



# Brush Monsters

## Lesson Plan

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## **Brush Monsters Summary**

Recommended level – Years 4-6

Time taken – 5-6 hours

Pupils to work in groups of 3

Additional adult help is useful – you could invite in parent helpers

Expectation – each group to complete one working brush monster

Associated resources:

Brush monsters PowerPoint

Brush monsters worksheet

Brush monsters worksheet - suggested answers

How to make a brush monster blog

## **STEM Links**

- Science: electrical circuits
- Technology: electrical systems, making and testing products
- Engineering: troubleshooting, how a brush monster works
- Mathematics: measure distance and time, calculate average speed

**Curriculum Learning Objectives** – it is recommended to cover these topics prior to the exercise so that the pupils are reinforcing their knowledge and understanding, rather than meeting the topics for the first time.

## **Science: Electricity**

(Years 4 & 6)

Pupils should be taught to:

- construct a simple series electrical circuit, identifying and naming its basic parts
- recognise that a switch opens and closes a circuit
- recognise some common conductors and insulators, and associate metals with being good conductors
- use their circuits to create simple devices
- use recognised symbols when representing a simple circuit in a diagram
- pupils should be taught about precautions for working safely with electricity

## **Design and Technology**

(Key Stage 2)

Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making. When designing and making, pupils should be taught to:

### **Design and Technology: Design**

- design innovative, functional, appealing products that are fit for purpose

### **Design and Technology: Make**

- select from and use a wide range of tools and equipment to perform practical tasks
- select from and use a wide range of materials and components according to their functional properties and aesthetic qualities

### **Design and Technology: Evaluate**

- evaluate their ideas and products

### **Design and Technology: Technical knowledge**

- understand and use electrical systems in their products

## Mathematics

Pupils should be taught to:

- Measure length and record time
- Compare duration of events

Pupils could be introduced to compound units for speed and apply their knowledge in science or other subjects.

## Equipment needed

### Parts provided in the kit per brush monster (total in kit):

- 1 dustpan and brush (total 10)
- 1 battery holder (total 10)
- 1 snap battery connector (total 50)
- 1 toggle switch (total 10)
- 1 motor (total 10)
- 1 motor mount (total 10)
- 1 eraser (total 40)
- 3 crocodile leads (total 30)
- 6 cable ties (total 100)
- Googly eyes (total 560)
- Pipe cleaners (total 1 pack)
- Feathers (total 1 pack)
- Self-adhesive foam sheet (total 1 pack of 10 coloured sheets 200mm x 300mm)
- Self-adhesive hook and eye dots (total 250)

Check you have received the correct contents in your class kit. Please let TTS know if there are any problems as soon as possible.

### Tools and consumables required but not included in the kit:

- 2 AA cells (these are often called batteries) per brush monster. It is very important to use **zinc chloride** type of cells, **not** alkaline or re-chargeable ones. If the pupils accidentally short circuit their battery (which often happens) then alkaline or re-chargeable cells get extremely hot and can cause burns. Zinc chloride type cells are cheap and easily available (e.g. from discount stores).
- Rulers
- Ball point pens
- Large scissors
- Low melt glue guns and glue sticks (several needed, e.g. 4-5, as there is likely to be a large queue to use them!). **Note: High melt temperature glue guns should not be used, as they can cause nasty burns.**
- Pliers may be required to loosen the nuts on the switches if they are too tight

## Risk Assessment

Conduct a risk assessment before undertaking the activity. A sample risk assessment is given below; you can use this as a starting point when writing your own.

Activity	Identified Hazard	Initial Risk Rating L/M/H	Control Measures	Controlled Risk Rating L/M/H
Use of glue guns	Burns	H	Children should be supervised by a responsible adult at all times when using the glue guns. Explain to children how to use the glue guns. Warn them that the ends are very hot. Use only low melt temperature glue guns.	M

			If burned hold under running water for ten minutes. Don't switch on the glue guns until after the safety briefing. In some schools children wear safety goggles when using glue guns.	
Accidentally short-circuiting battery	Burns, smoke inhalation	M	Explain how to avoid short circuits. Use only zinc chloride cells, not alkaline or re-chargeable ones as these can get very hot if short circuited.	L
Use of scissors	Injury e.g. to fingers	M	Make the children aware of the dangers. Do not give out the scissors until after the safety briefing.	L
Rotating eraser flying off motor shaft and hitting someone in the eye	Bruising or damage	M	Explain the dangers to the children. Check the erasers fit tightly on the motor shafts. Children could wear safety goggles.	L
Running extension leads along floor for glue guns	Trip hazard	M	Avoid using extension leads if possible. Otherwise make sure extension leads are run where they cannot be tripped over.	L
Damaged extension leads or glue gun leads	Electrocution hazard	H	Conduct a visual check of all electrical items before session to ensure the leads are undamaged.	L

### **Vocabulary list**

Battery / cell – this converts chemical energy into electrical energy. It is used to ‘push electricity around a circuit. If you connect cells together you get more ‘push’ – a battery consists of two or more cells.

Conductor – an electrical conductor allows electricity to flow through it. Metals are good conductors.

Insulator – an electrical insulator stops electricity passing through. Plastic, wood, rubber and glass are insulators.

Offset – the distance by which something is not in line or not central.

Short circuit – an electric circuit which allows the electricity to flow round it with very little resistance, so the battery will drain quickly and get hot.

### **Preparation needed**

- You could build a sample brush monster to explore any pitfalls. Instructions are given in the ‘Make a brush monster’ blog. If you have 30 pupils then you will need to dismantle your brush monster to re-use the parts.
- Lay out the electrical parts in trays (e.g. you can re-use clean plastic food trays) for the pupils to collect.
- Borrow ten bowls or use plastic food trays for the pupils to collect their electrical parts in. Then they are less likely to drop or lose them.
- Print out one worksheet per brush monster.

## **Hints and tips**

### **Glue Guns**

- Allow ten minutes for them to warm up before use. You can jam the glue guns by trying to use them before they are fully warm.
- Do not use the glue guns after they have been switched off, as you could jam them while they are cooling down.
- Keep spare glue sticks in a bag or box. If you leave them out on the gluing station they can get glue on and then jam the glue gun when inserted.
- Keep the glue guns spaced well apart to avoid gluing up the glue stick of the gun next to them.
- Don't pull the glue sticks out of the glue guns, as you could damage them.

### **Title slides**

- Highlight the variety of different brush monster designs shown, to give the pupils some idea of the scope of what they might do.

### **Slide 2 – Electrical parts**

- You could hold up each electrical component and ask pupils to name it.

### **Slide 4 – Avoid short circuits**

- Explain what a short circuit is (see vocabulary list above).

### **Slide 5 – Make your circuit**

- It is helpful to lay out a set of components in a triangle and then demonstrate how to connect them up and fit the cells.
- Pupils can then go and collect their electrical parts in a bowl or tray so they don't drop or lose them.
- It is difficult to hear whether the motor is on in a noisy classroom. Instead you can feel whether the shaft is turning with your finger.

### **Slide 6 – Prepare your eraser**

- Demonstrate how to make a hole in the eraser using the motor.

### **Slide 7 – Prepare your motor**

- Demonstrate how to push the motor into the motor mount from the end (not above) and rotate it so the terminals are at the same height.

### **Slide 8 – Fit your motor**

- Check the motor mounts are about 6mm from the end of the brush, and that there is a small gap between the eraser and brush before moving on to the next slide (when they will be cable tied in position).

### **Slide 9 – Attach your motor firmly**

- One child could hold the bristles apart while another feeds the cable tie through the gap. Cable ties only work one way round. Check the cable ties are really tight before cutting the end off.

**Slide 10 – Attach your battery**

- The reason for the gap between the motor and battery is to allow the crocodile leads to lie flat along the top of the battery. It is easiest to have the battery snap connector at the end furthest from the motor. The reason for cable tying down the crocodile leads together with the battery box is to prevent the crocodile clips from vibrating off the motor contacts.

**Slide 11 – Attach your switch**

- Show the children which way round the switch goes as it will make it easier to attach. Make sure the cable tie is really tight before cutting the end off, or the switch can work loose.

**Slide 12 – Tidy up the crocodile leads**

- Be careful not to cut the crocodile leads by mistake when cutting off the ends of the cable ties!.

**Slide 13 – Try out your brush monster**

- It is difficult to get the brush monsters to go in a straight line. You could make a race track, for example by putting benches on their sides, strips of cardboard or using lengths of square guttering. Or you could just measure the speed over a short distance and mark a start and finish line with chalk or masking tape. If you attach the eraser with a small offset distance it is more likely to go in a straight line.

**Slide 16 – Plenary**

- Because the eraser is mounted offset, as the motor turns the centre of gravity of the eraser moves round in a circle, which makes the brush vibrate. If you slide the brush over your hand you should be able to feel that it slides easily one way but not the other. You can see the bristles are sloping; one way the bristles are sliding over your hand, whilst the other way they are digging in and resisting movement. This is what causes the brush to move forwards as it vibrates; it is called the 'ratchet effect'.

Suggested answers to various questions on the slides are to be found in 'Vibrating Brush Monsters Worksheet – Suggested Answers'.