ACTIVITY 4: Explaining Phenomena Involving Magnetism

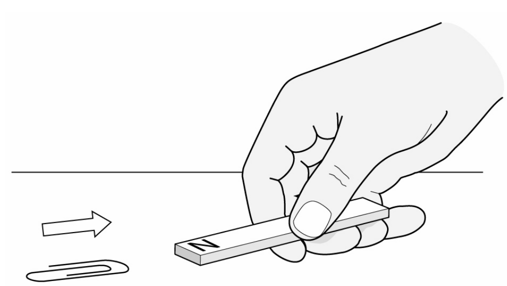
Comparing the Class Ideas and Scientists' Ideas

Scientists spent many years developing models for magnetism. You worked on it for a much shorter period of time. However, through a careful set of experiments you were able to modify your model until you felt reasonably satisfied that it could account for all (or at least most of) your observations. How does your model compare with one that seems satisfactory to scientists? Your teacher will distribute a copy of *Scientists' Ideas: The Magnetic Interaction.* Review the ideas and the magnetism model described in this handout to see how they compare with the ideas and model you developed. Add evidence from the experiments you did that would support each of the idea statements. This handout introduces the *domain model* for magnetism, which is very similar to the *small magnets model* introduced in the homework for activity 3. This handout also supplements and extends the magnetism interaction ideas introduced earlier in the *Scientists' Ideas* in Chapter 3.

Explaining Magnetism Phenomena

From now on you should use the domain model to help guide your explanations. The diagrams you draw in your explanations should include pictures of the domains inside the nail or piece of iron. Your written narrative should include a description of what happens to the domains in the given situation. As always, your explanation should be accurate, complete, and logically consistent and written clearly.

Explanation #1: Explain why a magnet attracts an unmagnetized paper clip.



(Hint: You can think of the paperclip as similar to the unrubbed nail you studied in activity 3.)

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Draw diagrams before the magnet is brought near the paperclip, and after the magnet is near the paperclip:

Write the narrative:

Explanation #2: Explain why the middle and ends of a bar magnet compare the way they do in strength.

Make a prediction. Is the middle of a bar magnet weaker or stronger than the ends, or do the middle and ends have about the same strength? Write an explanation to support your prediction.

Draw a diagram:

Write the narrative that supports your prediction:

Design an experiment to find out whether the middle of the magnet is stronger, weaker, or equally as strong as the ends. State what you did and describe your results.

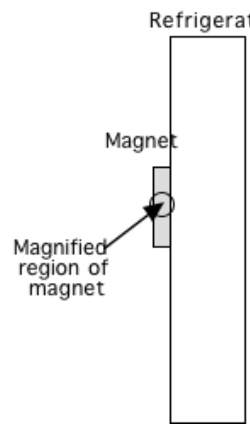
If your observations are different from your original prediction, then write a new explanation below to account for your results.

Draw a diagram:

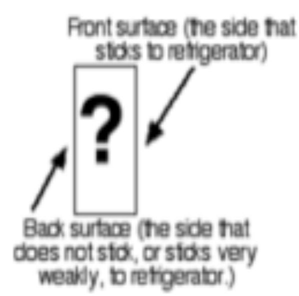
Write the narrative that supports your observation:

(Optional) Explanation #3: Explain why a refrigerator magnet sticks on one side, but not the other.

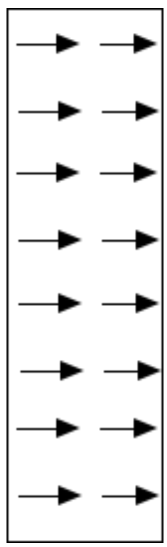
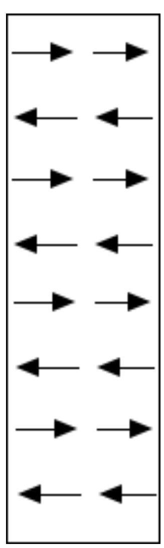
You are familiar with refrigerator magnets. They tend to be thin, with designs on them, and they easily stick to the refrigerator. The refrigerator is a ferromagnetic material that is not, itself, a magnet. So it would seem that the explanation for why the refrigerator magnet sticks to the refrigerator is similar to why a magnet would stick to a paper clip (except that the refrigerator is so massive that it wouldn't move towards the magnet.) However, there is something different here, because if you flip the refrigerator magnet around, front to back, *it no longer sticks to the refrigerator* (or it sticks very weakly). So it seems that the refrigerator magnet only works on one side, but not the other! How can this happen?

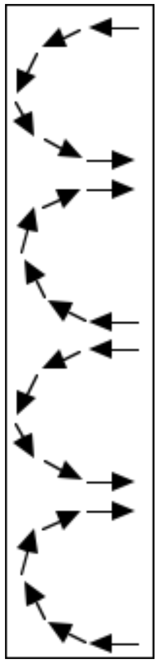
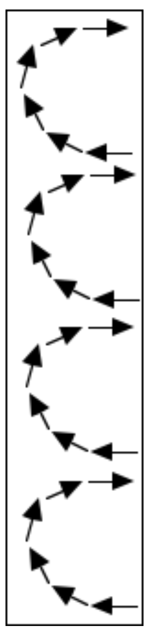


Last year a student was trying to figure out how the magnetic domains inside the refrigerator magnet might be arranged in order to produce the kind of behavior that was observed: that the magnet sticks to the refrigerator on one side, but not on the other. He came up with four possible models to consider. These are shown on the next two pages, and each represents a side-view diagram of what a tiny magnified cross-sectional region of the refrigerator magnet might look like in terms of the domain model. In each case, a single domain is represented as an arrow: the arrowhead represents the north pole of the entity.



Consider each of these four models. Decide which **one** of these four seems to best account for the observed behavior of the refrigerator magnet; that the front surface sticks to the refrigerator, and the back surface does not (or does so very weakly). Briefly explain why. Also briefly explain why the other three are less good models to explain the behavior of the refrigerator magnet. (You do not need to do an analysis. Just apply the domain model to this new situation. As a hint, you may wish to think about the arrangement of domains in a horseshoe-shaped magnet, and what happens when several horseshoe magnets are placed side-by-side.)

Model	**Diagram of Model for Refrigerator Magnet**	**Your conclusion: Will this model work?** **If *Yes*, briefly explain why.** **If *No*, briefly explain why not.**
A		
B		

C		
D		

Participate in a class discussion to go over the explanations.