The Virginia Instructors of Physics
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PHANTASTIC PHERROMAGNETIC PHILINGS OF PHYSICS PHUN !

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Va. SOL:

PS.1 The student will plan and conduct investigations in which
PS.11 The student will investigate and understand basic principles of electricity and magnetism. Key concepts include

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PH.12 The student will investigate and understand how to use the field concept to describe the effects of gravitational, electric, and magnetic forces. Key concepts include

National Standards:

- Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces, and moving magnets produce electric forces. These effects help students to understand electric motors and generators.

Topic/Concept

Magnetizing of objects using a permanent magnet. Ferromagnetic domains. Magnetic field of the Earth

Materials

- Iron filings
- Test tube w/ stopper
- Magnetic compass
- Strong magnet

Safety Considerations

Take appropriate precautions with very strong magnets. Pose a pinching danger and can cause small ferrous materials to fly.

Presentation

The student will cause and observe a vial of fillings becoming magnetized and make inferences about how a nail or permanent magnet is magnetized as well as how a door frame or filing cabinet in the room has become magnetized.

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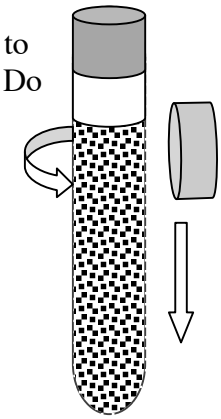
Experiment #1

1- Check for interactions between the test tube of iron filings and the magnetic compass. Describe in detail any interactions you observe.

2- Use one face of the disk magnet to "stroke" the test tube. Stroke the test tube from top to bottom with the same face of the magnet. Rotate the test tube slightly between strokes. Do this 20 times. Record observations of how the filings behave during this process.



3- Check for interactions between the test tube of iron filings and the magnetic compass. Describe in detail any interactions you observe. How are these interactions different than before?

4- Give the test tube of iron filings 1 vertical shake. Test the interactions. Record your observations. Give the tube 2 more shakes. Test the interactions. Record. 3 shakes… you get the picture.

Analysis

1- How do you **know** that changes inside the test tube of iron filings have occurred?

2- What do you think happened inside the test tube of iron filings while you were stroking it with the magnet?

3- What do you think happened inside the test tube of iron filings while you were shaking it?

Experiment #2
Repeat the procedure you used on the test tube of filings with a nail. Once you get to step 4, instead of shaking the nail, drop it from a meter high onto a hard surface.

Write a paragraph or two that compares and contrasts what happens with the nail to what happened with the filings.

Experiment #3
Use the magnetic compass to investigate a metal door frame, filing cabinet, or bookshelf in the room. Record your observations. Make sure you investigate thoroughly. Write a summary about what your observations are telling you about the object you investigated. Hypothesize how or why this occurred.

Teacher Tips Regarding Lab

For the experiment above you need a very strong magnet. I use a 10 mm neodymium magnet I bought from Educational Innovations, Inc. This experiment requires some careful observation on the student's part. When the test tube is initially brought near the compass, both ends of the compass will be attracted weakly to the iron filings. While the student is magnetizing the filings in the test tube, she should observe the filings trying to line up with each other as they align to the external magnetic field. Once the test tube has been "magnetized" the bottom of the test tube will have an obvious attraction for one end of the compass and the top of the tube will have an obvious attraction for the other end. Lab groups will find different polarity depending on which pole of the magnet was facing the test tube during the magnetizing. Some student groups will need guidance to make sure they explore all of the test tube and not just one end. It is also important to keep the compass horizontal for it to work correctly.

As the magnetized tube of filings is given progressively more vertical shakes, the magnetic strength of the tube of filings will weaken. The student will get similar results with the nail but the aligning of the domains in not observable and must be inferred. This provides the students with a clear model of the concept of magnetic domains.

The web site
http://www.ndt-ed.org/EducationResources/HighSchool/Magnetism/hs_mag_index.htm from Non Destructive Testing is pretty cool, simple and interactive and would provide teacher or student a good background on magnet issues.

When the compass is held near the floor beside a metal doorframe the south pointing needle will attract. As the compass moves upwards slowly along the doorframe there will be one or more reversals. Cool, huh? Why stop there! Check out your filing cabinet, metal bookshelves, a student who has been standing in one place for a long time. Wanting an explanation? I have some ideas but…well… this section is running a bit long. Have fun exploring!

Sources & References

http://www.ndt-ed.org/EducationResources/HighSchool/Magnetism/hs_mag_index.htm from Non Destructive Testing

educational innovations www.teachersource.com