

Interactive Notes-“Magnetism”

Materials (per group of 4 students):

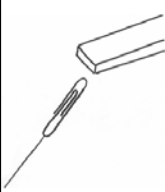
Demo 1	1-small paper clip with 20cm of fishing line or very fine thread tied to it 1-ring stand and utility clamp 1-bar magnet
Demo 2	1-compass 1-small strip of newspaper (~ 1cm x 8cm) 1-small strip of aluminum foil (~ 1cm x 8cm) 1-small piece of steel wool
Demo 3	1-hanging magnet holder (see demo 3 for instructions)
Demo 4	1-blank sheet of copy paper 1-sandwich bag with about 2 grams of iron filings (item #WW94154M06 at sciencekit.com), with a small hole in a bottom corner
...and	4-note sheets (see last page)

Additionally- PowerPoint (see last page)

Beforehand:

- Tie strings to paper clips (see demo #1) and make the hanging bar magnet holders (demo #3).
- Hang the bar magnet holders from the ceiling around the room, one near where each group will be.
- Fasten all bar magnets in the jaws of the utility clamp, about 8 inches off the table surface.
- Set out all materials *the day before*. Leave yourself time to realize you're missing something, to practice the new demonstrations, research something, or even make a change. In the morning, read through the slides and notes one last time. Relax and have fun along with your students. Remember- you're only as effective as your plan.
- Charge up your bar magnets with a magnetizer. If you don't have a Hi-Strength Magnetizer (item [#WW69601M05 at sciencekit.com](#)), consider investing in one. This recharges bar magnets and horse-shoe magnets in about 1 second back to full strength.
- Keep an extra set of materials for yourself up front so you can show to students how to do the demos. Even the best worded explanation sometimes isn't enough.
- Have an earth globe set out too. You'll refer to it a couple of times throughout the notes.
- Insert page and paragraph numbers from relevant pages in your textbook at the bottom of slides 1 and 2 if you choose to have the class read from it together. This is a good way to connect with your textbook as well as transition into the next demo. You can also delete these page inserts, ignore them, or Copy and Paste them onto later slides if needed.
- As with any other demonstration, try these out ahead of time for yourself so you know how they work best and so you know what to expect.
- Print extra copies of the notes pages on paper for yourself, students that are slow writers or can't see well, and for absentees. Click "File" → "Print" → then where it says "Print what:" select "Handouts" → and then "OK".
- For a follow-up activity, check out the "Encrypted Magnetism Statements" activity.

Interactive Notes: Magnetism



Do: Dangled a paper clip near a magnet.

See: The magnet attracted the paper clip.

What's Happening: **Magnetism** is the force of attraction and repulsion between two objects or materials.

Read p. 11 together

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1.


Tell student #1 (of the 4) to dangle the paper clip on the end of a string near the magnet, and observe how it behaves. Now it's time to do the impossible- as the picture shows, hold the paper clip below, but still close enough to the magnet that it stays when you let go. Make sure the paper clip and magnet are not touching and that a gap between them can be clearly seen.

Tie a 20cm piece of fishing line or very fine thread, which weighs very little, to each paper clip. Use *small* steel paper clips. Don't use jumbo paper clips or those that are painted- they are too heavy and won't "fly".

Fastening the bar magnet to the utility clamp allows it to stay perfectly still, so it's much easier to get the paper clip to fly.

Referring to the phrase "force of attraction and repulsion" in the notes, magnets obviously attract things with iron in them, like paper clips. But ask- "What do they repel?" (*answer- the opposite poles on other magnets*)

2.




Do: Dragged a magnet 30 times over newspaper, aluminum, & steel wool. Checked with compass.

See: The compass did not respond to newspaper or aluminum. It did to iron.

What's Happening: Some things can be **magnetized**, some cannot. Each iron atom in the wool has its own north and south pole, called the **domain**. The more these domains line up the same way, the stronger the current.

Before



After

Read p. 11 together

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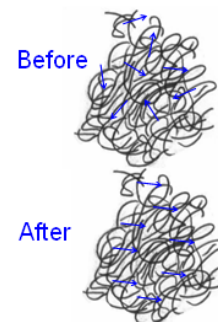
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Before student #2 begins their demo, student #3 needs to set theirs up so it can settle and be ready for them later. Have student #3 lay a magnet in the arms of the holder. Right after they put it in they'll need to "shepherd" the magnet still with little nudges until it stops swinging and eventually is perfectly still. Also, keep the ring stand away from the magnet- if it's too close, the magnet will attract it and throw off its alignment with earth.

Have student #2 find the strips of aluminum and newspaper, the piece of steel wool, and compass. Ask the class which of these 3 materials- paper, aluminum, and steel wool- can and cannot be magnetized. You'll get all kinds of answers. Have student #2 drag/stroke the newspaper strip over the clamped magnet 30 times and check its magneticity using the compass. The needle doesn't deflect, so it's not. Do the same with the aluminum (it's not), and the steel wool (it is!).

This demo fools many students. Most assume that since aluminum is metal that conducts that it can be magnetized. Some students even believe the paper can be magnetized before they try to do it.

As students are dragging the steel wool over the magnet, tell them what they're doing is like combing tangled hair. It's tough at first to comb, but it gets easier. With each stroke over the magnet the domains in the steel wool lined up more and more, becoming less "tangled". This is illustrated in the "Before" and "After" picture sets on the slide.

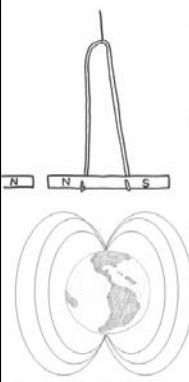


If you're doing ok on time, have student #2 pull the wool apart into little pieces and then put it back together and check it again with the compass and they'll see it has lost all charge. What happened? (read on)

The more they stroked the magnet over the wool, the more they lined up the domains in it to face the same way. And the more the domains pull in the same direction, the stronger the magnetism. Sort of like tug-of-war on the atomic level- the more domains pull together in a common direction, the stronger the force becomes. Oppositely, when the wool is pulled apart, you disorganized all the domains, and they become "tangled" again. They're still there and pulling, but now in different directions, so they cancel each other out. To see if students are catching on, ask them why dropping a bar magnet on a hard floor causes it to weaken (*the domains become random- or, back to the earlier analogy, the hair becomes tangled again*).

Only nickel, iron, cobalt, and their alloys can be magnetized.

3.



The diagram shows a wire coat hanger bent into a U-shape, suspended by a string. Below it is a bar magnet with 'N' and 'S' poles. To the right, a globe of Earth is shown with magnetic field lines looping from its top to its bottom.

Do: Placed a bar magnet in the holder.

See: It lined up with earth's magnetic poles. It also attracted and repelled other magnets.

What's Happening: Like poles (n/n, s/s) repel, and opposites (n/s, s/n) attract. Earth is a giant (but weak) magnet, mostly as a result of the churning magma in the interior.

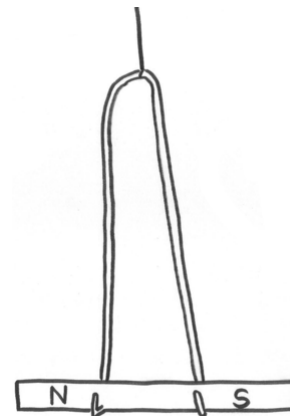
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Have student #3 check back on the magnet in the hanging holder, which should now either be perfectly still or close to it. Ask which way the north end of it is oriented (towards earth's south). Then go around the room, and “discover” that all the magnets in the room are doing the same thing! Coincidence? There must be another magnet at work somewhere causing this to happen. Where is it? (*earth!*)

A hanging magnet holder is nothing more than a wire coat hanger that's been cut and bent into the shape you see. A string ties it to the ceiling. You can get 2 out of each coat hanger. Cover the sharp ends with tape since they are hanging near eye level. If hanging these from the ceiling seems like too much trouble, you can see how well this demo works with students holding the string in their hands. If it works “well enough” for you, then you won't have to bother with tying them to the ceiling.

When putting these away at the end of the day, take care to wind the string up carefully because it tangles very easily! Slide the knot where the string attaches down close to a hook, wind the string around the hooks, and then put each holder in it's own plastic bag.


These holders are also used in the Interactive Notes on the Atom. It's the same demo but with a different application.



Before this activity put a “north”, “south”, “east”, and “west” sign on your walls that tell direction. You'll be referring to north and south quite a few times today.

Time-permitting, you can use another bar magnet to chase the one hanging around. That's fun to do, but this shouldn't happen if you think about it. Since earth is much more massive than the bar magnet, its magnetic field should be much stronger, right? So why is this little bar magnet more powerful than our earth? Earth's magnetic field is weak because we think its magnetic poles are getting ready to reverse themselves. They appear to do this every half million years or so. And a reversal may happen in the next thousand years. See if your book has a section on magnetic striping, a related topic. There's also a great video about this called [“Magnetic Storm”](#).

4.



Do: Covered a bar magnet with a sheet of paper and sprinkled on iron filings.

See: The filings formed a pattern of loops, leaving one part of the magnet and entering another.

What's Happening: Bar magnets have **lines of force** looping out and back in. These make up its invisible **magnetic field**. The **poles** are strongest and the middle is weakest.

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Have student #4 lay the bar magnet on the table in front of them, cover it with a sheet of paper, and sprinkle iron filings all over the paper. Patterns showing the gorgeous lines of force emerge.

Tell students to not move the paper around once the filings are on it. If they do, they'll lose the lines of force, which is the whole point of doing this.

Put about 2 grams of iron filings in each sandwich bag, and then cut a very small hole in one of the bottom corners. It will leak a little throughout the day, but this is still the best way to sprinkle on the filings. That's because if you give students filings in a beaker, they'll just dump them in a pile on the magnet and see nothing. And if you ask them to take and sprinkle a pinch with their fingers, their hands get dirty and the filings still end up in a pile. You want a thin, even layer over the whole paper.

The filings don't land randomly. "Something" tells them to line up the way they do. Each line of force is actually a stream of moving charged particles that exit from the south pole of the magnet and then re-enters at the north.

Earth's lines of force are the same as those on the bar magnet, only bigger. They run thousands of miles long and stretch well into space. Every living creature on earth owes its life to them. All combined, these giant lines of force make up the Magnetosphere, which protects us from the sun's most harmful energy.

Sunspots are a related topic. They look like...well, spots on the sun. They're caused by enormous magnetic storms on and just below the surface of the sun, and many are larger than our planet. We think they are caused by the uneven rotation speeds of different parts of the sun, which causes massive binding and twisting of the lines of force. Sunspots always occur in pairs because, as we saw on the bar magnet, each is a line of force that exits from one place (south) and enters another (north). Where this happens on the sun, this causes cooling, and thus darkening of the sun's surface.

Clean Up

Person 1

- Put paper clip in box
- Put magnet in box (leave other one clamped)

Person 2

- Throw steel wool away; get another piece
- Put pieces of newspaper & foil in box

Person 3

- Count 4 new note sheets

Person 4

- Slide iron filings back into baggie

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Use this slide to direct students how to clean up and reset everything for the next class.

You'll need at least 5 minutes at the end of class to reset everything for the next class.

Leave a stack of note sheets somewhere for students to get, and pieces of steel wool. Keep extra aluminum and newspaper strips handy.

If you don't want this slide to show, right-click on the slide and select "Hide Slide".

To help you with clean up, have your last science class take everything out of the boxes and put them in like piles in the back of your room.

Come back and visit InteractiveScienceTeacher.com to upgrade this lesson with:

PowerPoint- lead your students through the lesson click-by-click

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Before
After

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Read p. 1 together Interactive Science Teacher

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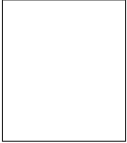
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Student Handout

Topic: _____

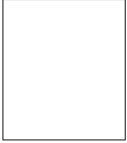
Date: ___/___/___



Do: _____

See: _____

What's happening: _____



Do: _____

See: _____

What's happening: _____

