## **Part I** The Refrigerator and the Magnet

* In the elicitation activity at the beginning of this unit, you considered the situation of the refrigerator magnet. You may or may not have noticed that either side of a refrigerator magnet will stick to the refrigerator door, even though the refrigerator door itself is NOT a magnet.
* We will now try to modify our original model of magnetism by explaining and representing how and why the magnet sticks. Below are drawing showing a cross-section of the refrigerator magnet and refrigerator door.

Particles (domains) are randomly aligned.

The door is considered electrically neutral (equal # of protons and electrons distributed evenly).

The particles near the magnet are magnetically induced (domains are aligned).

The door is considered electrically neutral (equal # of protons and electrons distributed evenly).

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**BEFORE Contact**

# Door and magnet apart

**During Contact**

Door and magnet apart

* The magnet has both north and south poles in it. So does the door near the magnet, when the magnet is sticking to it. Two north poles repel each other, and so do two south poles.
* Why should the magnet be attracted to the door?

**The magnet overpowers the magnetism induced in the door and forces the attraction. You also observed this in the wool-rubbed balloon and paper punches activity. The paper punches were drawn to the balloon by induction. Once the paper punches touch the balloon, conduction causes them to have the same charge as the balloon (negative). They should repel and “jump” off the balloon, but very few do. This is because the electrostatic force overpowers the small paper punches.**

**Part II** Magnetizing by Heating

* One method that can be used to magnetize an iron bar is to heat it to high temperatures, then let it cool slowly while it is lying in a **north-south** direction.

**The heat increases the kinetic energy of the particles (domains) of the iron (Fe), and they align randomly. So, initially, the metal becomes demagnetized. However, during the cooling process, the Earth’s magnetic alignment INDUCES the iron bar to become magnetized (aligning the domains in a particular way to form poles).**

**Part III** The Coat Hanger Effect

Fishing line

hanger or nail

Attachment for the system

* A student observed that a metal coat hanger, which is hung on a fishing line, aligns itself North-South. Another student tried this with a different hanger and saw no preferred orientation. What possible explanation is there for both of these observations? (*Assume that the strings from which they are hanging are the same.)*
* You can try doing this simple experiment using a piece of coat hanger and a string or fishing line hung from the ceiling. Try to keep metal objects at a distance from the set up.

**The second hanger may have a different composition than the first. Not all hangers are created equal. The hanger that pointed north contained more magnetic metal than the hanger that took no orientation.**

CONCLUSION FOR MAGNETISM MODEL

There must be “tiny things” (domains) inside a magnet that take on a particular orientation when magnetized.

A Simple “Microscopic” model of Magnetism and Static Electricity

MAGNETISM

Non-magnetized metal

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N

N

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STATIC ELECTRICITY

ELECTRIC DIPOLE

NEUTRAL

ELECTRIC DIPOLE