

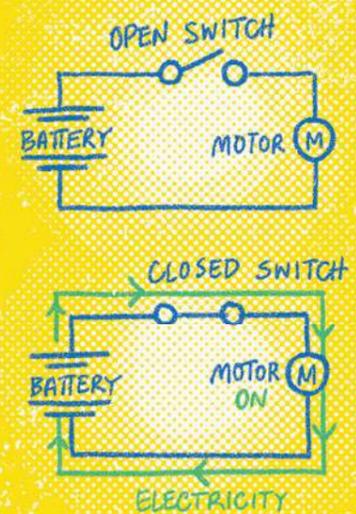
WROOM!

MAKE A MOTORISED CAR



You may have made an electrical circuit before. When you study them at school, the first one is usually made from electrical wires, two AA batteries, a light bulb and a switch. You join them together to make a circle and *Hey Presto!* The bulb lights up when the switch is closed!

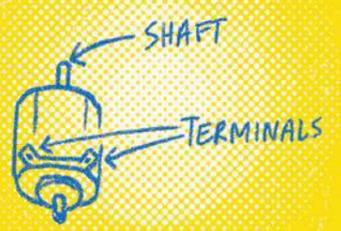
Now, have you ever made a motorised car? A robot car, if you will. You haven't? Let's get making then!



GO WITH THE FLOW

First, take a look at these **circuit diagrams**. The first one is a circuit with the switch open (or off) – the electricity cannot flow around the whole circuit, so the motor stays off. The second is a complete circuit. Here, the electricity can flow from the battery, along a conductive wire, through the closed switch, to the motor (which turns on), then along a conductive wire back to the battery again. **The motor changes electrical energy into mechanical energy so that we get movement.** *Clever! Ed*

We'll use a 9V DC motor, which looks like this:

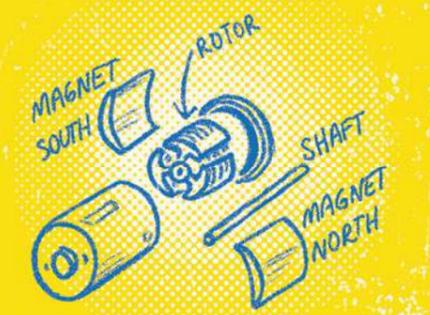


PLEASE DO NOT TAKE IT APART! – If you did take it apart, you would see that the **shaft** (turning part) is attached to the **rotor**. The rotor has three coils of copper wire wrapped around it and the

electricity flows through these to make an **electromagnetic field**.

If you have ever played with magnets, you'll know that opposite poles **attract**. North-south pull together but south-south and north-north **repel** – they push away.

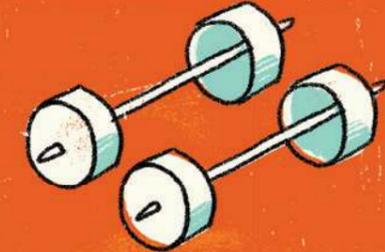
The electromagnetic field interacts with two curved magnets inside the motor. At the same time, the motor is turning the electricity on and off, which makes the electromagnetic field also turn on and off. The result is a turning rotor. The rotor is attached to the shaft, so that turns too. Electrical energy has become mechanical energy! *I've said it before and I'll say it again, clever. Ed*



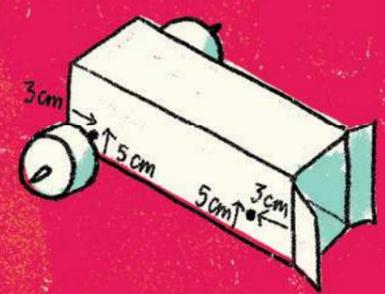
MAKE A ROBO CAR

- YOU WILL NEED:**
- Adult helper
 - 4 x identical bottle caps
 - 3 x cocktail sticks
 - Long rectangular box eg: toothpaste/puree box or similar
 - Ruler
 - Pencil
 - Scissors
 - Short elastic band
 - Sticky tape
 - 9V battery plus holder with switch
 - 9V DC motor

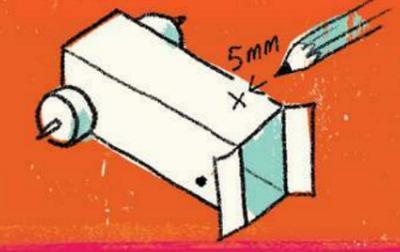
1 Make two sets of wheels from the plastic lids and cocktail sticks. You will need an adult to help you make the holes in the lids.



2 Carefully use the third cocktail stick to make the holes in the box for the axles. You'll need to add an axle about 3 cm in from each end to balance your car. They need to be about 5 mm up from the base of the box to make sure they can rotate freely. Add the wheeled axle at one end only, this one will not be powered.



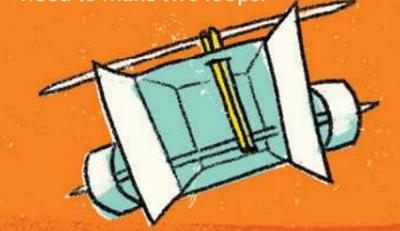
3 You are now going to work on the powered axle. Use a pencil to mark an X on the top of your car. It should be directly above the remaining axle holes and about 5 mm from one edge. Use sharp scissors to make a 5 mm hole where the X is.



4 Poke one end of the elastic band through the hole you have just made and use the cocktail stick to stop it falling through.



5 Add the second axle, taking care to thread the cocktail stick through the elastic band. The elastic band needs to be tight enough to grip, so you might need to make two loops.



6 Now it's time to add the motor! The elastic band loop, which pokes out of the roof of the car, needs to wrap round the shaft of the motor. Carefully pull the elastic band upwards, remove the cocktail stick and poke the shaft through the loop as shown. Use sticky tape to hold the motor in place.



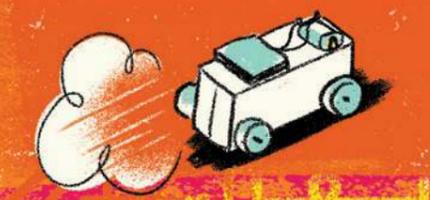
7 Finally, stick the battery holder on top of the box, put it towards the middle but so the wires can still reach the terminals on the motor. Make sure you can access the switch! Close the ends of the box.



8 Check the battery holder is switched off, then attach the wires to the motor terminals. Hook the wire round the terminal and make sure the shiny metal of the wire is in contact with the shiny metal terminal. Use a piece of sticky tape to secure it.



9 Put the car on the floor, switch it on and watch it zoom off!



EXPLORE!

Your car will work best on a smooth wooden, tiled or paved floor – carpets are usually too rough! Why do you think that is?

- What happens if you connect the wires to the opposite terminals? Does the car still travel in the same direction?
- Can you replace your wheels with different lids or circles of card? What effect does that have? Some lids have really textured edges, which helps to give your wheels **traction** as they grip the ground better.