


Experiment P-52 Magnetic Field



Objectives

- To learn about basic properties of magnets.
- To study the magnetic field around a bar magnet through a magnetic field sensor.

Modules and Sensors

- PC + NeuLog application
- USB-200 module 
- NUL-214 Magnetic field logger sensor 

Equipment and Accessories

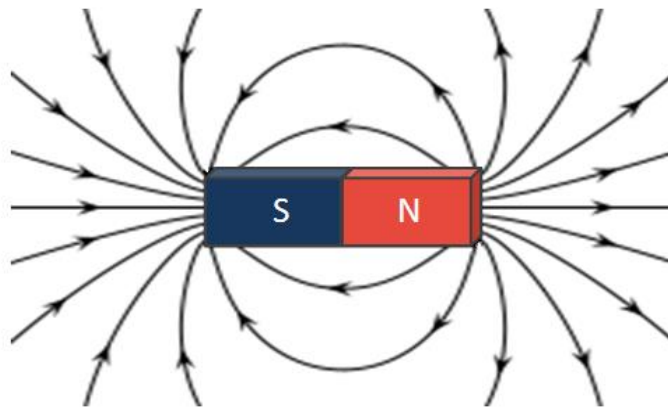
▪ Magnet in plastic case
▪ Alnico bar magnet
▪ Ruler

- The items above are included in the NeuLog Magnets kit, MAG-KIT. The magnet in the plastic case is also included in the NeuLog Mechanics kit, MEC-KIT.

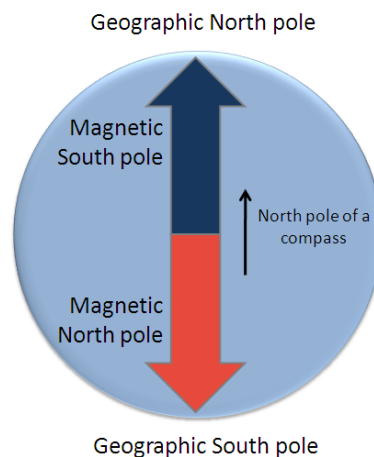
Introduction

A bar magnet has two ends known as magnetic poles. One is called the north pole and the other the south pole of the magnet. 'Unlike magnet poles' attract each other and 'like magnet poles' repel each other. Magnets also attract other materials which are not normally magnetic (various sorts of metals).

Magnetic fields are force fields produced by electric currents. The magnetic force only acts on charged particles in motion. A magnetic field can be represented as lines of force. These lines indicate the direction of the field in a given area, and their number per unit area is proportional to the field strength in that area. The field is stronger near the pole (where the lines converge), and the strength diminishes with the inverse square of the distance from it.



The Earth has a magnetic field similar to that of a bar magnet. The north pole of a compass needle (a magnet) is attracted to the magnetic south pole of the Earth, which is the geographic north.

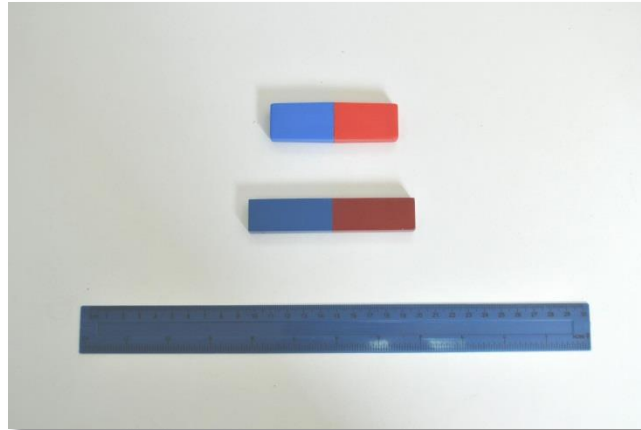


In this experiment we will measure the magnetic field strength at different locations on a bar magnet.

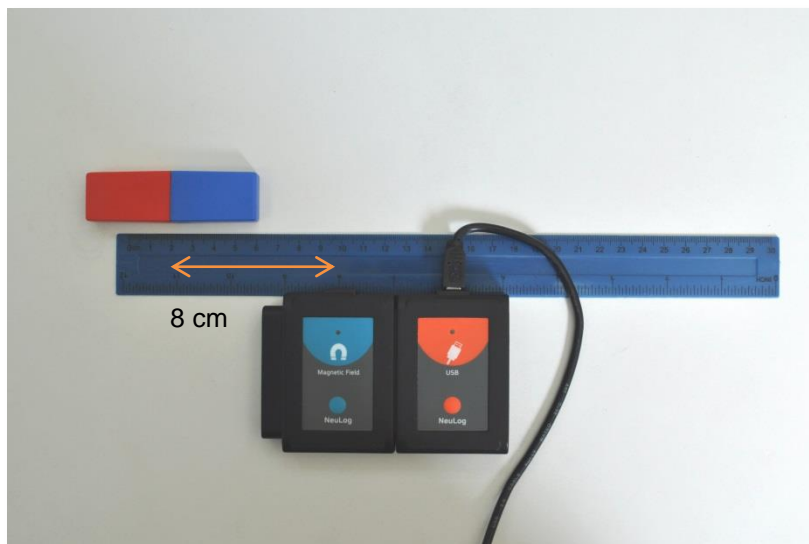
Procedure

Experiment setup

1. Set up the experiment as shown in the picture below.





2. Prepare the two magnets and a ruler.



3. Place the ruler in front of the magnetic field sensor. The middle of the sensing part should be in front of the 10 cm line.
4. Place the magnet (with the plastic case) in front of the sensor so that the end of the blue south pole will be on the 6 cm line and the middle of the magnet will be on the 2 cm line. In this way the middle of the magnet is 8 cm away from the sensing part of the magnetic field sensor. Make sure that the USB

module cable does not block the magnet as you will move it across the sensor.

Sensor setup





5. Connect the USB-200 module  to the PC.
6. Check that the magnetic field sensor  is connected to the USB-200 module.

Note:

The following application functions are explained in short. It is recommended to practice the NeuLog application functions (as described in the user manual) beforehand.

7. Run the NeuLog application and check that the magnetic field sensor is identified.

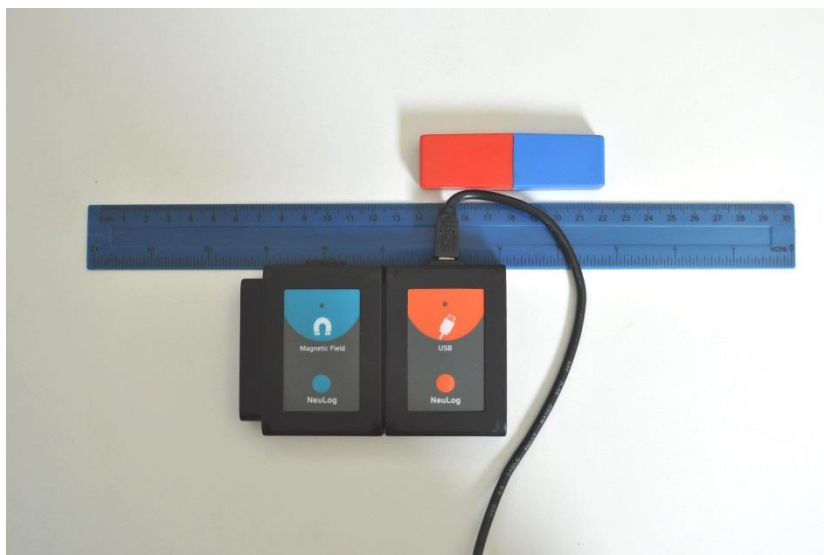
Testing and measurements

8. Click on the **Single Step** icon  to measure the magnetic field strength 8 cm from the middle of the magnet.
9. Click on the **Table** icon  on the bottom part of the screen. A table will be displayed for data record.
10. Click on the **Manual values** icon  and change the "Manual values" column name to "Distance from the middle of the magnet". Insert "cm" in the units section.
11. Move the magnet one cm towards the sensor along the ruler, this will be 7 cm from the sensing part and click on the **Single Step** icon  (the blue south pole should be on the 7 cm line and the middle of the magnet should be on the 3 cm line).

12. Continue with the measurements according to the following table.

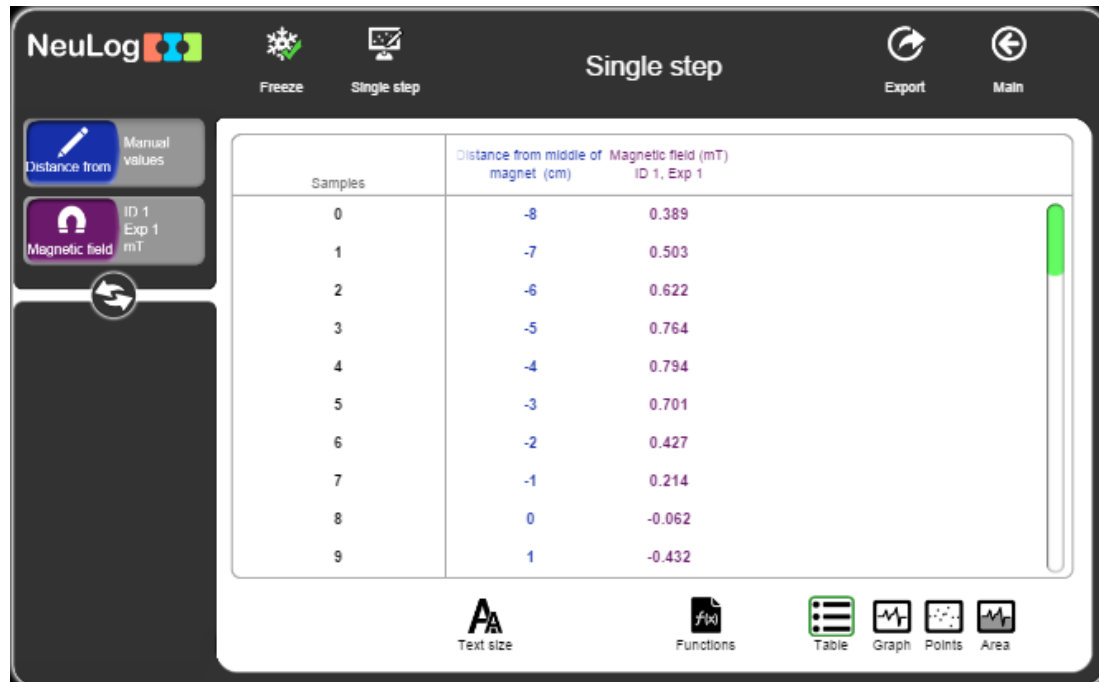
Measurement number	Distance from the middle of the magnet [cm]
1	-8
2	-7
3	-6
4	-5
5	-4
6	-3
7	-2
8	-1
9	0
10	1
11	2
12	3
13	4
14	5
15	6
16	7
17	8





This is the last stage of the experiment (the middle of the magnet is 8 cm from the sensing part on the other side):



13. Insert the distance values into the "Distance from the middle of the magnet [cm]" column.

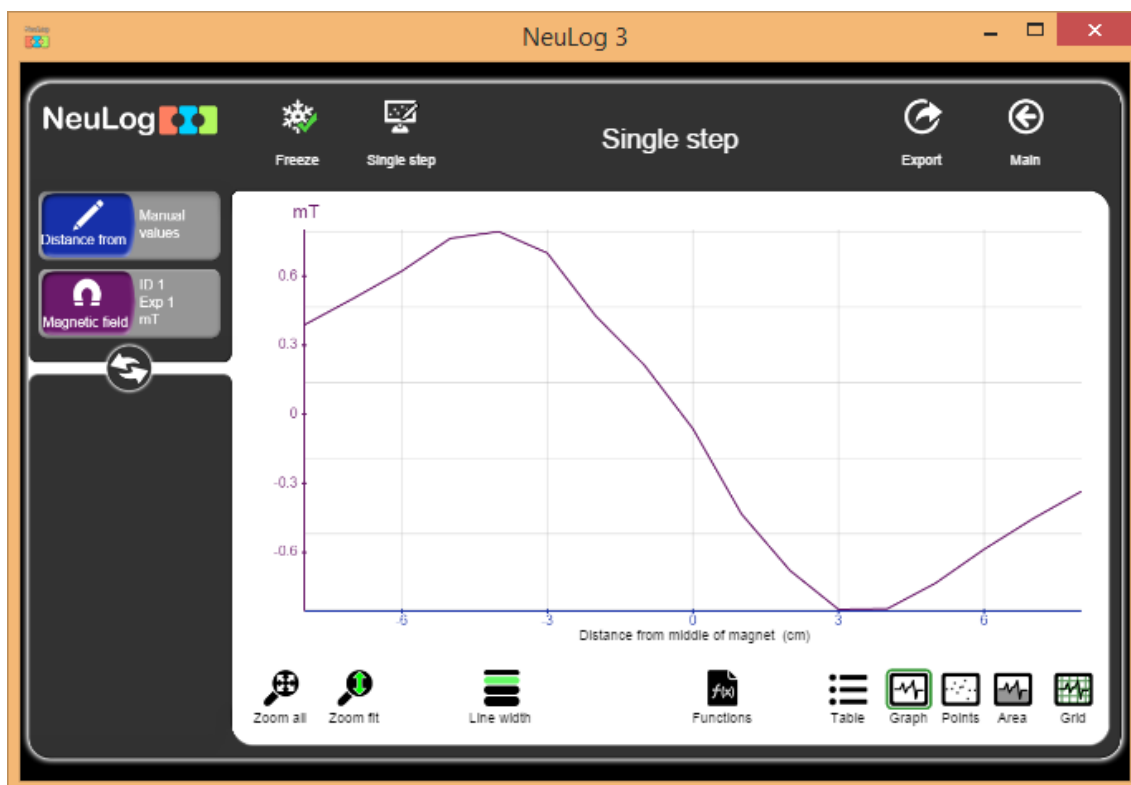
Your data should be similar to the following:



14. Click on the **Export** icon  and then on the **Save value table (.CSV)** button to save your graph.
15. We can see that the values are positive when the blue pole is closer to the sensing part and negative when the red pole is closer to the sensing part.
16. Click on the **Graph** icon .
17. Click on the **Functions** icon  and then click on the X axis button.
18. Click on the sensor button and choose "Distance from the middle of the magnet [cm]."
19. Click on the  icon to go back to the graph.

20. Click on the **Zoom fit** icon .

21. Your graph should be similar to the following:



Challenge research

22. Repeat the experiment with the alnico bar magnet.

Summary questions

1. At which point on the magnet, the reading was closest to zero? Explain.
2. At which point on the magnet, the reading was the highest (highest negative and positive)?
3. Explain the results in terms of the lines of force, the figure on page 2 can assist you.
4. Print your graph and draw the predicted ends of it as if you measured beyond 8 cm from the sensing part.