DISCREPANT EVENTS GALORE – AND MORE
NSTA National 2000

SPINNER ELECTROSCOPE

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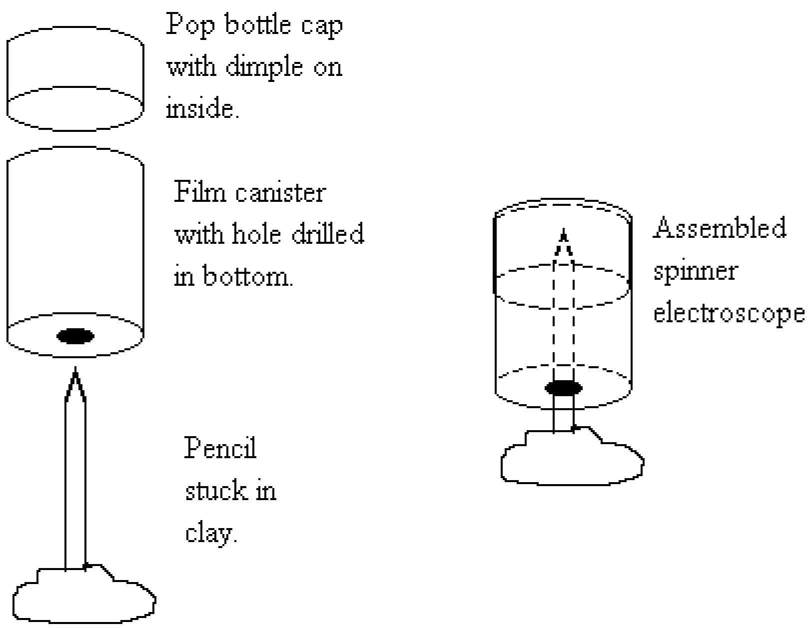
A simple spinner electroscope can be made from just a tape canister, a pop bottle cap, a pencil and some clay. To begin, drill a hole in the bottom of the film canister slightly larger than the pencil. Drill a small dimple in the inside top of the pop bottle cap. Be careful not to drill all the way through the plastic. The pop bottle cap can then be gently inserted into the film canister such that the top of the cap is level with the top rim of the film canister. Stick the pencil, point up, into some clay and then place the film canister over the pencil such that the dimple in the pop bottle top is over the point of the pencil.



After the spinner is assembled, rubbed objects can be placed on top of the spinner while a second rubbed object is brought close by. The resulting movement of the 1st object can help is a good indicator of whether the 2nd object has a similar or different charge than the 1st object.

It is relative simple to obtain rods that become + or – upon rubbing. Common PVC tubing from the hardware store is very cheap and when rubbed with cellulose (common paper towels) will become – charged. A rod that will become + charged when rubbed with paper towel can be made by taping the outside of a PVC rod with clear plastic packing tape (glass tape).

TRIBOELECTRIC SERIES

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When two materials on this list are rubbed together, the material higher on the list will become positively charged while the material lower on the list will become negatively charged.

I	P	**+++**	Air
n	o		Acetate (for overhead projectors)
c	s		Human hands
r	i		Acrylic plastic (Plexiglas)
e	t		Asbestos
a	i		Rabbit fur
s	v		Glass
i	e		Mica
n		**++**	Human hair
g			Nylon
l			Wool
y			Cat Fur
			Lead
		+	Silk
			Aluminum
			Paper
		Neutral	Cotton
			Steel
			Wood
			Amber
		-	Sealing wax
			Hard rubber
			Nickel, copper
I	N		Gold, platinum
n	e		Sulfur
c	g		Acetate, Rayon
r	i		Polyester
e	t	**--**	Celluloid
a	i		Orlon
s	v		Saran
i	e		Polyurethane
n			Polyethylene
g			Polypropylene
l			PVC (vinyl)
y			Silicon
		---	Teflon

VISUAL MAGNET MODEL

The material that makes up the ceramic magnets can be crushed up and put in a small transparent container. (I used a clear film canister) Although the material is crushed into a number of tiny magnetic pieces, when shaken the container will not display any magnetic field. This is similar to a normal piece of iron where all the magnetic domains are randomly positioned. When the container is grought near a strong magnet, the small magnetic pieces will align themselves. This allignment can even be seen in the container. This is similar to the allignment of the magnetic domains in a permenant magnetic. The container will now behave like a normal magnet until shaken again.

MAGNETIC MONEY

Although quarters are not made from magnetic material, it is possible for them to be influenced by a magnet if the coin or magnet is moving. A quarter rolling past a strong neodymium super magnet will be noticeably lowed down. If one of the Super magnets is quickly moved just above the op of a quarter resting on the table the quarter will be moved in the direction of motion. The physics of this demonstration involves Lentz's W. Electrical currents produced by a changing magnetic field produce opposing magnetic fields.

NOTE:Here is another nifty experiment that really does not involve electromagnetism but is just fun. If a neodymium super magnet is brought near one side of a dollar bill the bill will be attracted because bills are printed with magnetic ink.

FALLING MAGNETS - ELECTROMAGNETIC INDUCTION

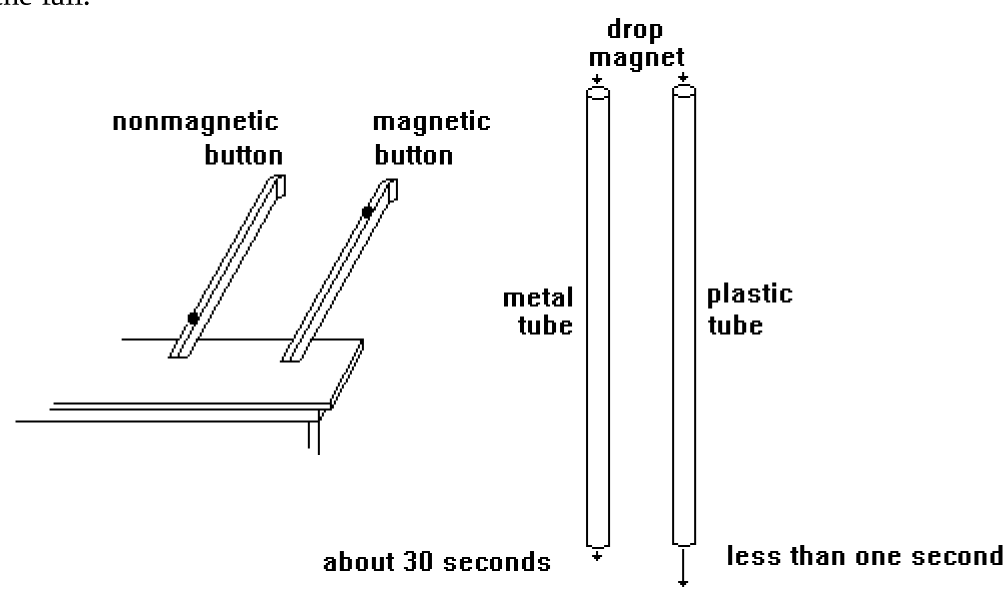
Moving electric charge (electric current) produces magnetic fields and moving magnets produce electric fields. This dynamic relationship between Electricity and Magnetism can be used to demonstrate some very interesting phenomena.

If a falling magnet is surrounded by metal, the electric field produced by the moving magnet will induce an electric current in the metal. The magnetic field produced by the induced electric current opposes the fall of the magnet according to Lentz's law. If the magnet is strong enough, the induced electric current can produce a magnetic field strong enough to appreciably slow the fall of the magnet. This is also an interesting example of the conservation of energy. As the falling magnet loses potential energy it induces an electric current which in turn is converted to heat. An interesting example of this can be seen as the "fail safe" brake on free fall rides in amusement parks.

This can be demonstrated two ways:

1. A neodymium button magnet about 1 cm in diameter can be rolled down a piece of Aluminum channel. The motion of the magnetic can be compared to the motion of a similar non-magnetic button. The non-magnetic button will accelerate unimpeded down the channel while the magnetic button will roll slowly down the channel with a constant velocity.

2. A neodymium button magnetic can also be dropped down a vertical piece of copper or aluminum tubing about 1/2 inch in diameter. A similar non-magnetic button will accelerated down the tube with an acceleration nearly that of "g". The magnetic button will move through the tube very slowly taking 5 or 10 seconds to fall a meter. If the button magnetic is dropped through a piece of PVC tubing it will fall with the same acceleration as the non-magnetic button. The falling buttons can be heard as they move through the tubing as they bump against the walls during the fall.



FLASHING - ELECTROMAGNETIC INDUCTION

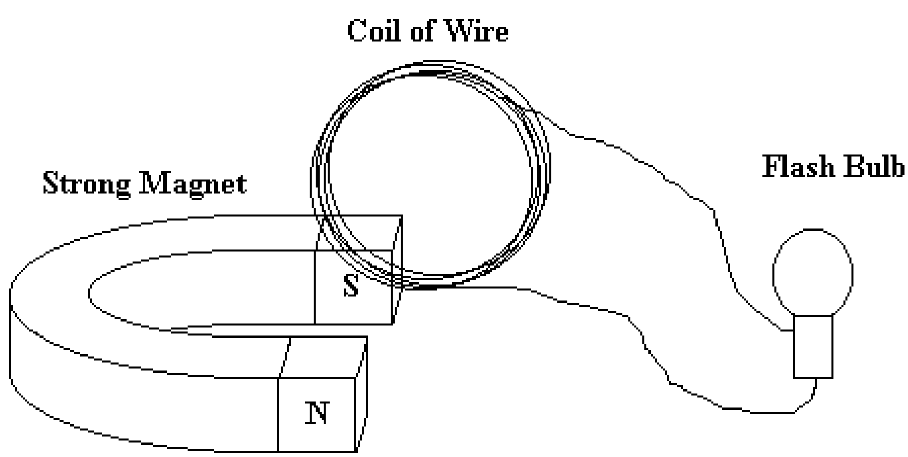
The idea that moving electric current produces a perpendicular surrounding magnetic field is relatively easy to demonstrate with a compass needle and a long straight wire. The concept of a changing magnetic field can produce an electric current is a bit harder to demonstrate to a large group. One of the easiest and most attention getting demonstrations is to use a conventional flash bulb.

If a conventional flash bulb (it can be a single bulb or flash cube, it can not be a Magic X cube) is attached by wires about 1 meter long to a coil of wire (20 to 50 turns, 10 cm. in diameter), when the coil is quickly moved through a strong magnetic field the resulting current will set off the flash bulb. This is usually quite convincing to students since most students understand that it take electric current to excite a flash bulb.

The magnet that produces the field must be quite strong. It can be a large horse shoe magnetic or two of the neodymium super magnets (about 2 cm. cubed) held two to three centimeters apart.

Flash bulbs and cubes are getting harder to find but some times show up in reasonable quantities at reasonable prices at Goodwill Stores or garage sales.

The demonstration works because as the coil of wire is moved the magnetic flux passing inside the coil changes. This changing magnetic flux produces a current in the wire which in turn flashes the bulb.



CLASSROOM RADIO - ELECTROMAGNETIC INDUCTION

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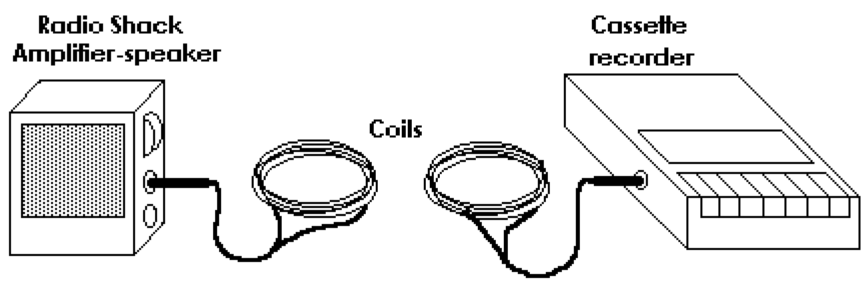
Students often have difficulty understanding the concept of electromagnetic induction. One problem is that induction is often demonstrated using apparatus that is foreign to students' everyday life. The common demonstrations also usually lack excitement since they only involve watching a meter attached to a coil of wire as electrical current is varied in another coil near by. The following demonstration of electromagnetic induction is simple in concept but very effective in the classroom. It also has the added benefits of using familiar equipment and involving more than just the sense of sight.

Students in high school usually have had a lot of experience using cassette recorders. They realize that the recorder uses electricity to reproduce the sound (that's why they have to replace batteries from time to time). Since the sound is constantly changing, the electric current must also be constantly changing. This changing electric current can be brought outside the recorder by plugging headphones into the jack on the side of the recorder. A coil of wire can be attached to this jack rather than a headphone. Usable coils of wire can be made by winding about 50 turns of #26 magnet wire in a circle 5 cm. in diameter or if available an old PSSC solenoids will work well. The changing electric current will then produce a changing magnetic field around the coil. This changing magnetic field can be detected by placing a second coil near by. If this second coil is attached to the input of a small amplifier-speaker, the music being played on the recorder can be heard on the amplifier-speaker some distance away. An ideal amplifier-speaker for this experiment can be purchased at Radio Shack (#277-1008B) for about twelve dollars. The loudness of the music will vary as the second coil is moved around. The polarized nature of the magnetic fields can also be demonstrated by turning the second coil at right angles to the first and observing that the music stops playing all together.



FARADAY CAGE

Faraday was the first to understand that inside a hollow conducting sphere, the electric field becomes zero. This is because the electric charges will on the outside of the sphere will align themselves such the field is zero. This is also true if the hollow object has any other shape. Since this time a hollow conducting object has been known as a Faraday cage. An easy example of a Faraday cage is some hardware cloth (a wire mesh available at a hardware store) is wrapped into a cylinder. Obtain a small AM transistor radio, turn it on loudly, and set on a strong AM station. When the radio is placed in the center of the cylinder, its volume will noticeably decrease and disappear. When the radio is brought out of the cylinder it will start playing loudly again. While it is inside the cylinder, the cylinder acts as a Faraday cage, the electric field inside remains zero, and nothing can be heard until it is removed. This is why it is difficult to get good AM reception inside a metal car, or a building with a metal superstructure, or an enclosed metal bridge.