

RUNNING ON A BATTERY

Equipment that has moving parts often works on electricity. It has an electric motor. That sounds complicated but with a few simple bits of material, you can build one. And that's exactly what you are going to do. Run your own electric motor!

WHAT DO YOU NEED?

Materials:

- Ceramic disk magnets, 15 x 6 millimeters in diameter
- A flat 4.5 volt battery
- Electrical wire
- Lacquered copper wire
- Metal paperclips, ordinary
- Metal paperclips, big
- Paper or plastic beaker
- Adhesive tape

Tools:

- Pencil
- Ruler
- Stripping pliers
- Fine sandpaper
- Black, waterproof marker

BUILDING PLAN

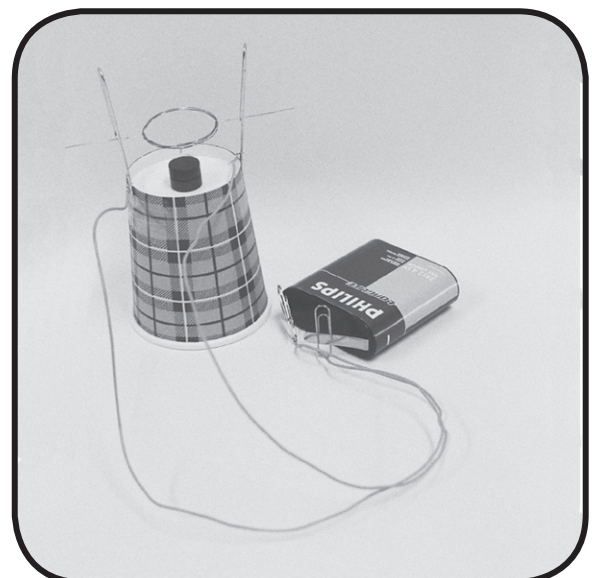
Before he starts building, a builder of exhibits first makes a building plan of the exhibit. That's what you are going to do too. A building plan shows how something is made and how big it will be.

First look at the photo and the drawings under 'How are you going to make it?' This will give you an idea of what the exhibit will look like and how it should be constructed.

Tips: 1. You can read the text accompanying the drawings already. 2. If the materials for your exhibit are already available, it's a good idea to have a look at them too.

Under 'What do you need?' you can see all the materials and tools that you need. But the list of materials does not show exactly how much of them you will need. You will know that only when you have decided how big the exhibit will be. So first decide with your pal how big the exhibit should be and how you are going to draw it.

Discuss your plan with your **teacher**.



Now use a pencil and ruler to make a building plan in your **workbook**. You both make your own building plan in your workbooks, but you do it in the same way. You make the drawing to scale 1:2. This means that one centimeter in the drawing is really two centimeters in real life. So if your electric motor is fifteen centimeters high in real life, it will be seven and a half centimeters high in your building plan. Write the real measurements next to the different parts. For this, use the description under 'How are you going to make it?'

You are going to show the building plan to the rest of your class. Tell them how you plan to build the exhibit. Ask the other children and the teacher what they think of the building plan. Maybe they have an idea to make it even better.

Show your improved building plan to the **teacher**. When he or she has approved your drawing, you can start making the list of materials together.

LIST OF MATERIALS

The building plan is ready, so you now know the size of all the materials and you can count how many of each part you need. Make the list of materials in your **workbook** and give the list to your **teacher**. Ask him or her where you can get these things. Then you can really start building!

HOW ARE YOU GOING TO MAKE IT?

To build an exhibit together you have to discuss a lot and make agreements. How are you going to tackle it? Who does what?

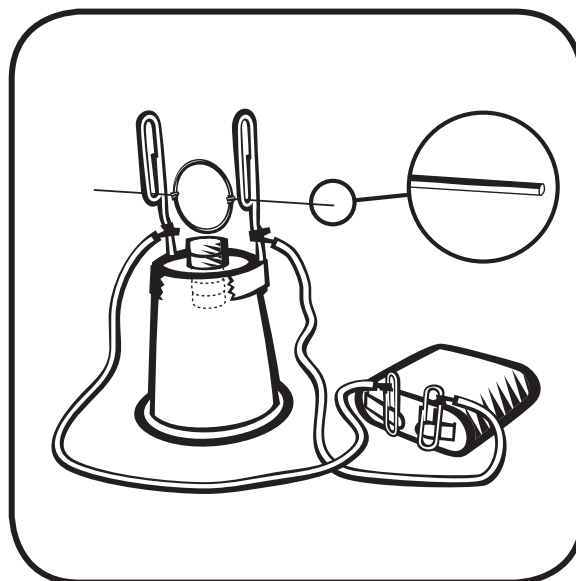
Divide up the different tasks as fairly as possible.

Try to work together as much as possible, so that you both get some experience of building.

If you come across a difficult word, look it up in a dictionary.

1.

Turn a paper or plastic beaker upside down. Place 2 ceramic disk magnets in the middle of the bottom of the beaker. Click 3 other magnets on the inside of the beaker, directly under the first 2 magnets.





2.

Take 2 big paperclips. Fold the outermost end of the paperclips open. Fix these ends with adhesive tape to the sides of the beaker as in the drawing.



3.

Now take the lacquered copper wire. With this you are going to make a wire coil. A coil is wound electrical wire like thread on a bobbin.

You roll the copper wire by winding it round three fingers. Make 5 loops.

Now have a good look at the drawing. Wind the ends of the copper wire a couple of times around the rolled wires on both sides of the coil. This keeps the wires next to each other. Allow the ends to stick out 5 centimeters on both sides. If they are too long, snip them off.



4.

Using sandpaper, rub off the layer of lacquer on both ends of the copper wire. Do this for about 4 centimeters.



5.

This next job is very tricky! Bend the ends so that together they form an axle around which the coil can turn.

Have a good look at the drawing. If you hold the coil as in the drawing, you must color the upper half of one of the ends that you have just sanded black with a waterproof marker.



6.

Place the ends of the copper wire in the openings of the paperclips. When you hold the coil as in the drawing, the underside must be 1.5 millimeters above the magnets. You can change the height of the paperclips a bit to get this right.

Make sure that the axle is exactly in the middle of the coil and that it is balanced.



7.

Now take the electricity wire. Cut two pieces of approximately 30 centimeters. Remove 3 centimeters of the plastic covering from both ends of the electrical wires with the stripping pliers. You call this, stripping electrical wire.

You attach each of both wires by one end to an unfolded paperclip just above the beaker. Attach a paperclip to the other ends of both wires. Push each paperclip over a pole of the flat 4.5 volt battery.



HOW DOES IT WORK?

The exhibit is ready. It works as follows. Give the coil a push so that it turns.

If the coil does not keep on turning, there may be a number of causes:

- the coil is not balanced;
- there is still a bit of lacquer on the copper wire;

- one half of the copper wire has not been blackened enough or the wire is completely black;
- the coil is touching the magnet or is too far away from it;
- the ends of the copper wire are not making a good contact with the paperclips.

Try to get the electric motor going by changing one of the above things.

▶ WHAT DO YOU SEE HAPPENING?

If the exhibit works, the coil will keep on turning.

Sometimes it takes a long time to get it going. What did you have to do to get it to turn?

Write the answer to this question in your **workbook** under 'Research report 1'.

▶ WHAT'S THE ANSWER?

This exhibit is about electricity and magnetism. Now you are going to find information about these subjects. You can look for information in the school media library, the library or the Internet.

Go to www.sciencecenteropschool.nl and then to 'primary school pupils' and click on 'links'. Under the title of your exhibit, you will find a number of websites with background information.

Answer the questions below and write the answers in your **workbook** under 'Research report 2'.

○ **Operation:**

How does this electric motor work?

○ **Science:**

What is electricity? What is magnetism? What do electricity and magnetism have to do with each other?

○ **Invention:**

Who discovered that you can make a magnet with electricity? When was this?

○ **Application:**

What sort of equipment has an electric motor? Make a list of equipment in your home that has an electric motor.

What other types of motor are there?

Let your **teacher** read your answers.