Lab 7: Magnetic Field of a Permanent Magnet
(Magnetic Field Sensor)

Equipment Needed	Qty	Equipment Needed	Qty
Magnetic Field Sensor (CI-6520A)	1	Meter stick, non-metal	1
Magnet*, disk, Neodymium, 1/2 or 3/4"(EM-8648)	1		
Small compasses	10	A piece of paper	1

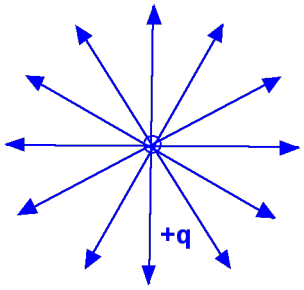
***Warning: Keep magnets away from the computers and computer disks.**

In this experiment variation of magnetic field of a permanent will be explored using a a bar magnet and a magnetic sensor.

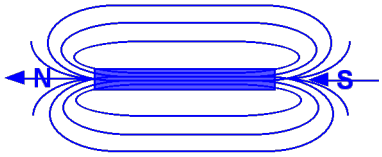
Theory

The strength of a magnetic field varies with distance from the magnet. The strength of the magnetic field could vary inversely as the square of distance, as with the strength of a gravitational field or an electrical field. The strength of the magnetic field could vary in a different way relative to distance.

The gravitational field or electric field of a point mass or charge is radial, while the magnetic field of a magnet consists of complete loops that surround and go through the magnet.



ELECTRIC FIELD LINES

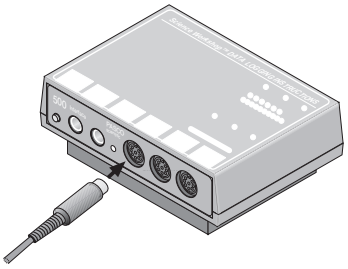


MAGNETIC FIELD LINES

For You To Do

Use the Magnetic Field Sensor to measure the magnetic field strength of a small neodymium magnet as the distance between the sensor and the magnet changes. Use *DataStudio* or *ScienceWorkshop* to record and display the magnetic field strength and the entered distance. Determine the relationship between the measured strength of the magnetic field and the distance from the magnet.

PART I: Computer Setup



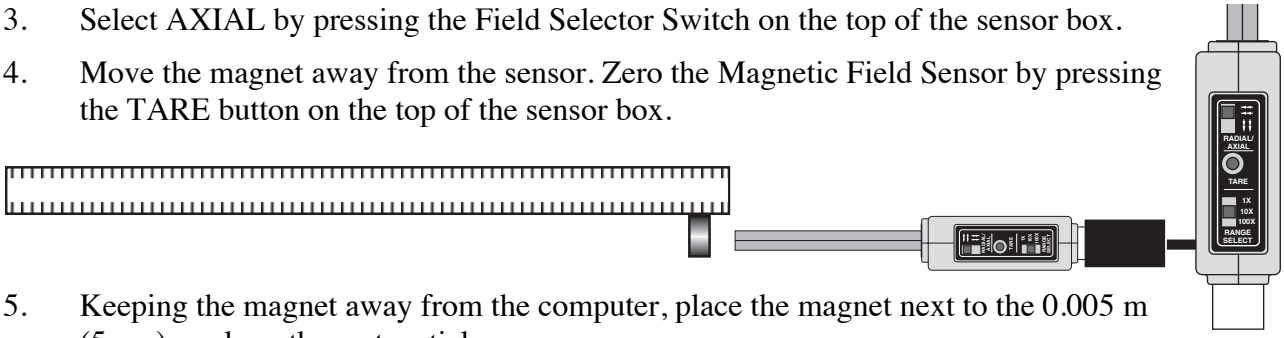
1. Connect the *ScienceWorkshop* interface to the computer, turn on the interface, and turn on the computer.
2. Connect the DIN plug of the Magnetic Field Sensor to Analog Channel A.
3. Open the document titled P31 Permanent magnet.ds

- The *DataStudio* document has a Workbook display. Read the instructions in the Workbook.

PART II: Sensor Calibration and Equipment Setup

- You do not need to calibrate the Magnetic Field Sensor.

1. Place the meter stick on a flat surface away from the computer.
2. Place the Magnetic Field Sensor so the end of the rod is even with the zero end of the meter stick.
3. Select AXIAL by pressing the Field Selector Switch on the top of the sensor box.
4. Move the magnet away from the sensor. Zero the Magnetic Field Sensor by pressing the TARE button on the top of the sensor box.



5. Keeping the magnet away from the computer, place the magnet next to the 0.005 m (5-cm) mark on the meter stick.

PART III: Data Recording

1. Before you start recording the data use the small compasses to map the magnetic field around the bar magnet.
2. Begin data recording.

In *DataStudio*, arrange the Table display so you can see it clearly. Click the Start button. The button turns into a 'Keep' and 'Stop' button (

). The magnetic field strength appears in the first cell in the Table display. Check to make sure that the strength is a large positive number. If it is not, flip the magnet to point the opposite pole towards the sensor. Click the 'Keep' button to record the magnetic field strength.

Note: If the default distance value does not correlate with the distance you measured for a given magnetic field strength, you may edit the distance. Select the 'Edit Data' tool from the tool bar on the Table Display ().

Click on the distance and type in the correct value.

3. Move the magnet 0.005 m further away so that it is 0.010 m from the end of the sensor.
3. Enter 0.010 m for the distance. Record the data by clicking on 'Keep' in *DataStudio* or 'Enter' in *ScienceWorkshop*.
4. Repeat the process of moving the magnet by 0.005 m increments, and recording the values until the magnetic field strength reaches about 10 Gauss, or does not change as the distance increases.
5. End data recording.
6. Repeat procedure 1 through 5 by taping two magnets together.

- Stop data recording by clicking on the 'Stop' button.

Analyzing the Data

1. Click to make the Graph display active.
2. Rescale the Graph axes to show the data and apply a fit to the data.

- Click the 'Scale to fit' button () to rescale the Graph axes. Next, click the 'Fit' menu button (

) and select 'Inverse Square'. If the Mean Square Error is large, click and hold down on the mouse button while dragging the mouse to select a region of data. When the mouse button is released, the data points will be highlighted. Only highlighted data points will be used for the fit.

3. Record the equation of fit in the Data Table in the Lab Report section.

Lab Report – Lab 11: Magnetic Field of a Permanent Magnet

What Do You Think?

How does the strength of the magnetic field of a permanent magnet change with distance?

Data Table

Item	Equation
Equation of Fit single magnet	
Equation of fit – two magnets	

Questions

1. Does the magnetic field strength increase or decrease as the distance from the magnet is increased?

2. Is the relationship between magnetic field strength and distance linear?

4. Based on the results of the curve fit in the statistics area, what is the relationship between the magnetic field strength and the distance from the magnet?

5. Qualitatively describe the similarities and differences of your experimental results for the two magnets (single and two taped together ones) used in the experiment.

Optional

- Repeat the activity with a different type of magnet.

Optional Data Table

Item	Equation
Equation of Fit	

Optional Questions

1. Does the magnetic field strength increase or decrease as the distance from the magnet is increased?

2. How does the plot of Magnetic Field Strength vs. Distance for this magnet compare with the plot for the original magnet?