun) and then discuss what components may make their locomotion different from others. (Encourage the students to take the lead on the discussion.)

8) Once the students have built their first basic bristlebot and discussed what makes it move most efficiently, they can sketch a design for a bristlebot using other decorative materials and/or types of toothbrushes. (Remind the students of what components makes a good bristlebot to prevent non-goal based experimentation).



Troubleshooting Tips:

- If the motor is not running, ensure that the positive side of the battery is touching the positive wire.
- Centralize the wires rather than letting them hang off the bristlebot to make it more efficient.
- If the bristlebot goes in circles, it may be a result of the placement of the motor, battery, or bristle shape.