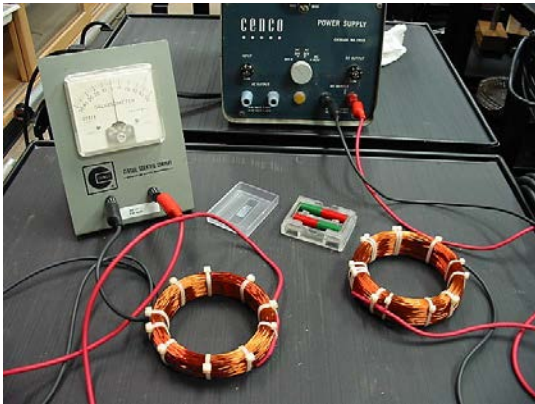
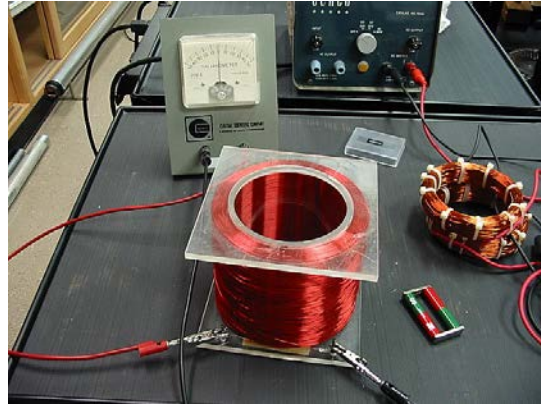


Induction and Lenz's Law



The Basic Stuff



**Same Experiment
More Turns!**

Purpose: Demonstrates the EMF induced by a changing B field and Lenz's Law regarding the sense of the induced current.

This demo is a fun, but rigorous, complement to a lecture on magnetic induction. The basis for the demo is a coil connected to a galvanometer. Using a permanent or electro-magnet, you can explore the sense of the current induced in the coil by various ways in which the flux Φ is changed.

Before anything else, you must demonstrate which way the galvanometer deflects for a given current. For the meter and leads shown in the photo, the deflection is to the right for a positive current (i.e. flowing red [+] to black [-]), and to the left for a negative current. You can verify this with the power supply by running a *small* current through the meter. You can do this by including your body in the circuit as a high resistance. **DO NOT** hook the power supply directly to the meter!!

We also have a large classroom galvanometer, however the smaller one shown has less inertia and is better damped. It is better suited for establishing the direction of short-lived currents.

Note: Faraday's law of induction claims that the induced EMF around a loop is directly related to the change in magnetic flux:

$$V = - dF/dt$$

The minus sign is Lenz's law which determines the sense of the current.

It is always easier to determine the current direction by figuring the way the current needs to flow in attempting to counteract the change. This is also a great demonstration for practicing the right-hand rule: when curling your (right hand) fingers in the direction of current flow in a loop, the magnetic field produced by the loop points in the direction of your thumb.

Some examples:

Suppose the coil is flat on a table, and we bring in a magnet from above with the *N* pole leading. Then the *B* field at the loop is pointing down, and increasing in magnitude with time. The coil wants to create its field pointing up to counter this change, and so current must flow counterclockwise (as seen from above).

Next, pulling the same magnet back out (upward), the *B* field still points down, but is now decreasing in strength. The coil now tries to counter this change by creating a field pointing down, and so the current flows clockwise.

Next, suppose you place the second coil over the first, and hook it to the power supply. (Adjust the supply ahead of time to run about 1.5 A through the coil) Suppose you have it connected so that the current will flow counterclockwise. Then, when the supply is turned on there will be a *B* field produced at the first coil pointing up, and increasing in strength. The first coil then wants to create its field

pointing down to counter this change, so a clockwise current will flow.

The combinations:

Source of B	Source of change in Φ
Permanent or electromagnet	Magnet moved
Permanent or electromagnet	Coil moved
Electromagnet	Power on/off

Finally, since a coil is a series connection of loops linking the same flux, the current is proportional to the number of turns of the coil. You can demonstrate this by using the big coil; the galvanometer deflection is much larger.

Extra Equipment: Magnets, power supply or 6 V battery, and leads.

Location: Shelf F3