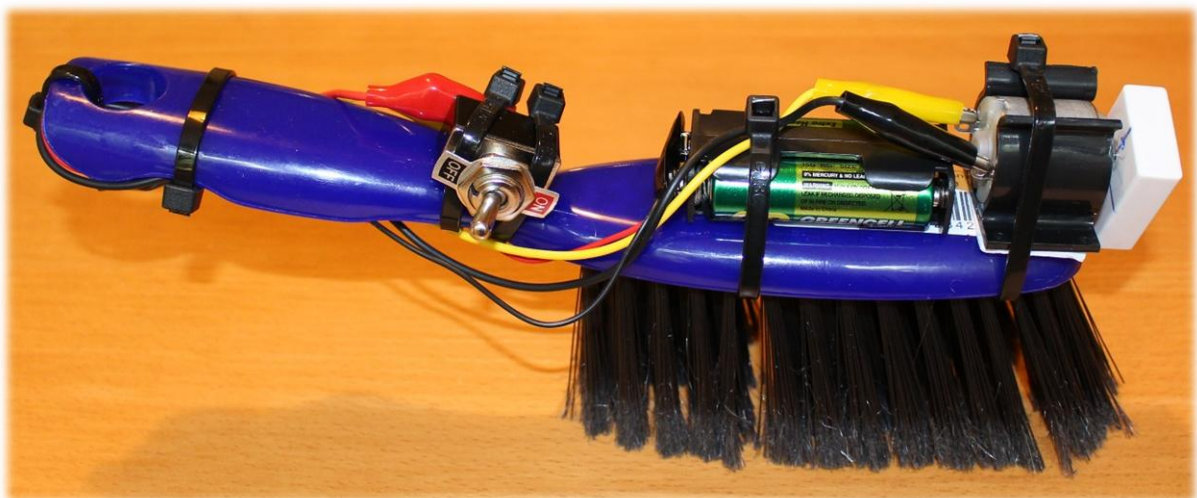


Brush Monster Instructions



Follow this step-by-step guide on how to make your own vibrating brush monster.

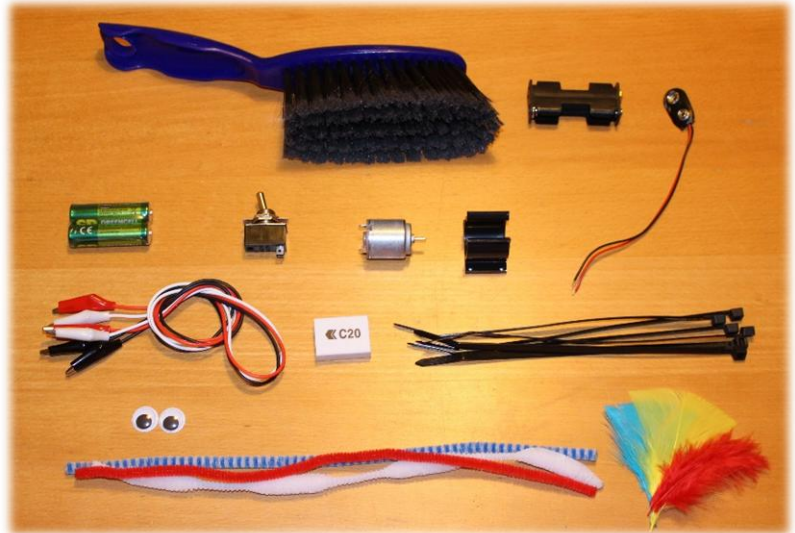
Associated resources:

- Brush Monsters Lesson Plan
- Brush Monsters Presentation
- Brush Monsters Worksheet

You will need:

Parts

- Dustpan brush
- Battery holder 2xAA
- Snap battery connector
- 2 AA cells (zinc cells, **not** alkaline or rechargeable)
- Toggle switch
- Motor
- Motor mount
- 3 crocodile leads
- Eraser
- 6 cable ties
- 2 wiggly eyes
- 3 pipe cleaners
- Feathers



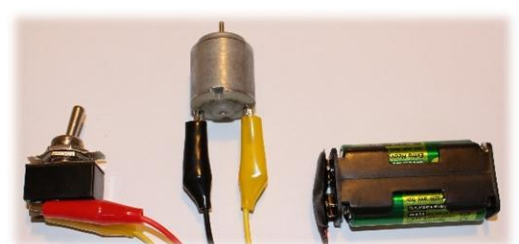
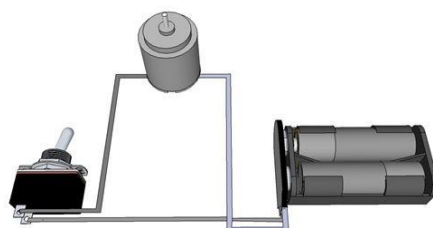
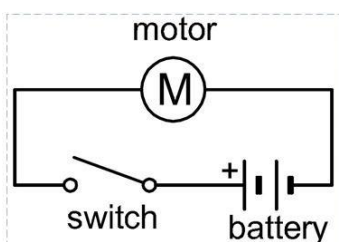
Tools and consumables

- Ruler
- Ball point pen
- Large scissors
- Low melt temperature glue gun
- Optional – double-sided foam sticky pads



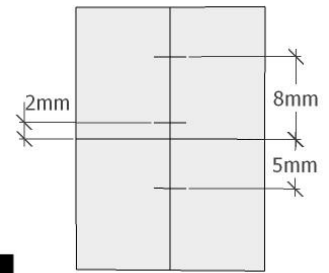
Step 1

Make the circuit below and check that the motor shaft goes round when you switch on. Then switch off. Make sure you clip onto the metal ends of the wires from the snap battery connector, not onto the plastic insulation! Be careful not to short circuit your battery (i.e. connect the wires from your battery directly together) - they must go via the motor. Tie the wires from your battery snap in a reef knot as shown on the right - then you are less likely to accidentally short circuit your battery. Also make sure the plastic sleeves cover the crocodile clips as shown.



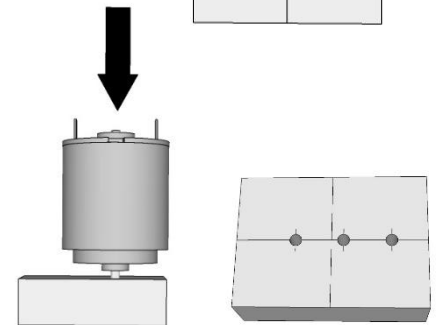
Step 2

Draw two centre lines on your eraser, on the blank side. Measure and mark lines 2mm, 5mm and 8mm from the shorter centre line as shown.



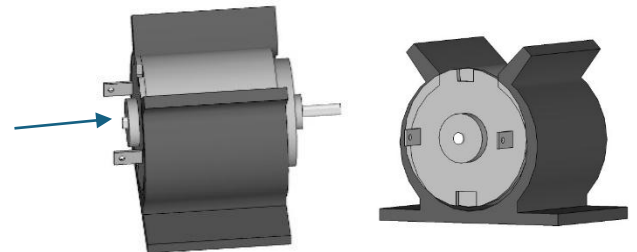
Step 3

Unclip the crocodile leads from the motor terminals. Put the eraser flat on the table with the lines you marked on the top. Use the motor shaft to make vertical holes in the three positions you marked. Push down hard in the middle of the motor – be careful not to bend the motor terminals. Remove the eraser from the motor shaft.



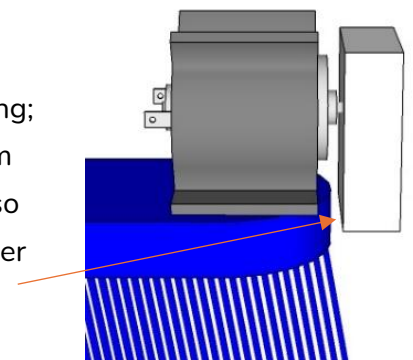
Step 4

Push the motor into the motor mount from the end (see the direction of the arrow - if you clip the motor in from above you can snap the motor mount). Rotate the motor in the mount until the motor terminals are roughly the same height. Push the motor shaft into one of the offset holes you made in the eraser.



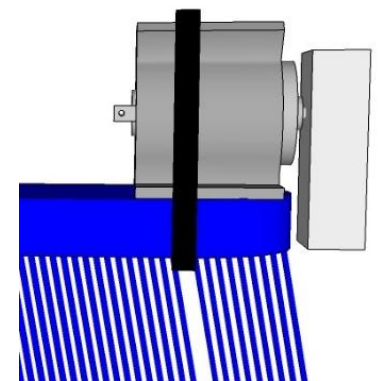
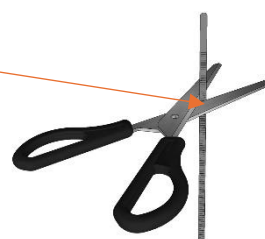
Step 5

Make sure the back of the motor lines up with the back of the motor housing; the front of the motor should protrude a little. Remove the plastic film from the sticky pad on the bottom of the motor. Stick it at the end of the brush so that the eraser hangs over the end. There must be a gap between the eraser and the end of the brush, so the eraser doesn't jam when the motor turns.



Step 6

Feed a cable tie between the bristles and use it to attach the motor firmly to the brush so it doesn't vibrate loose. Don't put the cable tie too near the end of the brush as it could slide off. Try to fit the cable tie into one of the gaps between the bristles so you don't distort the bristles too much. Pull the cable tie very tight and then trim off the loose end with large scissors. (The cable tie is quite hard to cut; it is easier if you cut close to the pivot part of the scissors as shown, to maximise the lever ratio of the scissors when cutting.)



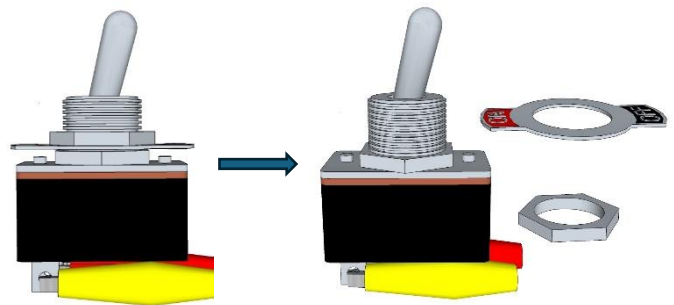
Step 7

Clip the crocodile leads back onto the motor terminals. Switch on and check the eraser rotates, then switch off. Place the battery holder on the brush close to the motor mount, allowing enough space for the crocodile clips on the motor terminals. You could use two double-sided foam sticky pads on the bottom of the battery holder to hold it in position. Cable tie both the battery holder and crocodile leads together to the brush, trying not to distort the bristles.



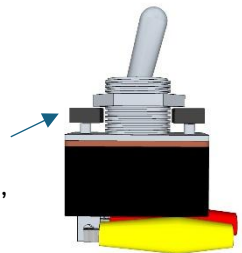
Step 8

Make sure the crocodile clips are lying flat along the bottom of the switch. Unscrew the top nut from the switch and remove the label. Don't lose these. If you have any difficulties loosening the nut, you could use pliers or a spanner or ask someone with stronger fingers to help you!



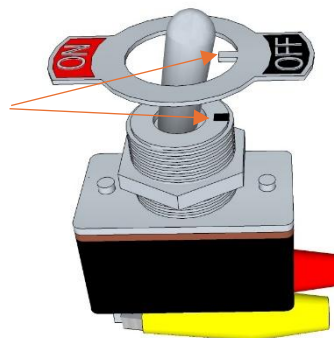
Step 9

Unscrew the second nut on the switch until there is enough space to fit a cable tie in between the body of the switch and the nut. Place the switch flat on top of the brush, where it narrows between the bristle end and the handle. You could use a double-sided foam sticky pad to hold it in position. Cable tie the switch and the crocodile clips to the bottom of the handle using two cable ties, one each side of the toggle, as shown. Trim off the ends of the cable ties, being careful not to cut the wires.



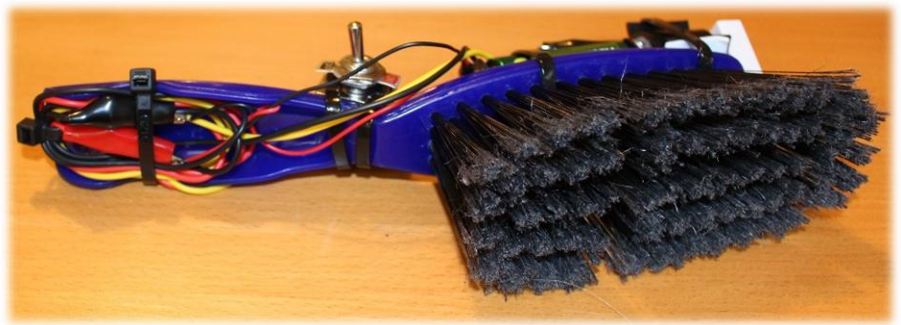
Step 10

Put back the label, making sure the lug on the 'off' side lines up with the notch in the side of the switch. Screw the top nut back on, being careful to screw it on straight, so that the thread does not get damaged.



Step 11

Tidy up the wires and crocodile leads – you could lay them along the underside of the brush handle and cable-tie to the brush as shown or coil them around the brush handle.



Step 12

Try out the brush monster on a smooth floor. You can try mounting the eraser using a different hole – the further the hole is from the centre, the more the brush should vibrate. When you push the eraser onto the motor hold the motor in position so that it doesn't move back, or the eraser could jam against the end of the brush. See if you can get the brush monster to go in a straight line. Swapping over the two crocodile clips attached to the motor contacts changes the direction of rotation and can change the direction of movement of the brush monster a little. If the eraser is mounted nearer its centre, the brush monster is more likely to go in a straight line, and the eraser is less likely to fly off. If the eraser flies off during operation, you can push it on further (as long as it doesn't touch the end of the brush) or mount it using a different hole. You can also make additional holes or use another eraser.



Step 13

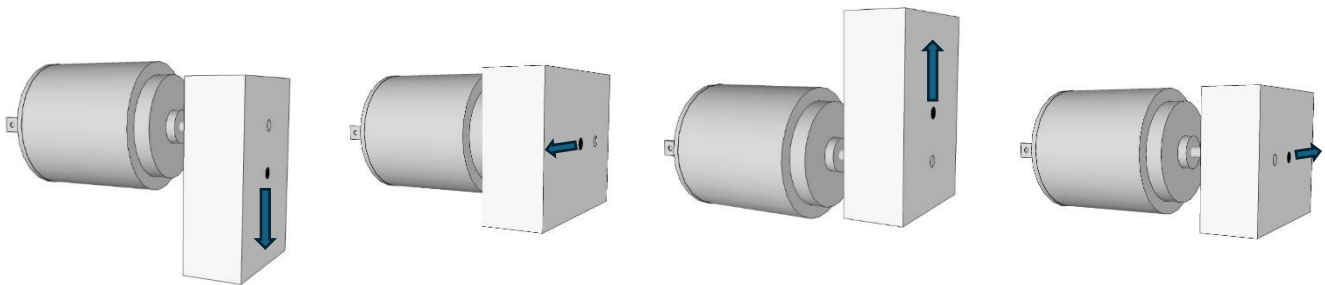
Decorate the brush monster. You can use the googly eyes, pipe cleaners, feathers and any other lightweight decorations you may have. If you want to turn the pipe cleaners into spiral shapes, you can coil them round a pencil.





How it works

Because the mounting holes in the eraser are not in the centre, when the eraser is mounted on the motor shaft, its centre of gravity is offset from the centre. When the eraser rotates, its centre of gravity travels round in a circle. This gives rise to a force, which also moves round in a circle. This moving force causes the brush to vibrate. The vibrations are transmitted down the bristles, making the brush move. As the eraser goes through its top point, the brush gives a tiny hop upwards.



The bristles of the brush are sloping. If you try sliding the brush along your hand, you can feel that the bristles move easily one way, but not the other. This helps the brush progress along the floor as it vibrates.

More details about how the brush monster works are given in the Brush Monsters Presentation.