

# Electro-Magnetism Demonstration

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## Main concepts:

Electricity flows through metal (we call metals conductors).

Electricity does not flow through plastic (we call plastics insulators).

Electricity will not flow unless you have a complete Circuit (a closed circle of wire).

Magnetic Fields can be used to create Electrical current.

Electrical current can create a Magnetic Field.

Generators use magnets to convert motion into Electrical current.

Motors use magnets to convert Electrical current into motion.

## What to do

### Circuits

Start with a walkman and headphones. **Q:** Why do the headphones need wires ??

Show a basic electrical circuit (battery, switch & Light bulb).

Electrons move through a wire like water moves through a pipe.

Voltage is the "Attraction" or "Force" that pushes the electrons (analogous to water pressure).

Current is how many electrons actually flow (analogous to the volume of water per second).

### Magnets

Show Lode Stones (Magnetic Rocks).

All magnets have North pole and a South Pole. Test them to see that S-S attracts, but N-N repels.

Draw an Electric Field (monopole). Draw a Magnetic Field (Dipole).

Magnetic fields are always Dipoles. We cannot have a Magnetic Monopole.

Use Iron Filings to show the shape of Magnetic fields.

Break the magnet in half. Test the Magnetic to show that each piece still has a North and a South pole.

This proves that we cannot have a Magnetic Monopole. Magnets always have two poles (Di-pole).

### Electro Magnets and Permanent Magnets

Show that current through a coil creates a Magnet.

Iron can be magnetized and becomes a permanent magnet.

### Magnets create electrical current.

OK now I have a mystery for you. Roll the aluminum disk through the high Magnetic field.

**Q:** Why does the disk slow down ?

Drop a NIB magnet through a plastic tube and through a copper tube. Hold the tube vertical and have the kids put their eye at the top end so they can see the magnet fall down through each tube.

**Q:** Why does the magnet fall so slowly in the copper, but falls quickly in the plastic tube ?

Show a magnet through a coil connected to a volt meter. The Magnet creates some voltage.

Show that many coils creates a larger voltage on the volt meter.

Imagine what were to happen if I cut my copper tube in to many little slices. Each slice acts as a coil.

Demonstrate the Leo Stick. Magnet drops through the tube and turns on the lights.

Actually the Leo Stick is just a simple generator. Anytime the amount of magnetic field changes through the area of a coil, that causes an electrical current to flow in the coil. What if we arrange the Magnets and coils around in a circle then we can turn a crank, and make electricity over and over again. This is what a Generator does.

### Generators

Show the hand held generators. Let the kids play with them.

Connect Generators together. The electricity from one generator makes another generator turn. We can see that a generator and a motor are really the same thing. It's just that a motor turns electricity into motion, but a Generator turns motion into electricity.

Show:

- Dynamo Torch
- Windmill Generator
- Generator Lantern.

### Optional (for the Older kids)

Lenz Law Hoops. Demonstrates the back force.

Explain how the back force (which makes the magnet fall through the copper tube slowly) is really just Conservation of Energy. Otherwise we would be able to make electricity for free (no energy). And we know we cannot create energy out of nothing.

### Equipment needed

Circuit (Battery, Switch, and light bulb)  
Clear plastic pipe full of Marbles.  
Little magnets with North/South marked  
Long broken magnet  
Iron Filings  
Copper Tube  
Plastic Tube  
NIB Magnet  
Leo stick  
Hand held Generators  
Dynamo Torch  
Windmill Generator  
Generator Lantern.