



# Make your own magnetometer

**In this session, you will have the opportunity to learn about magnetism and its link to space weather.**

You will have the opportunity to create your own Magnetometer to measure magnetic field and detect any anomalies which may indicate when a magnetic storm is taking place or even when the Northern Lights might be visible from where you are.

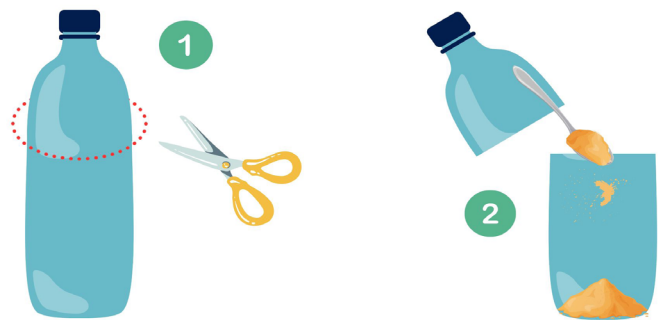
## Materials required:

- 1 x clear two-litre drinks bottle, with cap
- cotton thread
- 1 x small bar magnet
- 1 x small mirror, or you can use a piece of mirror card or reflective sequin
- 1 x piece of card
- Sand, or similar e.g. uncooked rice, dried lentils – this will be used to stabilise the bottle to stop it from falling over
- Blu-tac
- 1 x drinking straw
- Scissors, glue, sellotape, paper, pen/pencil, and a ruler
- Light source – e.g. a lamp or torch



## Method

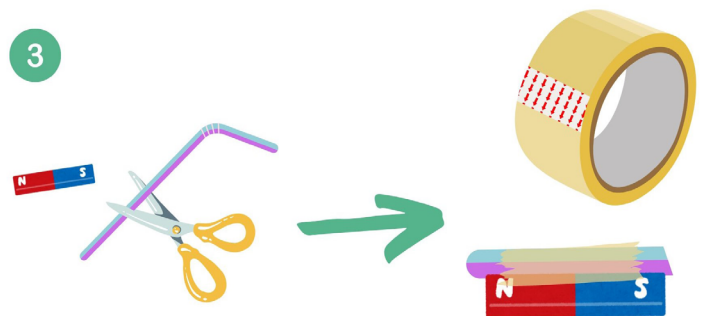
**01** Remove any labels from the side of your plastic bottle and draw a line about one-third down from the top of the bottle, following the circumference of the bottle. Carefully cut the bottle along the line, being careful of any sharp edges. Do not throw the top part away as we will need this later.



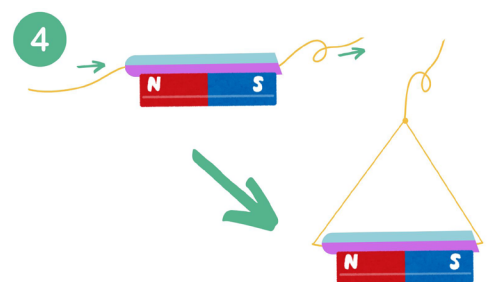
**02** Next, fill the bottom half with your stabiliser (sand, rice or similar), this should be about half full or one-third of the total bottle.

### **03** Suspending the magnet

Cut the straw slightly shorter than the magnet length and stick it to the top of the magnet using sellotape or glue, ensuring it's secure.

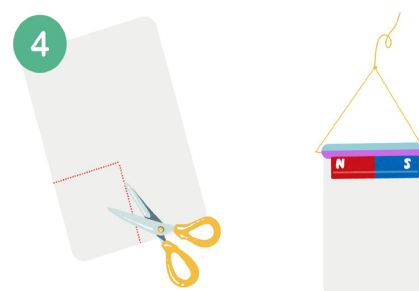


**04** Feed one end of the cotton thread through the straw and tie it onto the other end, creating a triangular loop with each side around 2 cm long. Do not cut the thread yet. It is also important the magnet hangs level so check this before proceeding to the next step.

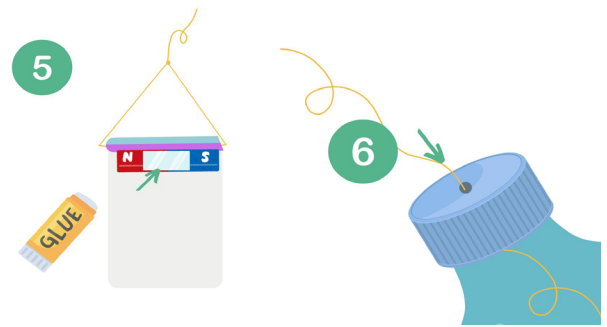


Now, cut one piece of card into a rectangle slightly larger than the magnet (it should be around 8-10 cm wide), this will stop the magnet from swinging too much. When placed in the plastic bottle, the card should not touch the sides of the bottle, so if you need to, trim the card slightly narrower so it can swing inside the bottle.

Stick the card to one side of the magnet so the magnet is at the top of the card, in the centre.

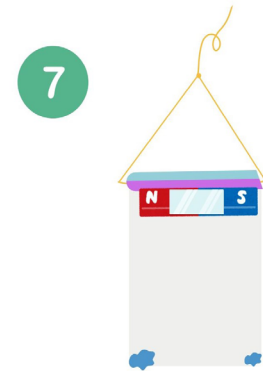


**05** Next, the mirror/sequin needs to be stuck to the other side of the magnet in the centre.



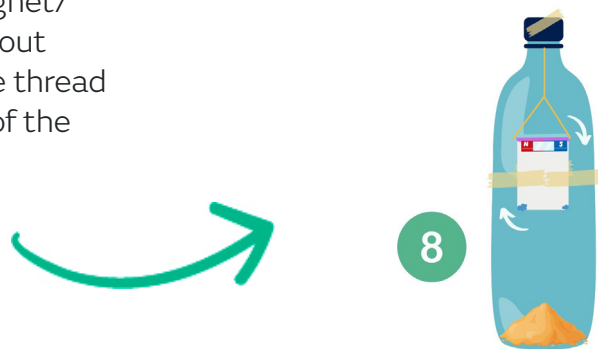
**06** Carefully puncture a small hole in the centre of the bottle cap, screw this onto the top of the bottle and feed the thread through the top of the bottle and cap.

**07** If the magnet is not hanging vertically, use some blu-tack to balance them by sticking this to the corners of the card. Now, carefully reattach the top part of the bottle to the bottom using sellotape and adjust the length of the cotton so that the mirror is a couple of centimetres above the cut in the bottle and ensure the card does not touch the sand in the bottom.



**08** When you are happy the card and magnet/mirror had enough room to swing without touching the bottom, you can stick the thread to the top of the cap and cut the end of the thread.

It should look something like this:



## How to take a reading

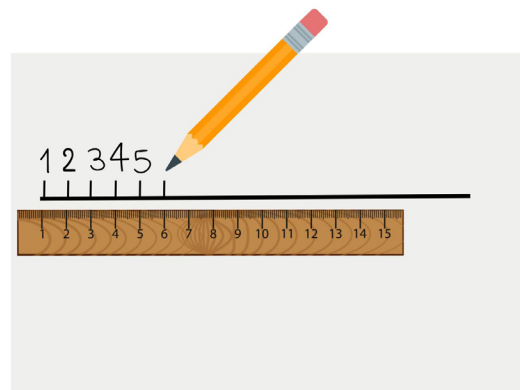
Set the bottle on a table or stable surface so that when a light is shone on the mirror the reflection is seen on a wall. The projected spot should show on a nearby wall, approximately 2 metres away.

You can use a desk lamp or torch, but the lightbulb must not be frosted as this will not produce a clear reflection.



## Make your own magnetometer | Activity steps

Now, using a ruler draw a 30 cm line on a piece of paper, making 1 cm increments and number them. Now secure the paper to the wall using some small pieces of blu-tack or tape.

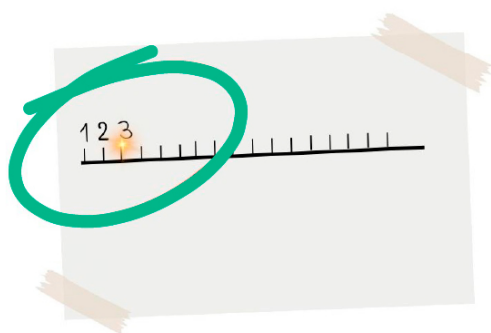
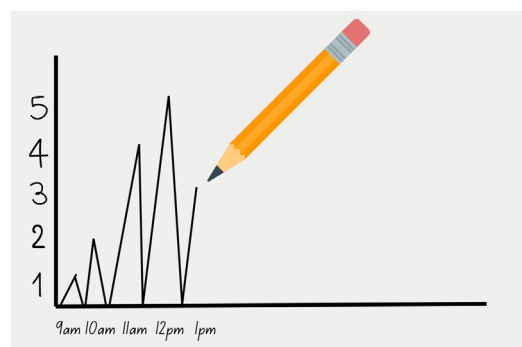


### What to look for

Try to record a reading every hour to begin with and more frequently if the reflection point moves more rapidly between readings. Record your measurement on a new piece of paper and record the time the reference spot was taken.

When a magnetic storm occurs, you will see the reflection point changes by several degrees within just a few hours, and then return to its normal orientation.

To calculate the measurement to Degrees of Deflection, multiply the change in reflection by 0.25 degrees.



For example, if the reflection point moves from the 1 cm point to the 3 cm point, the change of reflection is 2 cm multiplied by 0.25 degrees. This would be 0.5 degrees of deflection.

Some days may be quiet with only a small jump between reflection points, whilst some will be busy - abrupt changes or lots of business may be due to space weather - it may also be due to moving magnetic fields around you - e.g. if you're close to a rail line, when a train passes by. See if you work out the difference!

You may start to notice a regular daily cycle which is due to the Earth's rotation.

You may see that the bottom of the dip is around midday, when the Sun is close to being overhead (due south in the northern hemisphere), so at this point it switches from being on the east side to being in the west.

## Make your own magnetometer | Activity steps

You can find out more about how to interpret the results from your detector, and how to spot space weather activity, at [the AuroraWatch results page](<https://aurorawatch.lancs.ac.uk/detectors/results/>), or in [NASA's detailed guide](<https://science.nasa.gov/learn/heat/resource/soda-bottle-magnetometers-student-guide/>)!

Lesson plan source: [AuroraWatch UK](<https://aurorawatch.lancs.ac.uk/detectors/>)