Magnetism

Physical Science 101

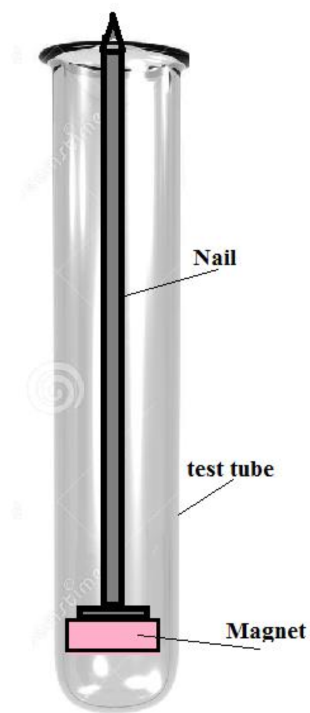
Name ________________________

Partner's Name _______________

Magnetism

Purpose: The purpose of this lab is to study various aspects of the magnetic force. Please be careful not to place any magnets beyond the work area that you are using in order to avoid damaging any computer disks. Work through each section carefully making sure that you have observed the phenomena before proceeding to the next section.

Section 1: Getting the feel of a magnet.

Equipment: 2 small magnets (1/4 inch thick by 3/8 inch (or ¼ inch) diameter), 1 plastic test tube, 2- iron or steel nails, compass, various materials. The test tube should be large enough for the magnet to slide easily within it, and the nail should be long enough so that when it is attached to the magnet, with the magnet at the bottom of the test tube, the nail's tip pokes out a little above the test tube (see figure 1 at right). This magnet-test tube-nail arrangement keeps the magnet from flipping over when one explore the interaction of this magnet with another magnet. See Figure 2	 Figure 1

A. What material is the magnet attracted to? Try the magnet on various materials in the lab like the faucets, door handles, sinks, books, counter top, your skin etc. Materials that are strongly attracted to magnets are called ferromagnetic. Iron is the most common material of this type. The sink is stainless steel. Some stainless steel is not magnetic. Name 4 items attracted to the magnet and four items not attracted

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Attracted _____________ , ______________ , __________________ , __________________

Not attracted _____________ , ______________ , ______________ , __________________

For the items below, circle those that are attracted by a magnet.

Copper nickel sheet nickel coin steel paper clip

iron nail aluminum rod dollar bill

B. Identify the north and south poles of your magnets using the compass. First make sure that the compass has not been polarized the wrong way by taking it some distance from any magnets and seeing if it does indeed point towards north. Label each pole on your magnet with tape and the letter N or S. The north pole of a compass will point to the south pole of a magnet and vice versa. The magnetic North pole of a magnet points towards Earth's North pole so the polarity of the magnetic pole located at high northern latitudes is actually South. Attach a steel screw (or bolt or nail) to each magnet to provide a good handle and place one of your magnets into a plastic graduated cylinder or plastic test tube (note which pole is down into the cylinder). The plastic tube and nail on the magnet is used to keep it from flipping too easily. Place the two north poles of your magnets close together, then the two south poles and finally a north pole near a south pole. Feel the force.

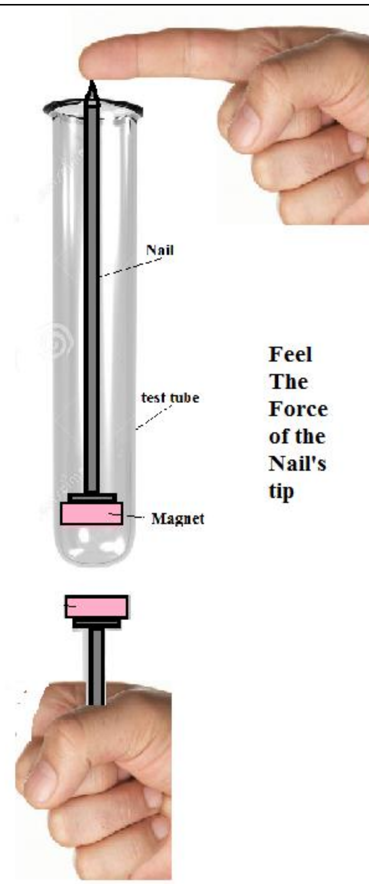

Figure 2.

Does the force seem to increase slowly or rapidly as the distance between the poles diminishes?

________________ .

What conclusions do you make regarding the attraction or repulsion of magnetic poles? (circle best answer)

Two north poles facing each other will (**Attract or Repel**)

Two south poles facing each other will (**Attract or Repel**)

A north pole facing a south pole will (**Attract or Repel**)

C. Hold a magnet near a compass needle so they attract each other. Now place a piece of paper between them. Do they still attract? ______ Can you wiggle the compass needle by wiggling the magnet? Try wiggling your magnet rapidly and then slowly. Try aluminum foil, plastic, iron, copper. Does the magnetic force pass through all of these? _________ Which one(s) don't let the magnet field though very well ? ______________ Can you really tell in all cases.

Section 2: Finding the magnetic declination and the dip angle.

Equipment: Compass with degree markings, dip needle.

The magnetic declination for an area is the number of degrees east or west that magnetic field deviates from true north. The dip angle is the angle that the earth's magnetic field makes with respect to the horizontal. Find the declination and dip angle for this area. The dip needle looks a little like a compass but oriented in the vertical direction. There are too many stray magnetic field in the lab to find the declination or an accurate dip angle. As a reference, the side of our building points towards true north. Use your compass and dip needle to find the declination and dip angle.

Declination ___________________ Dip angle ______________________

Section 3: Exploring the magnetic field around your disk magnets.

Equipment required: 2 small magnets (1/4 inch thick by 3/8 inch diameter), small compass

Make sure that the compass that you are using points towards Earth's north. Sometimes compasses become magnetized in the wrong direction when inadvertently held near a strong magnetic field. Put your two disk magnets together to make 1 larger magnet. Move the compass in the vicinity of your magnet in all three dimensions. The north pole of the compass will point to the south pole of the magnet. Identify which end of the magnet is the north end (sometimes the label is wrong).

On the sketch below, indicate the direction of the field at each point with an arrow as indicated by the compass needle when located at that point. That is, Place your magnet on the paper place the compass needle right over each point, note its direction, and then draw an arrow on the point on the paper showing the direction.

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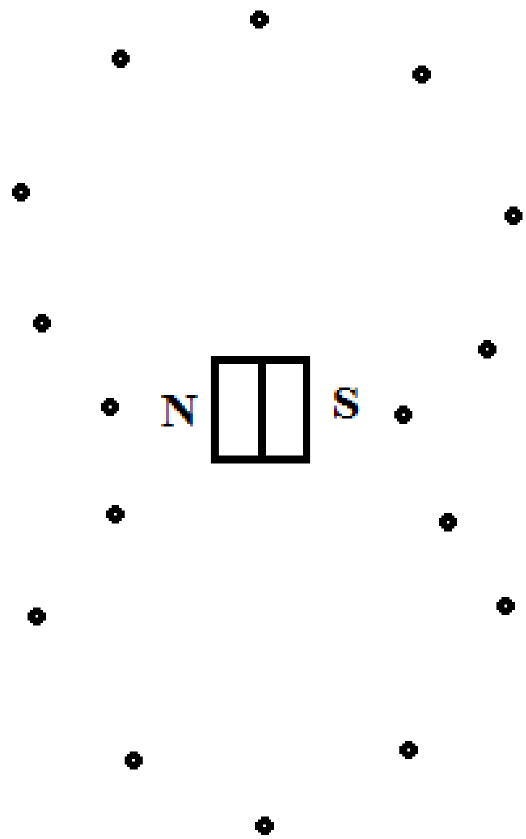

Separate your two disk magnets and place the two North poles facing each other as shown below. On the sketch below, indicate the direction of the field at each point with an arrow as indicated by the compass needle when located at that point.

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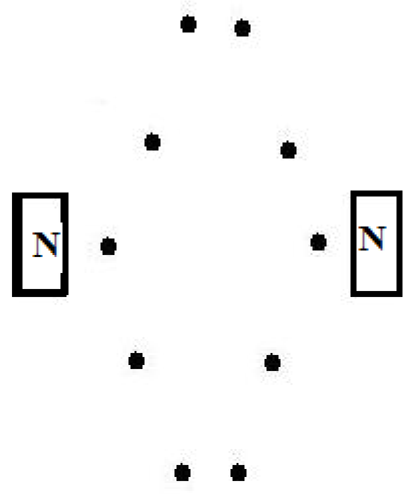
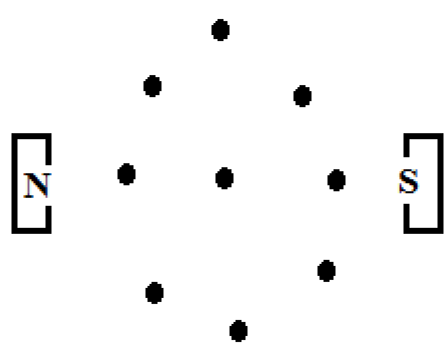


Place the North pole of one magnet facing the South pole of the other as shown below. On the sketch below, indicate the direction of the field at each point with an arrow as indicated by the compass needle when located at that point.



Section 4. The magnetic field of a wire.

Equipment: wire, battery, and compass.

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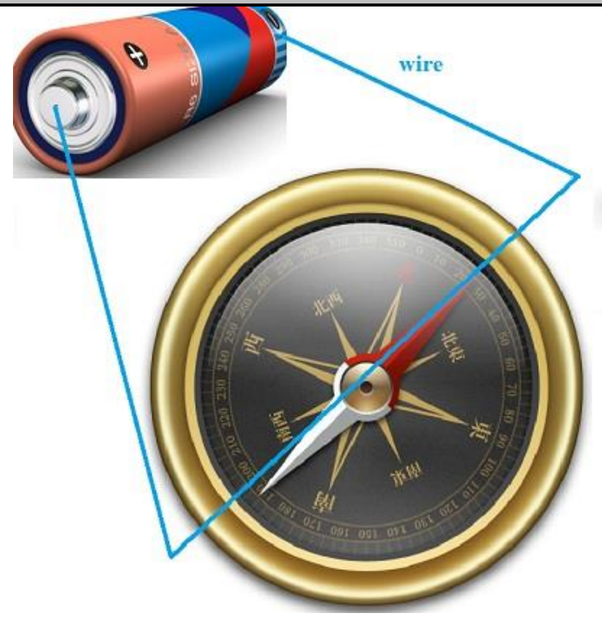
Orient the wire so the current runs South to North according to your compass. (to do this the + terminal of the battery must be connected to the South side of the wire as shown.) Place a small compass under the wire. Turn on the current for a second or two by touching both ends of the wire to the battery.



Which way does the compass needle point? (be specific) ______________

Hold the compass over the wire. Turn on the current for a second or two by touching both ends of the wire to the battery.

Which way does the compass needle point now? ______________

Is the direction of the magnetic field consistent with Right hand rule described below?

Right hand rule for field around a wire: grab the wire with your right hand with your thumb pointing in the direction of conventional current and you fingers will go around the wire in the direction of the magnetic field

Section 5: Faraday's Law

Equipment: 1 rare earth magnet, a heavy (1/2") bolt, a coil, and a galvanometer.

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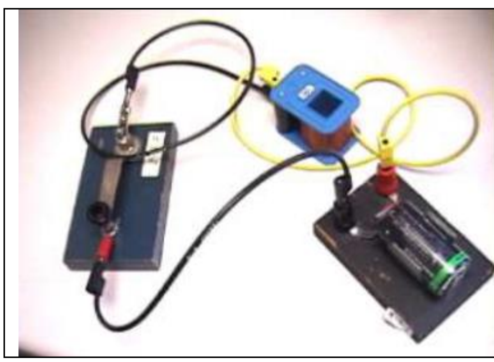
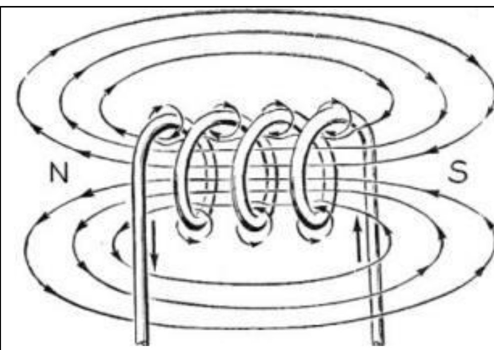
Connect the coil to the galvanometer as shown. Use your strong rare earth magnet that has been attached to nail and slowly insert it into the coil.
When the magnet moves into the coil the galvanometer deflects to the + or – direction. Circle correct answer + or –
When the magnet is pulled out of the coil the galvanometer deflects to the + or – direction. Circle correct answer + or -.
When the magnet moves slowly into the coil, the galvanometer deflection is large or small (circle answer)
When the magnet moves fast into the coil, the galvanometer deflection is large or small (circle answer)

Section 6. An Electromagnet. Connect a battery to the coil as shown. The switch allows one to easily turn the coil's current on and off.



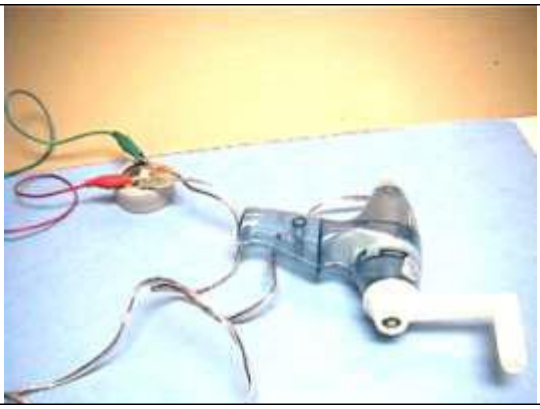


Now set the coil on its side and use you compass needle to explore the magnetic field of the coil. Does your coil have a magnetic field like the one show in the picture above right, or is it opposite to this (i.e. the North pole of the coil is on the right not the left as shown below).

____

What direction does your compass needle point when it is near the right hand opening? (assume the switch is closed)_________________________________
What direction does your compass needle point when it is near the left hand opening ?(assume the switch is closed)_________________________________
What direction does your compass needle point when it is near the middle of the coil and on the outside? (assume the switch is closed)_________________________________

Section 7. Electric Energy.
Learning Objectives: to explore electric energy generation

Locate the plastic hand-held generator and leads that go with it. Locate light bulb that can be connected to the generator.	

Crank the generator when it is not connected to the light bulb. Take notice of the effort on the handle needed to crank without a light-bulb.

Now crank the generator when it is connected to the light bulb. What did you notice regarding the effort on the handle ?

Now crank the generator when the leads coming from the generator are connected to each other. What do you notice regarding the effort on the handle ?

Now connect the leads of the generator to a battery. What do you observe.

What is another name for an electric generator that is connected to a battery?

Section 8. Making an Electric motor

Go to and make an electric motor.

http://www.evilmadscientist.com/article.php/HomopolarMotor

Or

Homopolar roller

Or

http://sci-toys.com/scitoys/scitoys/electro/electro.html#single (a motor in 10 minutes)

Have your instructor stamp you here once you are finished ________________

Section 9. Eddy currents

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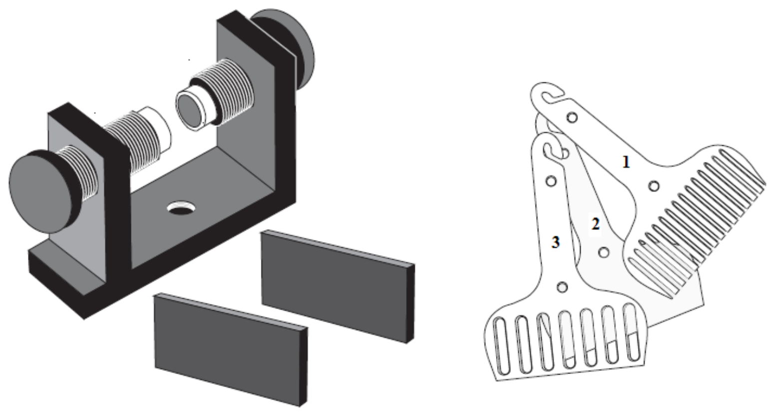

EM-8641 Variable Gap Magnet **(Close to smallest gap)**

Close the variable gap magnet to its smallest gap (~ 2 to 3 mm).

There are three aluminum accessary plates (labeled 1, 2, 3 in the figure above). In this exercise we will use plates 1 (solid flat) and 2 (flat comb shaped).

1. Move plate 2 (on edge) horizontally into the gap. What direction is the magnetic force acting on the plate as it moves horizontally into the gap?
   a. Pulls it in faster (i.e. in the same direction as the motion)
   b. Pushes it away (i.e. in the opposite direction as the motion)
   c. Force pushes plate up.
   d. Force pushes plate down.

2. Move plate 2 (on edge) horizontally out of the gap. What direction is the magnetic force acting on the plate as it moves horizontally out of the gap?
   a. Pulls it in faster (i.e. in the same direction as the motion)
   b. Pushes it away (i.e. in the opposite direction as the motion)
   c. Force pushes plate up.
   d. Force pushes plate down.

3. Move plate 1 (on edge) horizontally into the gap. What direction is the magnetic force acting on the plate as it moves horizontally into the gap?
   e. Pulls it in faster (i.e. in the same direction as the motion)
   f. Pushes it away (i.e. in the opposite direction as the motion)
   g. Force pushes plate up.
   h. Force pushes plate down.

4. Move plate1 (on edge) horizontally out of the gap. What direction is the magnetic force acting on the plate as it moves horizontally out of the gap?
   e. Pulls it in faster (i.e. in the same direction as the motion)
   f. Pushes it away (i.e. in the opposite direction as the motion)
   g. Force pushes plate up.
   h. Force pushes plate down.

   Compare how the results differ between using plate 2 the solid plate with those from plate 1 (the comb)

This completes this lab. Clean up your work area when you are finished.