Activity description: **BRISTLEBOTS**

- test the components (pager motor, battery)
- build and test the bristlebot
- customize the bristlebot
- races!

Age level: 7+

Time frame: short to medium

Equipment needed:

BASICS

- toothbrushes with the handles cut off
- pager motors (these can be ordered from ebay)
- 3V batteries (dollar store) – note 2 1.5V batteries can be stacked as well
- double-sided foam tape (dollar store)
- scissors

OPTIONAL CUSTOMIZATIONS

- eyes
- glue dots
- elastic bands
- chenille stems
- paperclips
- scotch tape
- toilet paper/paper towel tubes
- other??

Activity: The kids should be able to carry out all of these steps. Learning "moments" are indicated if the leaders wish!

1. **test the components**
   - get a pager motor and a battery. If you have a small battery (1.5V) then you need two of them, stacked so that the + side touches the – side of the other one. If you have a 3V battery then you only need one.
     (what is voltage? http://science.howstuffworks.com/what-is-voltage.htm)
   - hold the blue wire from the motor on the + side of the battery and the red wire on the – side of the battery. No, you won't get a shock. What happens?

- now reverse it: red to + side, blue to – side. What happens? (make sure the metal part of the wire is touching the battery, not just the plastic part. you should feel the motor vibrating – if you don't then try another battery or another motor)
- **What did we learn?** (explain about positive and negative terminals of the battery, and how when we create the circuit with the wires the electrons flow through the circuit. Nice explanation here: http://www.edinformatics.com/math_science/how_does_a_battery_work.htm)

2. build the bristlebot

- get a toothbrush head
- put a strip of doublesided foam tape on it
- stick the motor on the tape
- put the battery on the tape, making sure it is on top of one of the wires. Which wire? That depends on which way up your battery is! I put mine on top of the blue wire, because the – terminal of the battery was on the bottom.
- figure out how to get the other wire to touch the top of the battery
    - ideas: curve the wire; attach a paper clip and bend the wire around the clip, hold it down with an elastic band, bend a chenille stem around the battery and stick the wire under that …
- put your bristlebot on a smooth surface and watch it buzz around
- **What did we learn?** (how does it move? what makes the motor vibrate? is there anything in the real world that moves like this? what uses can you think of for this type of robot?)

3. customize the bristlebot

- does your bristlebot go straight? Do you think you could make it go straight?
- add eyes (using glue dots), antennae, wings, stabilizers, … to your bristlebot to see if you can affect how it moves. You can even try trimming the toothbrush bristles if you like, but be careful – you won't get another toothbrush if this one gets wrecked!

4. race your the bristlebot

- have some races to see whose bristlebot will get from point a to point b the fastest. No helping it out! Did your modifications make any difference?
- can your bristlebot carry anything, e.g. a roll of tape?
- can your bristlebot get through a paper towel/toilet paper tube?
- what surfaces does your bristlebot work on?

Resources

- this idea was copied entirely from websites such as http://www.evilmadscientist.com/2007/bristlebot-a-tiny-directional-vibrobot/ and http://www.instructables.com/id/How-to-make-a-bristlebot/
- other sites to check out:
    - http://www.bristlebotics.com/teaching-resources/animals-and-robots
    - http://www.genomicon.com/2009/06/return-of-the-bristlebot/ (bristlebots in space? in your body?)