**Unit 2 Pre-lab 1: Magnetic Field Around a Permanent Bar Magnet**

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| [**https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets**](https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets)  **Java – Bar Magnet tab** |

1. Open the simulation.
2. The compass should be to the left of the S pole of the bar magnet.
3. What end of the compass needle is pointing to the S pole of the bar magnet? **Red or white**
4. What polarity must the red compass needle be? **North or south**
5. Move the compass and place it to the right of the N pole.
6. What end of the compass needle is pointing to the S pole of the bar magnet? **Red or white**
7. What polarity must the white compass needle be? **North or south**
8. Move the compass and place it above the bar magnet.
9. What direction does the north pole red end of the compass needle point? **Towards the S pole of the bar magnet or towards the N pole of the bar magnet**
10. Move the compass and place it below the bar magnet.
11. What direction does the north pole red end of the compass needle point? **Towards the S pole of the bar magnet or towards the N pole of the bar magnet**
12. Click on “Flip Polarity” to change the polarity of the bar magnet.
13. What happens to the direction of the compass needle? Changes direction to still point to south pole of bar magnet\_\_
14. What general rule can be stated regarding the direction of the external magnetic field lines created by a bar magnet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
15. Click on “See Inside Magnet”.
16. What general rule can be stated regarding the direction of the internal magnetic field lines created by a bar magnet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
17. The field lines created by a bar magnet are continuous loops.
18. Click on “Show Planet Earth”.
19. The Earth creates a magnetic field that is very similar in shape to that of a bar magnet.
20. What pole of the Earth’s magnetic field is in the northern hemisphere? **North or south**
21. Move the compass to a spot above the northern hemisphere of the Earth.
22. What end of the compass needle is pointing to the S pole of the Earth’s magnet field? **Red or white**

**Unit 2 Pre-lab 2: Magnetic Field Around A Straight Current Carrying Conductor**

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| [**https://www.thephysicsaviary.com/Physics/Programs/Labs/FieldFromWire/index.html**](https://www.thephysicsaviary.com/Physics/Programs/Labs/FieldFromWire/index.html)  **Magnetic Field from a Wire Lab** |

1. Open the simulation.
2. Click on the “Direction” box and change to conventional current.
3. Use RHR#1 to verify that the magnetic field lines shown on the simulation match the direction indicated by RHR#1.
4. Click on the “Field Sensor” box. Note the magnitude of the magnetic field. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Click on the “Location of Field Sensor” box.
6. Move the magnetic field sensor to the right using the right arrow. Does the magnitude of the magnetic field change? **Yes or No.**
7. Click on the current box and reduce the current to zero.
8. Record the value of the current and magnetic field strength in the Table 1 below.
9. Complete Table 1 by increasing the current sensor and recording the magnetic field strengths.
10. Plot Graph 1, a graph of magnetic field strength vs. current in the space below.
11. What relationship does Graph 1 indicate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. Click on the “Grid” box.
13. Click on the “Location of Field Sensor” box and move the magnetic field sensor as close to the straight conductor as possible.
14. Record the distance and magnetic field strength in Table 2.
15. Complete Table 2 by moving the field sensor and recording the magnetic field strengths.
16. Plot Graph 2, a graph of magnetic field strength vs. distance.
17. What relationship does Graph 2 indicate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Table 1 - Effect of Current on Mag. Field Strength** | **Graph 1 – Magnetic Field Strength vs. Current** |
| |  |  |  |  | | --- | --- | --- | --- | | **Trial** | **Repetition** | **Elec. Current *I***  **(A)** | **Mag. Field Strength β**  **(µT)** | | **1** | **1** |  |  | | **2** | **1** |  |  | | **3** | **1** |  |  | | **4** | **1** |  |  | | **5** | **1** |  |  | | **6** | **1** |  |  | | **7** | **1** |  |  | | **8** | **1** |  |  | | **9** | **1** |  |  | | |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |
| **Table 2 - Effect of Distance on Mag. Field Strength** | **Graph 2 – Magnetic Field Strength vs. Distance** |
| |  |  |  |  | | --- | --- | --- | --- | | **Trial** | **Repetition** | **Distance *d***  **(cm)** | **Mag. Field Strength β**  **(µT)** | | **1** | **1** |  |  | | **2** | **1** |  |  | | **3** | **1** |  |  | | **4** | **1** |  |  | | **5** | **1** |  |  | | **6** | **1** |  |  | | **7** | **1** |  |  | | **8** | **1** |  |  | | |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  | |

**Unit 2 Factors Affecting Strength of a Solenoid Electromagnet**

**Data Collection**

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| [**https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets**](https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets)  **Java - Electromagnet tab for Part A and Part B** |

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| **Part A: Effect of Current (by Adjusting Electric Potential Difference) on Magnetic Field Strength** |
| **Table 3 – Effect of Electric Potential Difference on Magnetic Field Strength**  **Constant *\_N (turns)\_\_* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_; Constant \_*µ (magnetic permeability)*\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Trial** | **Repetition** | **Elec. Pot. Difference *V***  **(V)** | **Mag. Field Strength β**  **(G)** | **Note: the magnetic field strength meter is placed beside the coil on the second compass from the right hand side of the battery** | | **1** | **1** |  |  |  | | **2** | **1** |  |  |  | | **3** | **1** |  |  |  | | **4** | **1** |  |  |  | | **5** | **1** |  |  |  | | **6** | **1** |  |  |  | | **7** | **1** |  |  |  | | **8** | **1** |  |  |  | | **9** | **1** |  |  |  | | **10** | **1** |  |  |  | | **11** | **1** |  |  |  | |

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| **Part B: Effect of Number of Turns on Magnetic Field Strength** |
| **Table 4 – Effect of Number of Turns on Magnetic Field Strength**  **Constant *\_V (Elec. Pot. Difference)\_\_* =\_\_\_\_\_\_\_; Constant \_ *µ (magnetic permeability)*\_\_ = \_\_\_\_\_\_\_\_\_**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Trial** | **Repetition** | **Turns N**  **(dimensionless)** | **Mag. Field Strength β**  **(G)** |  | | **1** | **1** |  |  |  | | **2** | **1** |  |  |  | | **3** | **1** |  |  |  | | **4** | **1** |  |  |  | |

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| **In class experiment with Xplorer GLX**  [**https://www.engineeringtoolbox.com/permeability-d\_1923.html**](https://www.engineeringtoolbox.com/permeability-d_1923.html) |

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| **Part C: Effect of Magnetic Permeability on Magnetic Field Strength** |
| **Table 5 – Effect of Magnetic Permeability on Magnetic Field Strength**  **Constant *\_I, V (Current; Elec. Pot. Difference)* = \_\_\_\_\_\_\_\_\_\_\_\_; Constant *\_N (turns)\_*= \_\_\_\_\_\_\_\_\_\_\_;**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Trial** | **Repetition** | **Core Material** | **Relative Magnetic Permeability µ**  **(dimensionless)** | **Mag. Field Strength β**  **(G)** | | **1** | **1** | **Air** |  |  | | **2** | **1** | **Copper** |  |  | | **3** | **1** | **Aluminum** |  |  | | **4** | **1** | **Steel** |  |  | | **5** | **1** | **Iron** |  |  | |