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**Student Exploration:** **Magnetism**

**Vocabulary:** attract, bar magnet, ferromagnetic, magnetize, north pole, repel, south pole

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

1. What happens when you place two magnets close together? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. What objects do magnets stick to? Make a list. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. What do these objects have in common? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Gizmo Warm-up: What is attracted to magnets?**

A **bar magnet** is a simple rectangular magnet. If you hang a bar magnet by a string, the **north pole** (N) of the magnet will tend to point north while the **south pole** (S) of the magnet points south.

1. Look at the materials at the bottom of the Gizmo. Which ones do you think will stick to a bar magnet?

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1. **Ferromagnetic** materials are strongly attracted to magnets. Drag a bar magnet and the piece of **nickel** onto the scribbled line. Press **Play** (****).

A. Is nickel ferromagnetic? \_\_\_\_\_\_\_\_\_

B. How do you know? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Test copper, wood, glass, and iron. Which ones are ferromagnetic? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Activity A:** **Attract or repel?** | Get the Gizmo ready: * Check that the MAGNETIC FORCES tab is selected.
* Click **Reset** (Reset).
 | 631SE2 |

**Question: How do magnets interact?**

1. Observe: Drag two bar magnets onto the paper and press **Play**. Then click **Reset**. Change *one* of the magnets (either from **N-S** to **S-N**, or vice-versa). Click **Play** again.
	* 1. What happened the first time? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		2. What happened the second time? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Form hypothesis: Magnets are either pulled together (**attracted**) or pushed apart (**repelled**). Based on what you have seen, when are magnets attracted and when are they repelled?

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1. Predict: Based on your hypothesis, which pairs of magnets will be attracted to each other? Which will be repelled? Record your predictions below. (Leave the result blank for now.)

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| **Left magnet** | **Right magnet** | **Prediction****(Attract or repel?)** | **Result****(Attract or repel?)** |
| 631SE3 | 631SE3 |  |  |
| 631SE3 | 631SE4 |  |  |
| 631SE4 | 631SE4 |  |  |
| 631SE4 | 631SE3 |  |  |

1. Run Gizmo: Test your predictions using the Gizmo. Record your results in the table.
2. Draw conclusions: Fill in each blank below with the correct word.
	* 1. The south pole of a magnet is attracted to the \_\_\_\_\_\_\_\_\_\_\_ pole of another magnet.
		2. The south pole of a magnet is repelled by the \_\_\_\_\_\_\_\_\_\_\_ pole of another magnet.
		3. The north pole of a magnet and the north pole of another magnet will \_\_\_\_\_\_\_\_\_\_\_\_ each other.

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| **Activity B:** **Magnetic field lines** | Get the Gizmo ready: * Click **Reset** and drag all objects off the paper.
* Select the MAGNETIC FIELD LINES tab.
 | 631SE5 |

**Question: If you scatter iron filings (little slivers of iron) around a magnet, you will see a pattern of magnetic field lines. What do these lines show you?**

1. Observe: Drag *one* magnet onto the paper. Click **Sprinkle filings** and then **Tap table** five or six times. Sketch the pattern you see in the box:

What do you notice about the iron filings?

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1. Observe: Drag a second magnet next to the first. Click **Sprinkle filings** and then click **Tap table** several times. Sketch what you see.

Will these magnets be attracted or repelled?

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1. Observe: Now switch one of the magnets. Click **Sprinkle filings** and then click **Tap table** several times. Sketch what you see.

Will these magnets be attracted or repelled?

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1. Draw conclusions: Compare the magnetic field lines you have sketched. How can you use the field lines to tell if magnets will be attracted or repelled?

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1. Extend your thinking: Observe the magnetic field lines produced by an **N-S** magnet and the **mystery** magnet. Will these magnets attract or repel each other? First, make a prediction below. Then, check your answer on the MAGNETIC FORCES tab.

Prediction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Actual result: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Extension:****Magnetic materials** | Get the Gizmo ready: * Select the MAGNETIC FIELD LINES tab.
* Drag an **S-N** magnet and the **copper** bar onto the paper.
 | 631SE6 |

**Question: Why do magnets attract certain materials?**

1. Observe: Click **Sprinkle filings** and then click **Tap table** several times. Look closely at the filings near the **copper** bar. Does copper have any effect on the filings?

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1. Observe: Repeat the experiment with **iron**. What effect does iron have on the filings?

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1. Analyze: Which of these materials is ferromagnetic? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Draw conclusions: How can you tell if an object is ferromagnetic by looking at its field lines? Discuss your answer with your teacher and classmates.

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1. Apply: Select the MAGNETIC FORCES tab and experiment with the Gizmo. Try to answer the questions below. Share your findings with your classmates and teacher.
	1. Can a magnet ever *repel* a ferromagnetic material? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. In the Gizmo, does one ferromagnetic material attract another? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Experiment (optional): When a ferromagnetic material like iron is placed near a magnet, it becomes **magnetized**—it actually becomes a magnet! (Look at the field lines when iron is near a magnet.) Even after the magnet is removed, iron can stay magnetized for a while.

In “real life” (not in the Gizmo), rub a metal paper clip with a magnet. What happens when you touch another paper clip with your magnetized paper clip?

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