

BSA Electricity Merit Badge

Electricity Merit Badge

Basic Electricity

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This Electricity course was put together to be presented in 6 classes. It should take about 5 hours. That is if each student has individual tools. Otherwise if students have to share tools, it will take much longer.

Class 0 30 minutes - Careers in the Electricity Field

Class 1 60 minutes - Overview of Electricity. This class requires a tool for the students to build an electric magnet. A common power buss was build with a car battery as the power source.

Class 2 60 minutes - Overview of AC Electricity. We build a Circuit breaker box with a 12 volt light bulb. At car battery was attached to the input of the breaker box. Each student has a turn shorting out a wire that was plugged into an outlet. This tripped the circuit breaker. Each Student also had the opportunity to wire a plug.

Class 3 60 minutes - Overview of DC Electricity. Each student build a switch, then wired up a circuit box. You may use a kit from Radio Shack to achieve the same thing.

Class 4 60 minutes - Overview of safety with Electricity.

Class 5 30 minutes - Test. This is an open book test. Hopefully the student has been filling in the answers in their work book in each class.

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What is Electricity

Electricity results from the existence of positive and negative charges and the interaction of these charges.

All matter (material) is made up of hundreds of basic building blocks called elements.

These elements are themselves made of tiny particles called atoms.

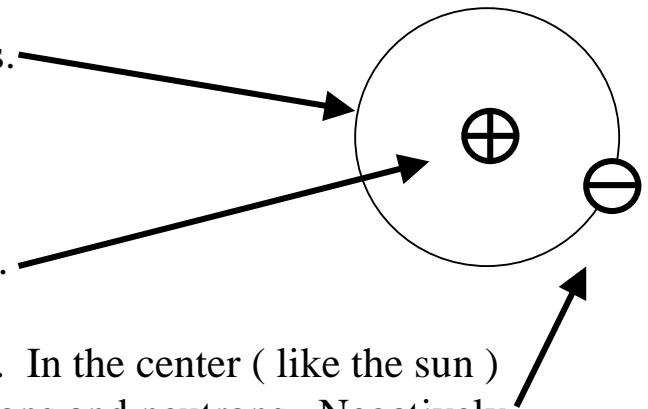
Atoms contain protons and neutrons

Protons are positive (plus +) charged and neutrons have no charge.

The atom can be compared to the arrangement of the solar system. In the center (like the sun) is the nucleus of the atom, which has a cluster of one or more protons and neutrons. Negatively charged particles called electrons surround the nucleus like planets orbiting the sun. The positive (or plus) charge protons equals the total negative charges of the electron.

For various reasons, an atom may lose one or more of its electrons. This leaves the atom positively charged, and out of balance. The atom may also borrow a few nearby electrons and become negatively charged. Electrons are easily lifted or rubbed off from an atom.

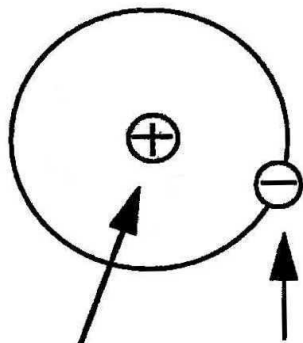
The electrical charge of the electron is the basic unit of electricity.



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Electrical Charges of Two Different Atoms

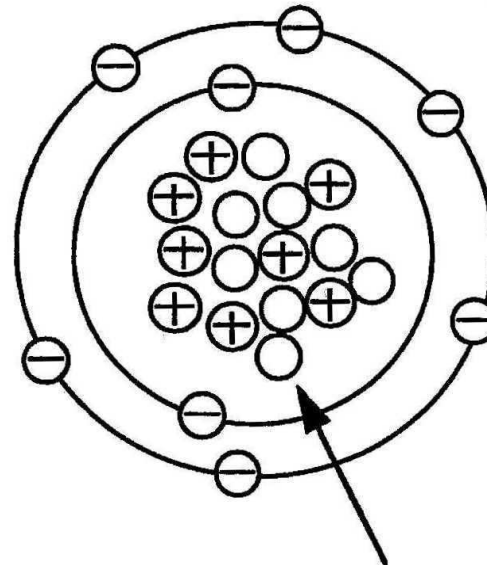
Hydrogen Atom



electrons are negative (minus -)

protons are positive (plus +)

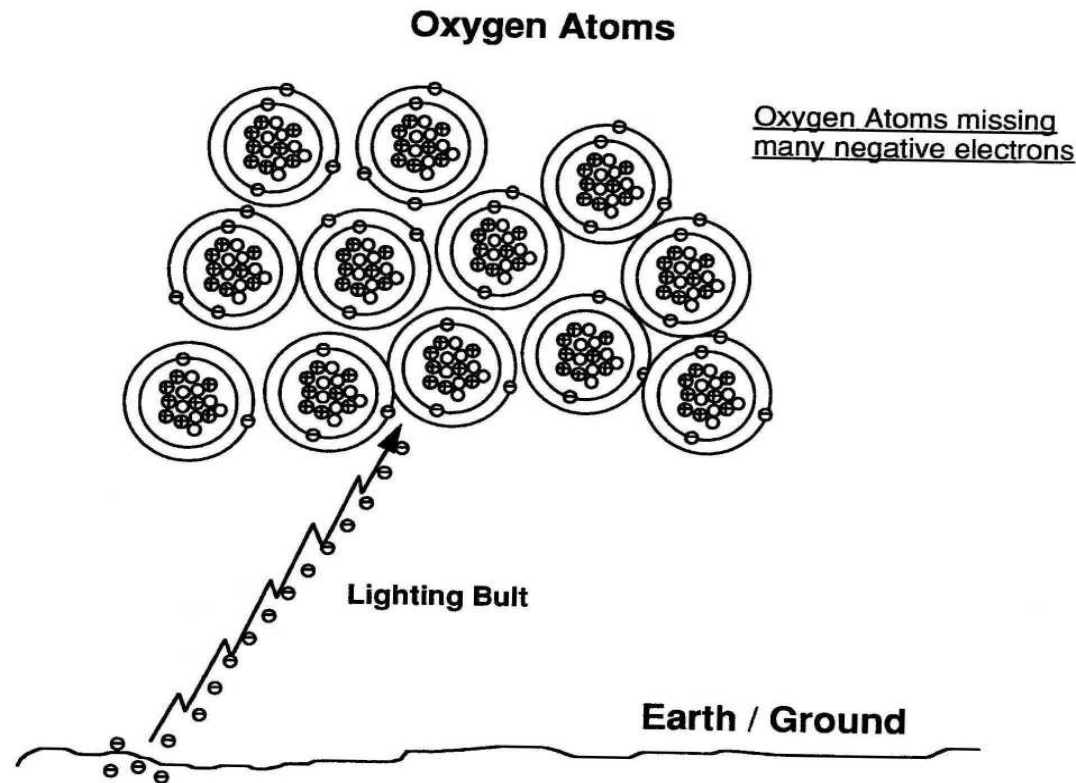
Oxygen Atom



neutrons have no charge.

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Why Lighting Happens

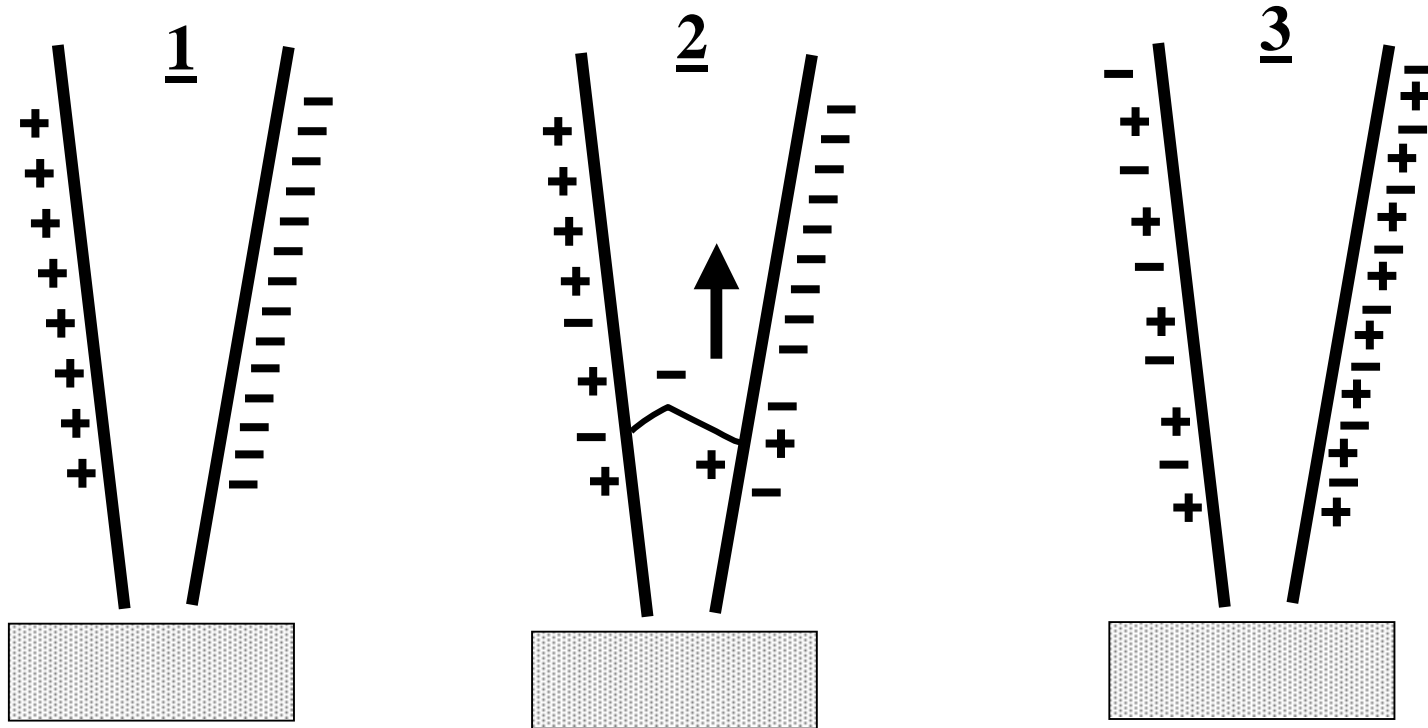


These Oxygen atoms are imbalance, because as air is moving the negative electrons get rubbed off. When enough of an imbalance is created, a surge of negative electrons will jump from the earth, creating a lighting bolt This balances off the electrons and protons.

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Jacobs Letter

Lightning Simulation



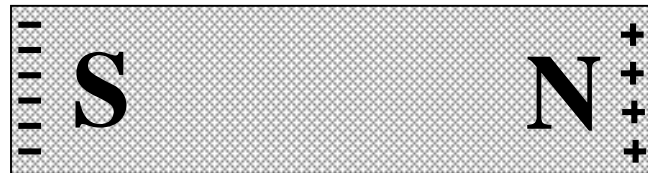
20 KV Transformer; 120 Volts in 20,000 Volts out.

In this example the lightning is happening thousands of times per second. The sequence is:

- 1) High voltage is applied with Positive on one side and negative on the other.
- 2) When the voltage gets high enough, the negative electrons jumps to the positive side all the way up.
- 3) The poles then become neutralized or balanced. The process starts all over again after the transformer charges the poles up again.

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Magnetic Field

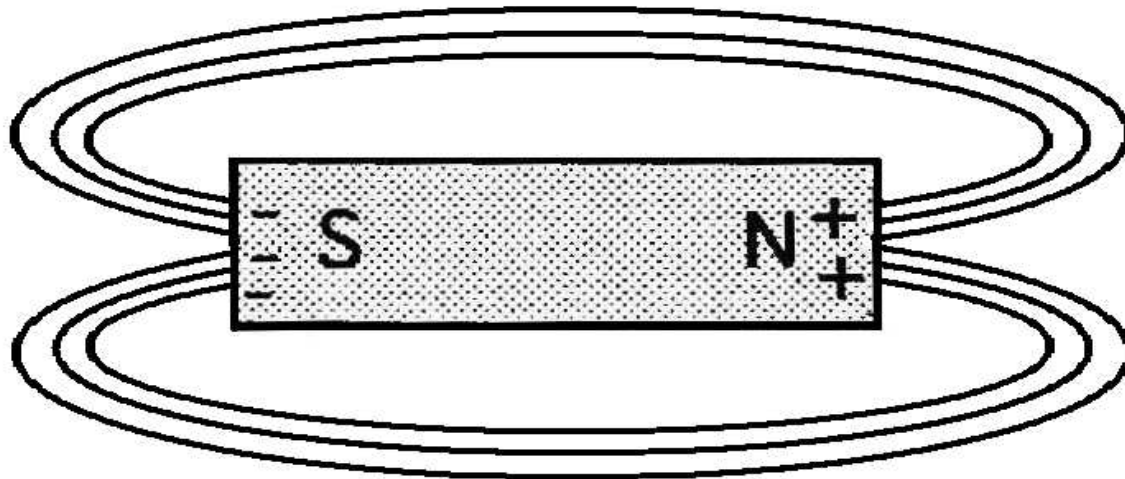


Draw the magnetic field around this magnet.

1 m
6 m

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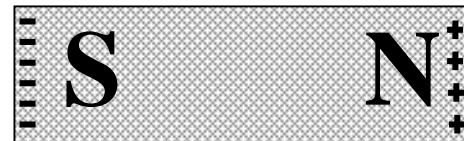
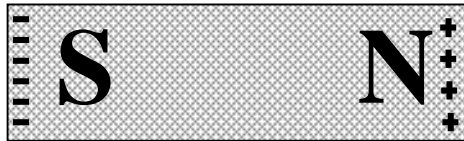
Magnetic Field



Draw the magnetic field around this magnet.

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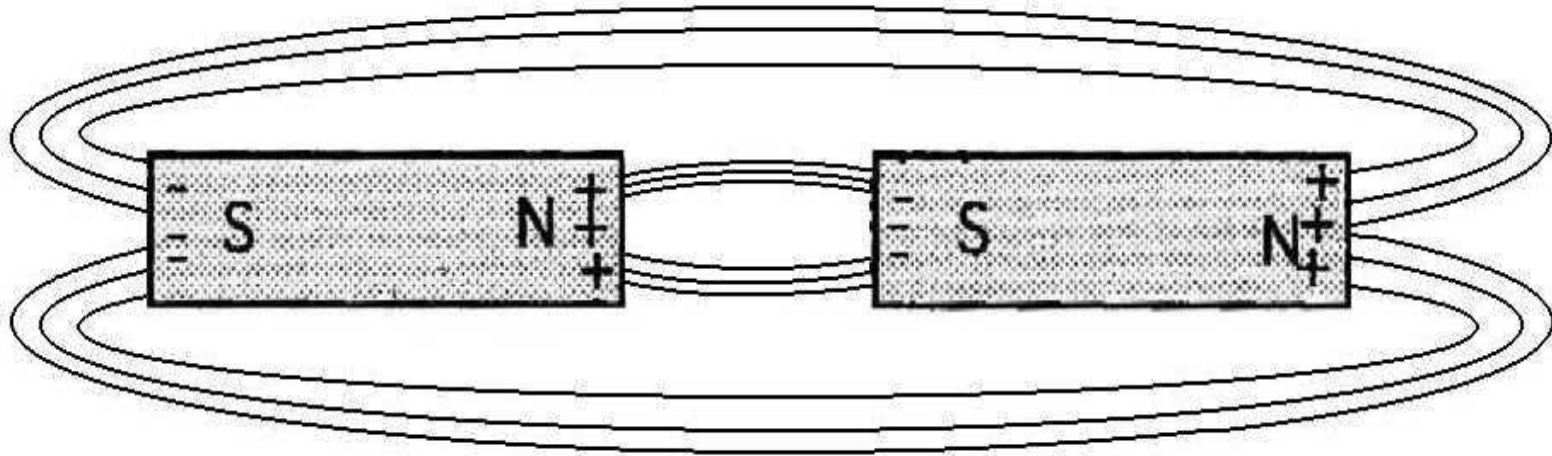
Magnetic Field



**Draw the magnetic poles around these two magnets.
Unlike poles attract - the 2 magnets become like one**

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Magnetic Field



**Draw the magnetic poles around these two magnets.
Unlike poles attract - the 2 magnets become like one**

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Magnetic Field

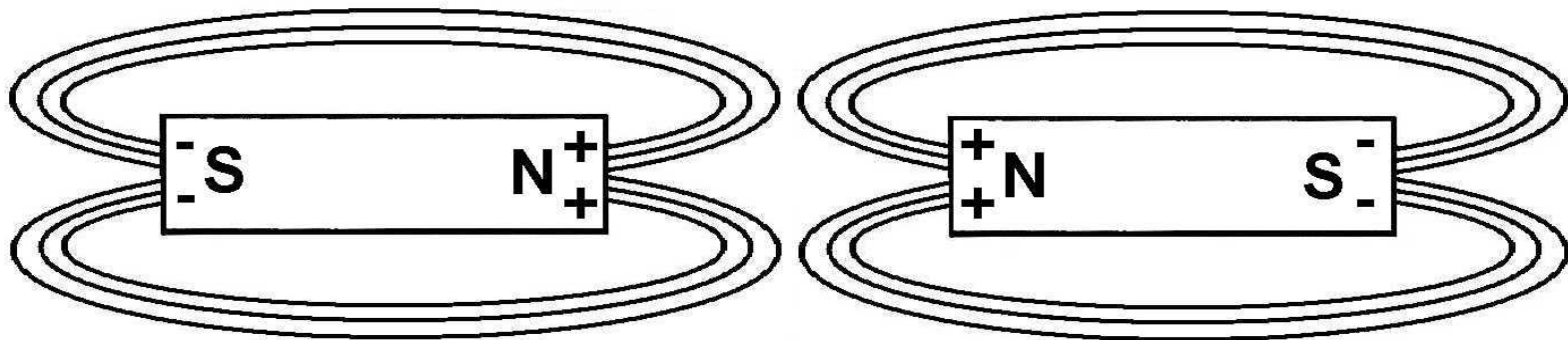


Draw the magnetic field around these two magnets.

Distribute the magnets and plates and try to duplicate these magnetic fields.

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Magnetic Field



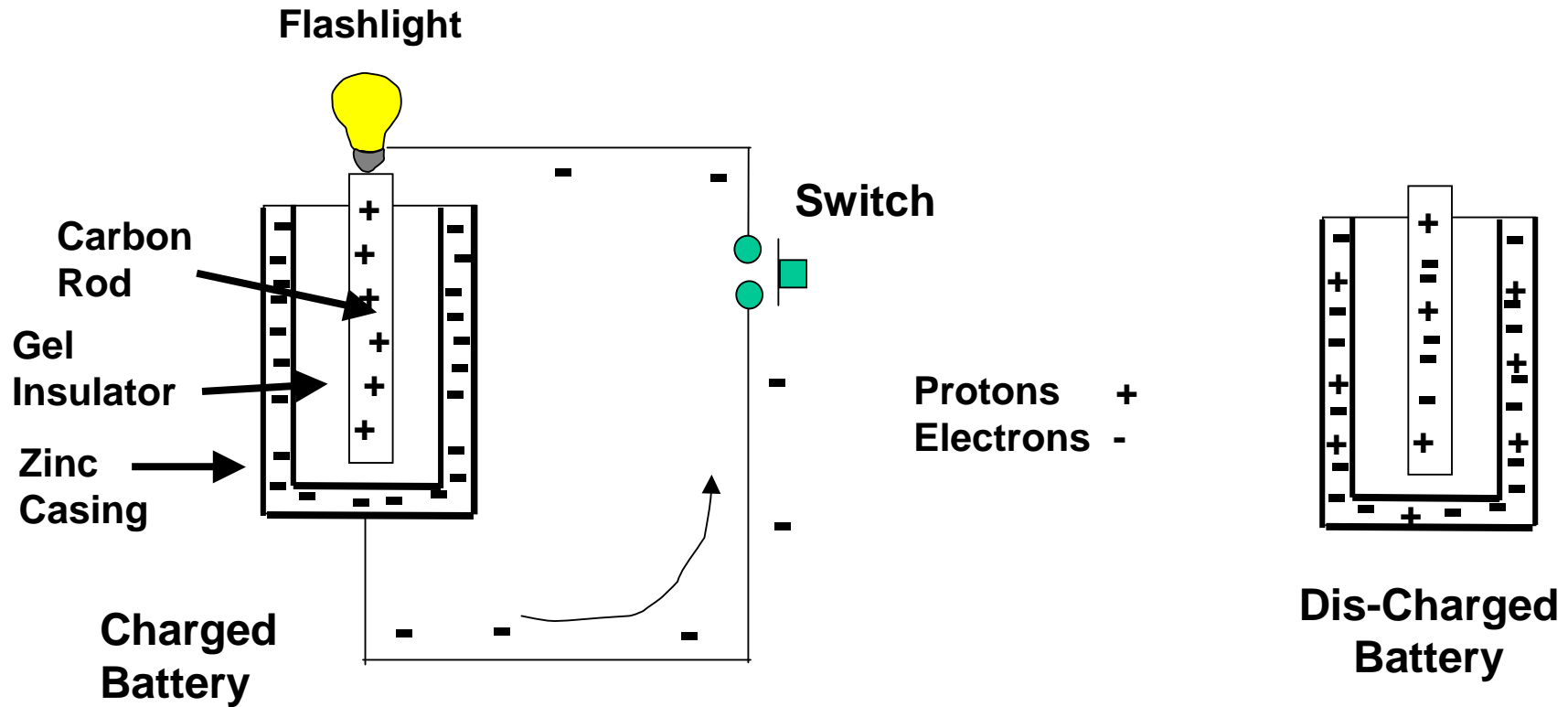
Draw the magnetic field around these two magnets.

Like poles repel - the two magnets push away from each other

Distribute the magnets and plates and try to duplicate these magnetic fields.

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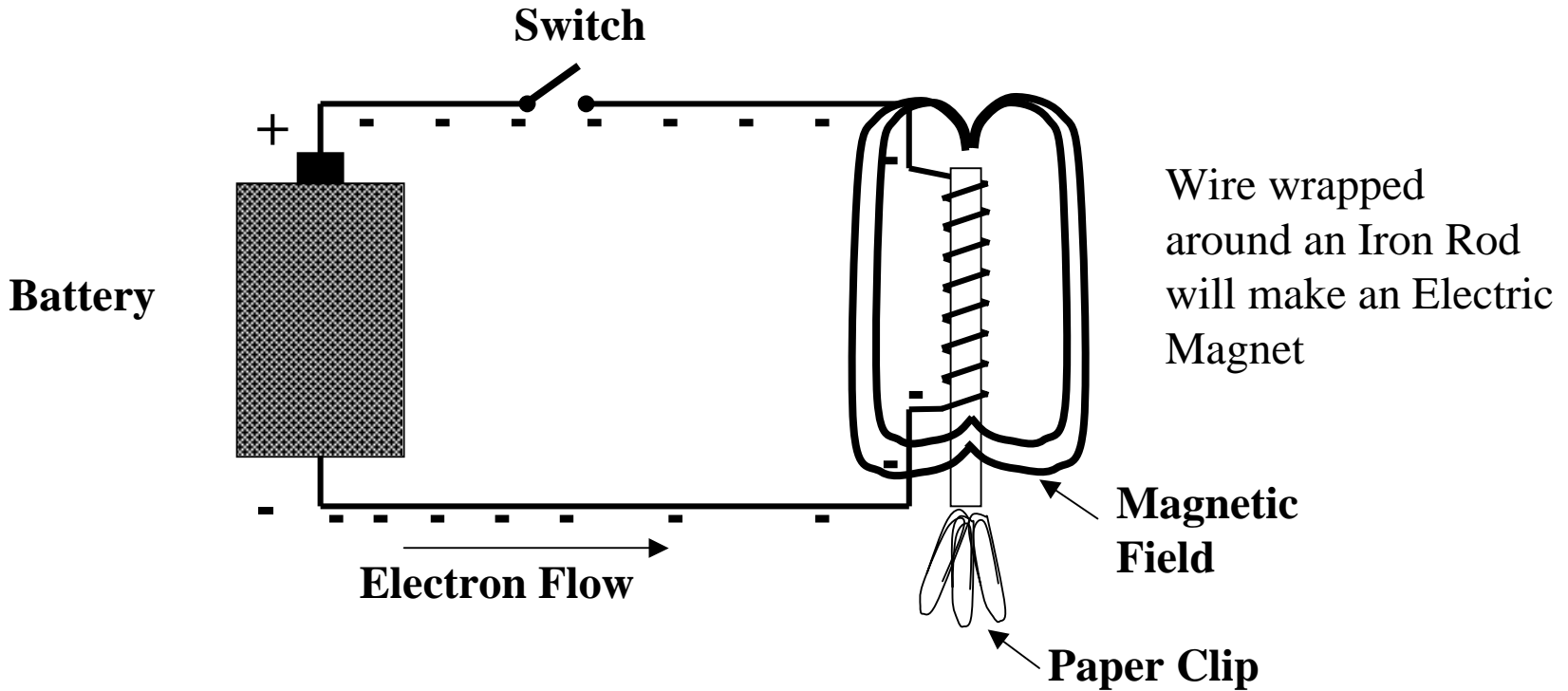
DC=Direct Current



Battery works from a chemical reaction between the carbon rod and zinc case

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Electric Magnet



When the switch is closed the electrons will flow through the wire. When electrons flows through the wire wrapped around the nail, it will create a large magnetic field and act like a solid steel magnet. Have the participants complete their diagram and write how this works.

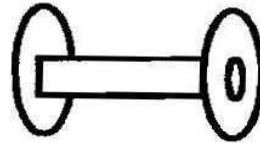
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Build an Electric Magnet

Wire



Bobbin



Nail



Clips



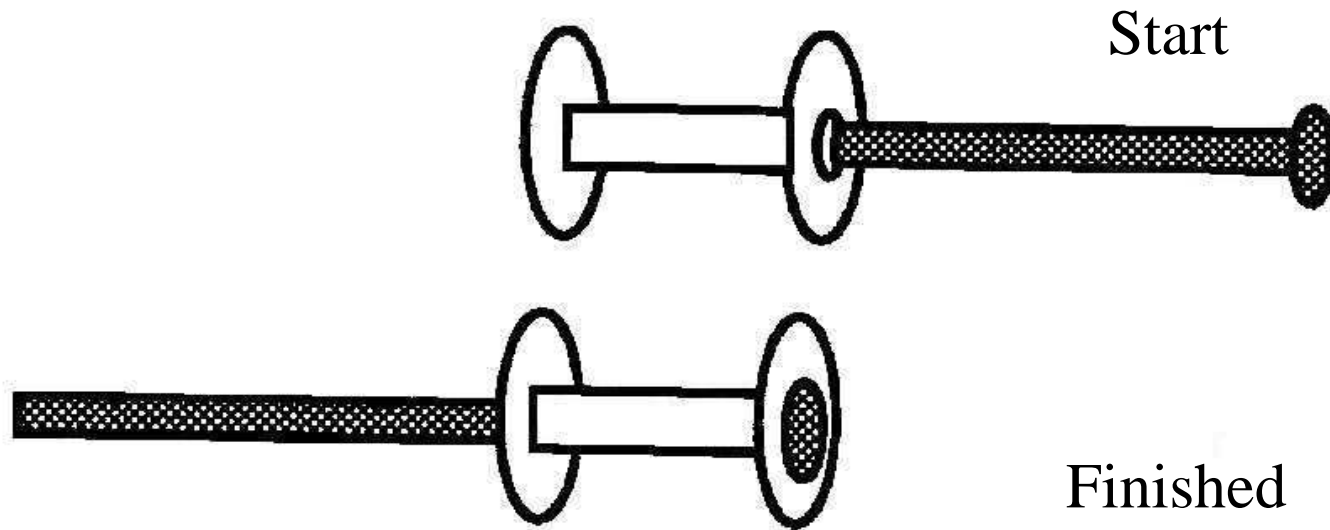
Discuss parts to be passed out

.5 m
14.5 m

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Build an Electric Magnet

Slide Nail into Bobbin



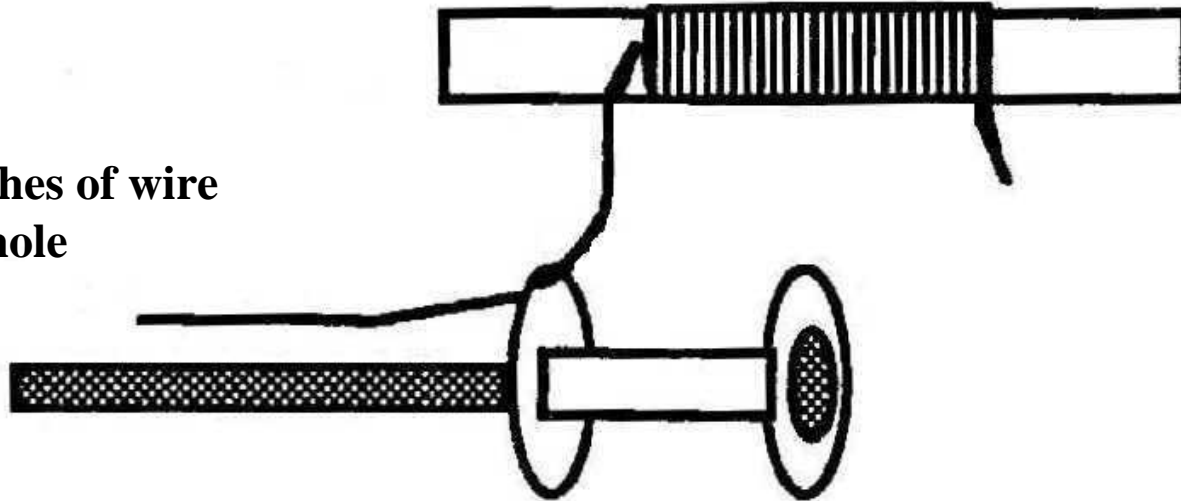
Discuss diagram

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Build an Electric Magnet

Unwrap a small portion of the wire (6 inches) from the spool and pass it through the hole in the bobbin as illustrated.

Pull 6 inches of wire
through hole



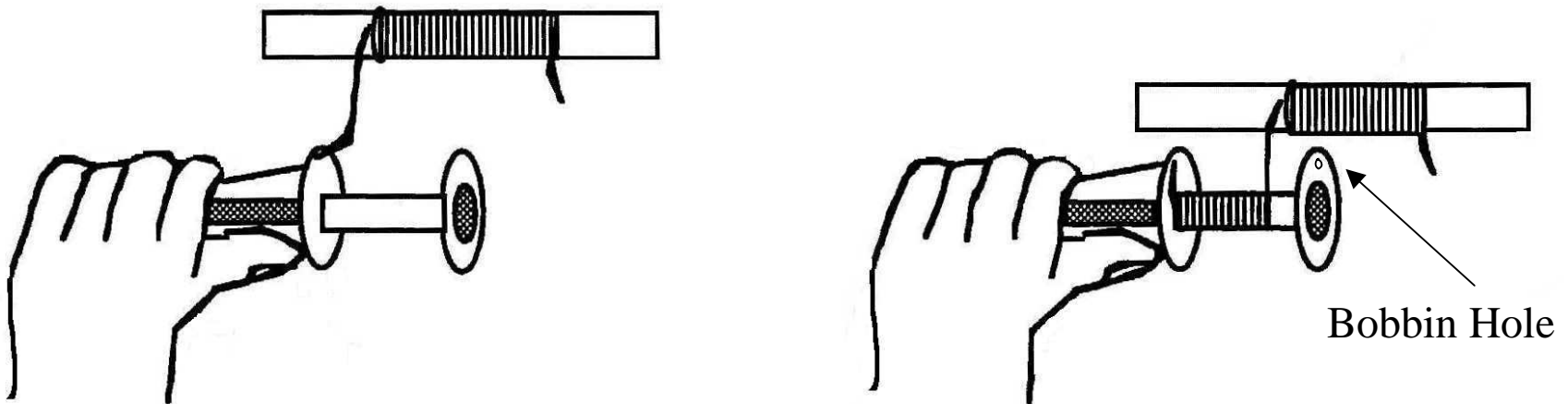
Discuss diagram

.5 m
15.5 m

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Build an Electric Magnet

Hold nail and wire in hand, pushing bobbin up against the nail head. This will prevent it from spinning when you wrap the wire around the bobbin. Now wind wire around Bobbin



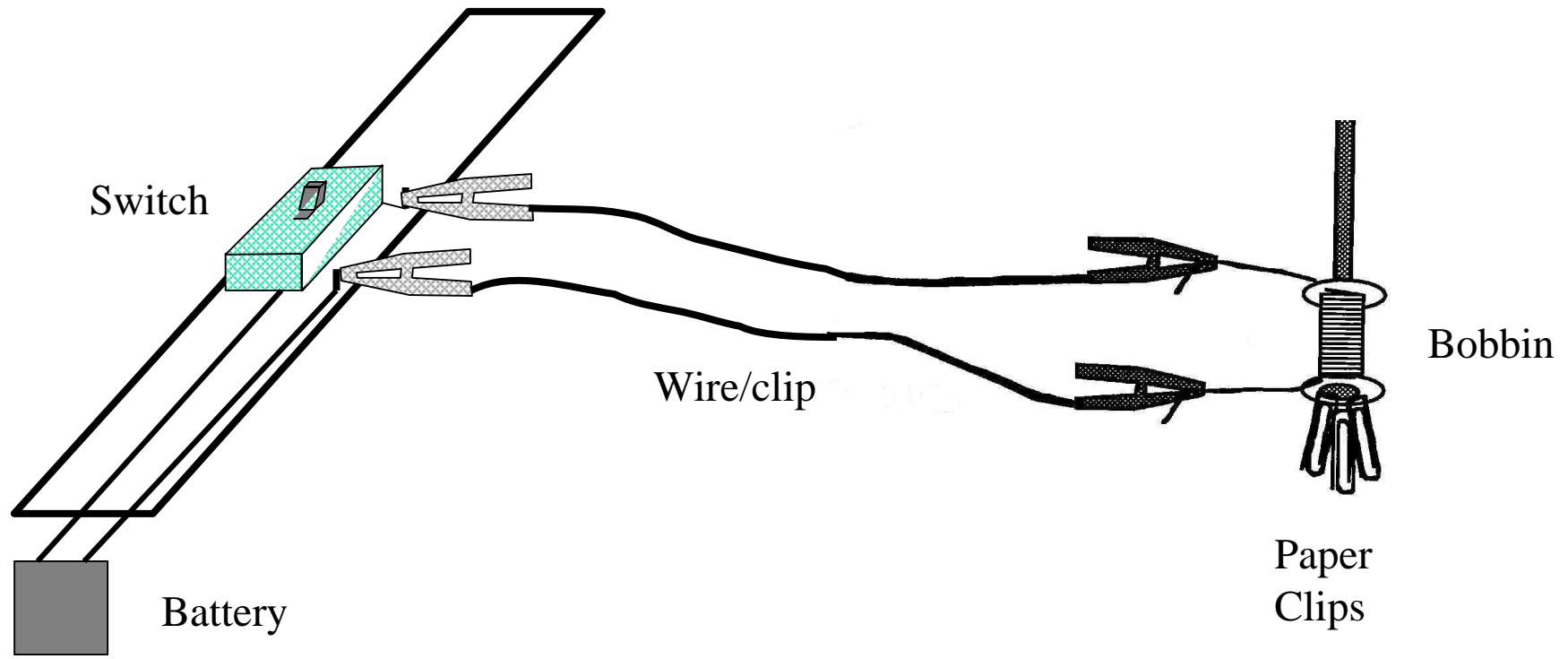
When finished slide other end of wire through other hole in Bobbin.

Discuss diagram

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Build an Electric Magnet

Connect the wire/clip from switch/board to bobbin wire as shown below. With nail head face down and close to paper clips, press switch to apply voltage to electric magnet. Raise nail from table and clips should be attached



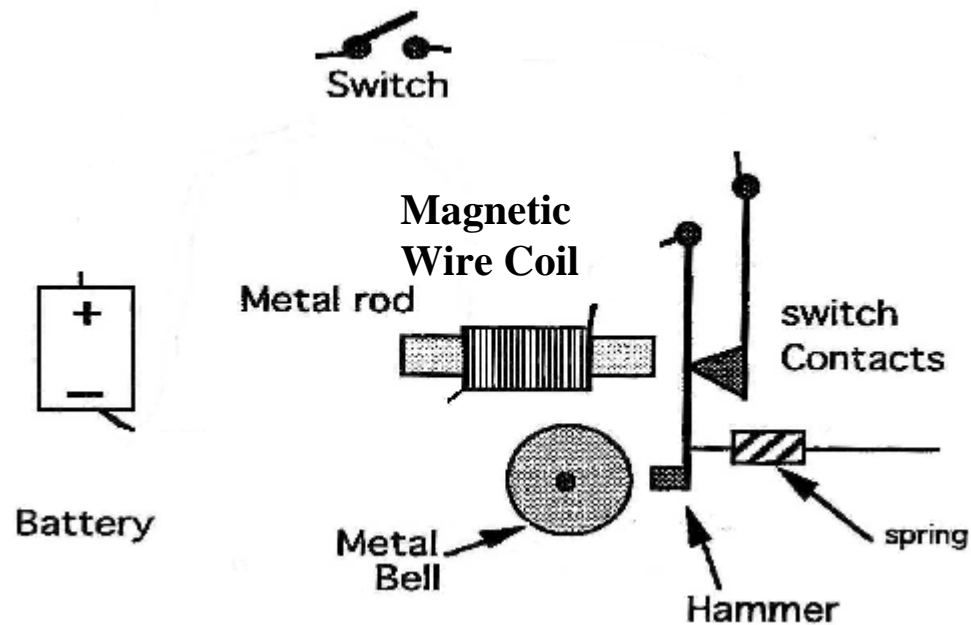
20 m
36 m

Pass out parts and have participants work at own pace

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Electric Magnet Makes Bell

Complete the electric magnet bell diagram.

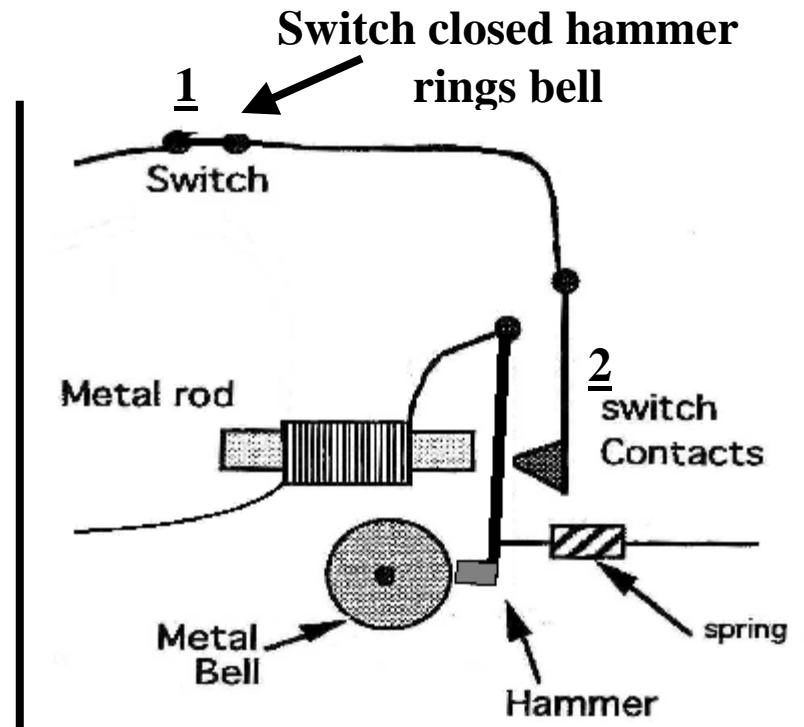
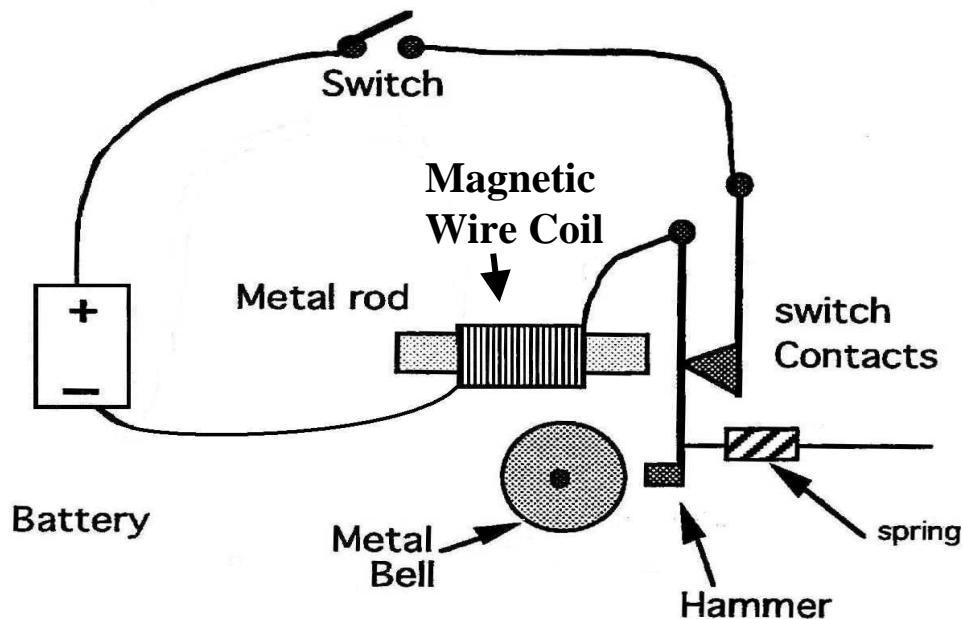


When switch is closed, voltage flows into magnetic wire coil. When coil becomes a magnet, it pulls the metal hammer toward the coil and rings the bell. At the same time the switch contact opens and the magnet turns off. The hammer returns to its original position.

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Electric Magnet Makes Bell

Complete the electric magnet bell diagram.



When switch is closed "1", voltage flows into magnetic wire coil. When coil becomes a magnet, it pulls the metal hammer toward the coil "2" and rings the bell. At the same time the switch contact opens and the magnet turns off. The hammer returns to its original position.