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TECHNOLOGY AT HOME: An Increase in the Quality of Living Due to Electronics Inventions.

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by Jacqueline Porter

Technology refers to all the ways people use their inventions and discoveries to satisfy their needs and desires. Science on the other hand attempts to explain why things happen. Technology is concerned with making things happen. The two of these things are important to everyone, but which is concentrated on depends on an individual's role in society. The consumer is busy wanting things to improve life, while the supplier utilizes scientist to create a solution to give consumers what they want. Students need to be aware of people's need to live in greater comfort than ever before. Thanks to electricity today, machines do most of the work. They have made work easier, it is now possible to do the same work with less effort and in less time. This allows people more leisure time.

I teach 6th , 7th & 8th grade self - contained special education at East Rock Global Magnet. I often run into the problem of finding something on a level that my students can understand yet interesting enough to entice them to learn. Electricity is something that they should definitely learn about, given that it is essential for how they are accustomed to living. By relating electricity to their everyday life, I believe it will spark enough interest in them to willingly participate and gain some knowledge in the process.

In this unit I plan to explore electronic inventions that are directly related to the evolving of Technology At Home through out the 20th century. We will look at household gadgets that use electricity that the students feel that they can't live without, such as: the telephone, refrigerator, television, stove, microwave, stereo, tape recorder, radio, vacuum cleaner, washer and dryer.

All of these products exist because of the discovery of electricity. Exploring the basic fundamentals of electricity I plan to give middle school students a good understanding of how electricity works. We will examine life before electricity. List some possible motivation that pushed for its discovery. Once discovered, what people made electric inventions that led to the contribution that enhance people living conditions and their continued improvement through technology.

Electricity that runs our homes is very powerful and to dangerous to experiment with. Therefore we will do simpler experiments with electricity and magnets, relating them to the electricity used in our homes to run our electrical appliances. We will examine each invention and their inventors. We will also take a look at how they have evolved since their conception. We will compare life in the past without these inventions, life when they were first introduced and life now with the latest version. We will also connect how the discovery of electricity made each invention possible. Finally we will attempt to foresee how these inventions will once again evolve in the 21st century and what impact they will have on our life in the home.

What Is Electricity?

Electricity is the "flow" of energy. All matter is made up of atoms, and atoms are made up of smaller particles, electrons, protons and neutrons. The protons and neutrons make up the center of the atom, which is the nucleus. The electrons spin around the nucleus just like the moon orbits the earth.

Two of these particles have a charge. Electrons have a negative charge. Protons have a positive charge and neutrons are neutral, they do not have a positive or negative charge.

Some kinds of atoms have electrons loosely attached. They can easily be made to move from one atom to another. When those electrons move among the atom of matter, a current of electricity is created (the flow of energy).(VanCleave,6)

Joseph John Thomson has been noted as the discoverer of the electron. " His experiments on stream particles emitted by cathode rays led to the discovery." He won the Nobel Prize in physics in 1906 for his work on the conduction of electricity.(Bird,2)

James Chadwick was awarded the Nobel Prize in physics in 1932. His discovery of the no charge particle in an atom called the neutron won him the prize. He also connected the atom number and the atomic charge. Chadwick is closely associated to the atomic bomb. (Bird,4)

Types Of Electricity

Static Electricity

Unlike current electricity that moves, static electricity stays in one place. It is the build up electric charges on an object. These charges are called static charges because they are stationary. The static charges can be positive or negative . When two substances are rubbed together, electrons are pulled over from the material that has the weaker attraction and attach to the material that has the stronger attraction. This causes both materials to become charged . The material losing electrons become positively charged and the material gaining electrons become negatively charged. Electric charges follow certain rules and one rule states that unlike charges are attracted to each other. When the charge on one object is great enough between the two objects the second object is also charged. This creates a path for the electrons to travel. Static discharge is the end result. The discharge can be very slow and quiet or quick causing a spark of light and sound. This is the theory of how lightning and thunder is created on a larger scale.(Ardley,118)

Benjamin Franklin proved that static discharge and lightning were the same thing. He tied an iron spike to a still kite and flew it during a thunderstorm. When lightning hit the rod it cause a spark. Although he proved his theory, it was a very dangerous thing to do. He also invented the lightning rod from the results of this experiment. (Rawsthorne,1)

Current Electricity

The path in electric current takes as it flows is called a circuit. The electric current that flows from a battery always travels in the same direction. This type of current is called direct current (DC). The electric current in battery is produced by chemicals. Inside the battery are two metal parts that are covered in chemicals. When the battery is connected to an appliance the chemical inside the battery reacts to each other, and produce charged particles. Negative charge collects on one end and positive collects on the others.

(Ardley,132) Alessandro Volta was the creator of batteries. Another scientist, Lugi Galvani thought that animal electricity caused a dead frog's leg to jump when it was touched with a steel knife. Volta realized that the two different metals, the steel knife and the tin tray that the frog was lying on was the cause of the movement in the frog's leg. He showed that when moisture comes between two different metals, electricity is created. This led to the widely used battery of today. Volta showed that electricity could travel through wire from place to place. Voltage is the energy that moves electrical charges between two parts through a wire. It gets its name from Volta.(Rawsthorne,1-2)

But most of the electricity we use comes from the supply lines from the power station. This current is constantly changing directions backward and forward. It changes directions as often as 50 - 60 times per second. (Ardley,122) It is called alternating current (AC). AC is used for the main supply because it can be transmitted more cheaply than DC , for most purposes AC is more efficient. When two identical objects are powered separately one by AC and the other by DC such as a light bulb or radio you can not see or hear the difference.

Conductors and Insulators

Electricity flows through some materials easily. These materials are called conductors. Metals are good conductors of electricity. But electricity can not flow through all materials. These materials that electricity can not flow through are called insulators. Both types of materials serve a very good but different purpose in the travel of electricity.

All metals conduct electricity. Silver is the best, which is used in circuits in computers, but expensive. The best least expensive metal is copper. Power lines use copper wires to supply us with electricity. Water is a weak conductor but you can still get a shock if you touch and electric appliance with wet hands. Insulators are used to prevent electricity from flowing where it is not wanted. Wires in the appliances we use are insulated to protect them and us from live wire with plastic coating. Plugs and sockets are usually made form plastic or rubber to make them safe to touch. Ceramic is not as flexible rubber or plastic but is an excellent insulator because; it can withstand high temperatures. It is used to coat electric ovens.(Ardley,125)

Electric charges are measured in the metric unit of coulombs; thus the flow rate of a current is measured in coulombs per second. The amount of current flowing through a conductor is usually expressed in amperes, which is equal to one coulomb per second. (VanCleave,34)

What Is A Magnet?

Magnets play a very important role in the electricity that we use daily. Most magnets are made from iron or steel, a metal made by adding carbon and other substances to iron. Magnets can also be made from more expensive metals such as nickel and cobalt. Strong magnets are made by mixing aluminum, nickel, cobalt, iron and samarium. Magnets need to be treated carefully or they will lose their magnetic power. A magnet's attraction is strongest at two points called poles, a north pole and south pole. Magnets will attract each other if opposite poles are near each other. Unlike poles attract, like poles repel.

The point where you can feel the magnet's attraction on an object is called a magnetic field. The field is stronger the closer you get to the magnet. Magnets are used in many items you use daily. Electric motors use magnets and many household appliances use motors. They are also used in cassette records, television, speedometer and burglar alarms.(Ardley,138)

Electro Magnets

We have noted that magnets have two poles, north and south while electricity has two charges positive and negative. In both cases opposites attract and similar repels. Poles and charges follow the same rules. What are some other connections?

A Danish physics name Osterd discovered the connection between electricity and magnets, magnetic field around a current. His discovery led people to believe that it was possible to make magnets with an electric current.(Gardner,71)

Most of the electricity we use is supplied by generators, which contain magnets. An English scientist called Michael Faraday discovered how to use magnets produce electric current. This discovery was used to invent the generator. He connected a coil of wire to the galvanometer, an instrument used to detect electric currents. When a bar magnet was pushed through coils, the needle on the galvanometer moved, proving an electric current flowed through the wire.(Gardner,97)

About 40 years after Faraday discovery, Thomas Edison and Joseph Swan built a DC generator. Edison used the generator to light his laboratory than later the streets of New York. Edison loved his DC generator while other scientist found fault with it.(Rawsthorne,2)

George Westinghouse bought Nikola Tesla's patented motor for generator alternating current. The AC generator allowed the transmission of larger blocks of electricity and more power from higher voltage through transformers. This would have been impossible with DC generators. Tesla's name was give to the unit of measurement of magnetic fields.(Rawsthorne,3)

In electric power stations huge generators are used to make electricity. These generators are turned using steam produced by boiling water. Large - scale electricity from a generator became practical with James Watt's steam engine. His name was given to the electric unit of power, the Watt. (Rawsthorne,3)

Unit Objectives

1. Identify all the things we use that require electricity.
2. Identify motivation for the discovery of electricity.
3. Understand basic concepts about electricity and magnetism.
4. Complete experiments that will help with the understanding of the basic concepts.
5. Identify the different personalities of scientist that relates to each other.
6. Individually research an electrical appliance and its inventor, of their choosing from its invention through today.
7. Present written research to teacher and report orally to class with visual aids.
8. Examine the technology of the invention that they choose to research from initial version to the latest and make an educated guess on a futuristic version.

Lessons

Each section of this unit will be typed on a sheet of paper separately and given to the students as content material. The content will be read, discussed and comprehension questions will be answered. Next experiments will be conducted to increase understanding of the content where possible.

Lesson #1: Introduction

Teacher - We are about to learn some exciting things about electricity. Electricity is something that we take for granted because it is always with us. I am sure that everyone or at least most of you here has experienced a black out from a storm or maybe someone hitting a utility pole that holds the wires that supplies electricity to your house. As a class we are going to make a list of all the things we use everyday in our home and what we use them for. Make sure you copy the list down, because we will use the list again later in the unit.

Student - List all things that they use throughout the day and copy the list from the board.

Teacher - Now let's go back and put a star by the things that use electricity. Once that is done let's think about that black out. What things on our list would we not be able to do? Let's examine the list and see how many things we are able to do without electricity.

Student - Write an essay on possible motivations for discovering electricity.

Lesson #2:

Content - What is electricity?

Comprehension Questions

1. What is electricity?
2. All matter is made up of what?
3. Where are these particles located?
4. What charges do they have?
5. Who was Joseph John Thompson
6. Who was James Chadwick.

Experiment(s):

Electricity Tester Project

Materials needed:

An empty matchbox, or a length of heavy cardboard (about 2 ½ - 3 ') long folded 6

times.

A spool of thin wire.
Sticky-putty adhesive or something equivalent.
A small compass
Sticky tape.
Two thumbtacks.

Procedure:

1) Wind the wire neatly around the matchbox, or cardboard, within 5mm from each end. When you have wound the wire from one end to the other, tape the end.
2) Fasten the coil to the wood block, with the sticky-putty. Remove the insulation from both ends of the wire and connect the wire to the two thumbtacks inserted in the block wood.
3) Put some sticky-putty adhesive on the back of the compass.
4) Place the compass on top of the coiled wire.

Explanation:

A magnetic field is created when electricity flows. The magnetic field will make the needle of the compass move. You can use your electricity tester to see if electricity is flowing. Test some things and write down what you tested and if electricity was flowing or not. (Weber,1&2)

Lesson #3

Content - Static Electricity

Comprehension Questions:

1. What is static electricity?
2. What charge does static electricity have?
3. What causes a material to become charged?
4. What is one rule about static electricity?
5. When is static discharged?
6. What is a good example of static discharge on a large scale?
7. What connection did Ben Franklin have with static discharge?

Experiment(s):

Making Static

Materials:

· A plastic comb
· Wool scarf
· Tiny bits of tissue paper
· Silk scarf
· Glass rod

Procedure:

1) Rub the comb several times on the wool scarf.
2) Then hold the comb close to the pieces of tissue paper.
3) Rub the glass rod several times on the silk scarf.
4) Then hold the glass rod close to the pieces of tissue paper

Explanation

When the comb is rubbed on the scarf, it becomes charged with static electricity and attracts the pieces of paper. Static charges can be positive or negative. An object with on kind of static charge will attract an object, with the opposite charge. In this experiment the comb has a negative charge and it attracts the paper, which has a positive charge. Does the same thing happen with the glass and tissue paper? See if you can explain why or why not? (Badges,1)

Sticky Balloons

Materials:

· Balloons
· Wool scarf

Procedure:

1) This trick shows you how to stick a balloon to the wall without using any glue.

2) Rub a balloon several times on wool scarf and hold it against a wall.
3) The strong static charge on the plastic skin of the balloon will make it cling to the wall as if it is glued there

Explanation:

There is a difference between the charges on the balloon and charge on the wall, so the balloon is pulled towards the wall. It will stay there until the static charge wears off. (Badges,2)

The Unfriendly Balloons

Materials:

· Wool scarf
· Balloons
· Thread
· Thin stick

Procedure:

1) Tie two balloons together with a piece of thread.
2) Ask a friend to hold a thin stick in front of him.
3) Hand the thread over the stick so the balloons are next to each other.
4) Then rub each balloon long and hard with a wool scarf.
5) Let go of the balloons and see what happens.

Explanation:

When you rub the balloons, you are giving them the same kind of static charge. Things that have the same charge try to push away (repel) each other. (Badges,2)

Zap

Materials:

· Scissors
· Ruler
· Plastic report folder
· Modeling clay
· Large paper clip
· Wool scarf

Procedure:

1) Cut a 2in x 8in (5cm x 20cm) strip from the plastic report folder.
2) Use a walnut sized piece of clay to stand the paper clip upright on the table.
3) Darken the room and wrap the scarf around the plastic strip.
4) Quickly pull the plastic through the scarf. Do this rapidly at least three times.
5) Immediately hold the plastic near, but not touching, the top of the paper clip.

Explanation:

Like all atoms, the atoms in the paper clip have a positive center, the nucleus, with negatively - charged electrons spinning around it. Rubbing the plastic against the wool causes some electrons from the wool to collect on the plastic. This build up of electrons produces static electricity. Holding the negatively charged plastic near the electrically neutral paper clip causes the negative charged electrons in the clip to move away because of the repulsion between like charges on the surface of the clip near the plastic.

When the charge on the plastic is great enough, the air between the two materials also become charged, thereby forming a path through which electrons can move. The resulting spark is called a static discharge. (VanCleave,16)

Lesson #4

Content - Current

Comprehension Questions

Experiment(s):

Make Your Own Battery

Materials:

· Two pieces of wire
· Sticky tape
· 4 copper coins
· 4 pieces of zinc
· blotting paper soaked in salty water

Procedure:

1) Sandwich a piece of the salty paper between a coin and a piece of zinc.
2) Tape the bare end of one wire to the coin and lay your sandwich down with the wire on the bottom.
3) Now make three more and put them on top.
4) Finally tape the bare end of the other wire to the piece of zinc on top of your voltaic pile.
5) Now take the free end of each wire and touch both ends of lightly on to your tongue.

Explanation:

In your voltaic pile, chemical reactions cause a tiny electric current. The current flows from one wire, through your tongue and into the other wire. The current is just enough to make your tongue tingle. (Badges,4)

Lemon Power

Materials:

· 18-gauge copper wire (smaller - gauge wire will work)
· Wire cutters

· Paper clip
· Coarse sandpaper
· Lemon
· Adult helper

Procedure:

1) Strip 2in (5cm) of insulation from the wire, and cut the bare wire with wire cutters.
2) Straighten out the paper clip and cut a 2in (5cm) piece from one end.
3) Use sandpaper to smooth any rough edges from the wire and the piece of paper clip.
4) Gently squeeze the lemon with your hands until it feels soft. Do not rupture the lemon.
5) Push the pieces of paper clip and wire into the lemon so that they are as close as possible without touching.
6) Moisten your tongue with saliva, and touch the tip of your wet tongue to the free ends of the wires.

Explanation:

The lemon battery you have created is called a voltaic battery, like all batteries, changes chemical energy into electrical energy. It is a battery made up of two different metals called electrodes which are placed in a liquid containing an electrolyte. In a solution of water plus an electrolyte, such as acid in the lemon, an excess of electron collects on one side of electrodes, at the same time electrons are lost from the other electrode. Touching the electrodes to your tongue closes the circuit and allows an electric current to flow. The tingle felt and the metallic taste is due to the movement of electrons through the saliva on your tongue.
(VanCleave,40-41)

A Juice Can Flashlight

Materials:

· 1 frozen juice container

· 2 D - size batteries
· 1 4.8 volt flashlight bulb
· 1 piece of flexible electrical wire, 6 inches long
1 1 strip of aluminum foil, 1 inch wide by 6 inches long
· String, 6 inches long
· Rubber band
· Newspaper
· Masking tape
· Scissors
· Sandpaper
· Hammer
· Nail

Procedure:

1) Punch a hole in the center of the bottom of the juice can, using the hammer and nail. Carefully enlarge this hole, using the pointed end of the scissors. The base if the flashlight bulb must fit snugly into this hole, so take your time making this opening the right size.
2) Cut the news paper into strips as wide as the can (usually 4 to 5 inches). Place the 2 - D size batteries on the edge of the paper. The should be lined up in the same direction, with the top of one battery touching the bottom of the other. When the batteries are inserted into the juice can, the flat end of one battery should touch the base of the light bulb.
3) Wrap the paper strips around the batteries to form a cylinder. Keep adding strips until this paper cylinder fits snugly inside the can.
4) Rub a small area on the side of the can with sandpaper so that the bare metal is exposed. If there is any plastic insulation or paint on the ends of the electrical wire, scrape it off. Tape one bare end of the wire to the exposed metal area of the can.
5) Test your flashlight by touching the free end of the electrical wire to the exposed end of the battery inside the can.

Explanation:

The arrangement of the materials in your juice can flash light is an example of a simple circuit. The batteries are the source of electricity. The wire and the can allow the electricity to flow to the bulb. When a complete pathway, or connection, is made between the two ends to the batteries, the bulb lights up. (Zubrowski,15-19)

Series

Materials:

· 3 12 inch (30cm) strips of aluminum foil
· New, clean penny
· Duct tape
· Size D battery

· Short, wide rubber band

· Flashlight bulb
· Paper clip

Procedure:

1) Wrap the end of one foil strip around the penny and tape the foil - wrapped penny to negative terminal of the battery.
2) Tape the second foil strip to the positive terminal of the battery.
3) Stretch the rubber band around the battery to secure the coin and strips tightly against the battery ends.
4) Twist the third foil strip tightly around the base of the flashlight bulb.
5) Use the paper clip to attach the free end of the third foil strip to the end of the strip that is attached to the negative terminal of the battery.
6) Touch the metal tip on the bottom of the bulb to the foil strip attached to the positive terminal of the battery.

Explanation:

When there is only one path for electric current to follow, the circuit is called a series circuit. Electricity flows from away from the negative terminal of the battery, through the bulb, and back to the positive terminal of the battery. (VanCleave,52-54)

Parallel

Materials:

· 4 12 inch (30cm) strips of aluminum foil
· New, clean penny
· Duct tape
· Size D battery
· Short, wide rubber band
· 2 flashlight bulbs
· Paper clip
· Helper

Procedure:

1) Wrap the end of one foil strip around the penny, and tape the foil wrapped penny to the negative terminal of the battery.
2) Tape the second foil strip to the positive terminal of the battery.
3) Stretch the rubber band around the battery to hold the coin and strips tightly against the battery ends.
4) Twist one end of each remaining foil strip tightly around the base of a flashlight bulb.
5) Use the paper clip to attach the free ends of the remaining foil strips to the foil strip attached to the negative terminal of the battery.
6) Rest the metal tips of the bulbs on the foil strip attached to the positive terminal of the battery.

Explanation:

When an electric circuit provides more than one path for electric current to follow through, the circuit is called a parallel circuit. The electric current leaves the negative terminal of the battery and arrives at point A, where it separates into two different paths. At point B, the divided current combines again and flows into the positive terminal of the battery. Even though the current divides and takes different paths, the "push" or voltage of the current is the same in each path; thus , the two light bulbs connected in a parallel circuit glow with equal intensity. (VanCleave,56 -57)

Lesson #5

Content - Conductors and Insulators

Comprehension Questions

Experiment(s):

Conductors and Insulators

Materials:

· Battery
· Bulb
· Wires
· Various objects (coin, paper clip, plastic pen top, glass, fork, wooden spoon, tin foil, cardboard, key, eraser, stone, pencil etc.)

Procedure:

1) Join the bulb to one end of the battery.
2) Join the wires to the bulb lights up and there is no loose connections.
3) Now touch the ends of both wires to the objects in your collection to see if the bulb lights up.
4) Put all the things which made the bulb light up in one pile. These are the conductors.
5) Make a list of the conductors and what they are made of.
6) Put all the things that did not make the bulb light up into another pile. These are insulators.
7) Make a list of the insulators and of what they are made.

Explanation:

To make a general observation of materials serve as conductors and what materials serve as insulators. (Badges,6)

Give and Take

Materials:

· Duct tape
· 3 size D batteries
· ½ cup (125ml) of distilled water
· Cereal bowl (very clean)
· 12 inch (30 inch) aluminum foil strip
· 2 clothespins
· Size D (1 ½ volt) flashlight bulb
· 2 helpers (one must be an adult)

Procedure:

1) Tape the three batteries together with positive terminals touching negative terminals.
2) Pour the distilled water into the bowl.
3) Stand the flat, negative terminal of the battery column in the bowl of water. Ask your adult helper to support the column.
4) Lay one end of the foil strip under the surface of the water in the bowl so that it is near, but not touching, the column of batteries. Hold the strip position by clipping it to the side of the bowl with a clothespin.
5) Tightly wrap the free end of the foil strip around the metal base of the flashlight bulb. Secure with a clothespin.
6) Squeeze the clothespin tightly against the base of the bulb while pressing the bulb's metal bottom against the raised, positive terminal of the battery column.
7) Ask a second helper to darken the room by closing the window shades and turning off the lights.
8) Observe the bulb for about 5 seconds.

WARNING: While the procedure in this experiment is safe, you should not touch this, or any, solution that is connected to an electric current.

Explanation:

The flashlight bulb glows only when an electric current flows through its filament. In a circuit, the negative terminal of the connected batteries repels electrons and the positive terminal attracts them, producing a flow of electric charge. However, for electric charges to flow, there must be a closed circuit which is an unbroken path connecting the bulb and the batteries. Distilled water is not a conductor, so the electric current is interrupted; thus, the bulb does not glow.

WARNING: While it is true that distilled water does not conduct electricity, most water is not distilled so you should never place any electrical appliances in water.
(VanCleaver,45-46)

Flow Rate

Materials:

· Pencil
· 7 oz (210ml) paper cup
· Masking tape
· 7oz (210ml)table salt
· Small bowl
· Stopwatch
· Helper

Procedure:

1) Use the pencil to punch hole in the center of the bottom of the paper cup. The hole should be equal to the circumference (the distance around a circle) of the pencil.
2) Place a piece of tape over the hole.
3) Fill the cup with salt
4) Hold the cup of salt about 6 inches (15cm) above the bowl, and ask your helper to start the stopwatch the second you remove the tape from over the hole in the cup.
5) Tell your helper to stop the stopwatch as soon as the salt stops pouring out the hole.
6) Calculate the flow rate of salt by using the following equation:

amount of salt pouring out, ounces (ml)

flow rate = total pouring time, seconds

Explanation:

The flow of salt passing through the hole can be described as the quantity of salt that passes a given point divided by the unit of time. The flow rate of the salt simulates but is not an exact model of, an electric current (the flow rate of electric charge), which is the amount of electric charges passing a given point per second. Electric charges are measured in the metric unit of coulombs; thus, the flow rate of a current is measured in coulombs per second. The amount of current flowing through a conductor is usually expressed in amperes (amps, for short), which is equal to one coulomb per second.

(VanCleave,32-34)

Lesson #6

Content - What Is A Magnet

Comprehension Questions

Experiment(s):

Identifying A Magnet's Poles

Materials:

· Two bar magnets or flat magnets
· Thumbtack or tape
· Masking tape
· Thread
· Magnetic compass

Procedure:

1) Hang a bar magnet or a flat magnet from a long thread.
2) You can attach the free end of the thread to a ceiling or a door frame, with a thumbtack or tape.
3) Make sure that the magnet is free to swing and is far away from any other metallic objects.
4) Wait until the magnet stops moving. You will see that it is aligned in a particular direction.
5) Turn the magnet slightly. Note if it stays where you turned it or does it return to its original position.

Explanation:

You will find that one end or face of the magnet is turned toward the north. That is why people call that end of the magnet the north pole or better the north seeking pole. (Gardner,15)

Test Magnets Strength

Materials:

· Different size magnets
· Variety of metallic objects

Procedure:

1) Attempt to pick up different objects with different magnets.
2) Note if size or shape have any thing to do with strength.

Explanation:

Realizing that bigger does not necessarily mean stronger.

Induced Magnetism

Materials:

· Paper clip
· Large base magnet

Procedure:

1) Place a paper clip on the magnet.

2) Balance another paper clip on the first paper clip.

3) Continue to add additional paper clips until no more clips are attracted to the standing clips.

Explanation:

When a paper clip, or any small piece of iron or steel, is attracted to a magnet, the clip itself becomes a magnet. Each paper clip becomes a magnet and attracts other clips and becomes a magnet itself. This type of magnetism is called "induced" magnetism. (Ardley,143)

Lines of Force

Materials:

· Bar magnet
· Sheet of paper
· Iron fillings
· Tape

Procedure:

1) Place a sheet of paper over a magnet.

2) Sprinkle iron fillings over the paper and gently tap it.

3) Tape over the fillings to preserve the lines of force.

Explanation:

Lines of force show the direction of the magnetic force near a magnet. They always run from the north pole of a magnet to the south pole. They are closest together near the poles where the magnetic force is strong. Away from the poles, where the magnetic force is weaker, the lines are further apart so as to show this. (Ardley,146)

Lesson #7

Content - Electromagnets

Comprehension Questions

Experiment(s):

Attractive

Materials:

· Wire cutter
· 1 yard (1m) 18 gauge wire
· 16 D iron nail
· 2 pencils
· Sheet of typing paper
· Duct tape
· 2 sized D batteries
· Iron fillings
· Adult helper

Procedure:

1) Ask an adult to use the wire cutters to strip 2 inches (5cm) of insulation from both ends of the wire.
2) Wrap the insulated part of the wire tightly around the nail, leaving about 6 inches (15cm) of wire on each end.
3) Lay the wrapped nail on wooden table and lay both pencils perpendicular to the nail, one at each end.
4) Cover the nail and pencils with the sheet of typing paper.
5) Tape the two batteries together with the positive terminal of one touching the negative terminal of the other.
6) Touch the free ends of the wire to the terminals of the connected batteries, one at each end.
7) While the wires are touching the batteries terminals, ask your helper to sprinkle iron filings on the paper above the nail. Tap the paper gently to help the pattern form.

Explanation:

All wires carrying a direct current are surrounded by a steady magnetic field. When an electric current flows through a coil of wire, the whole coil acts like a magnet. This type of magnet is called an electromagnet. Winding the wire into a coil increases the strength of the magnetic field around the electromagnet. The iron nail becomes magnetized by the magnetic field around the wire, adding to the strength of the electromagnet. The iron filings are attracted by the electromagnet and they line up in the direction of its magnetic force field, forming a pattern. (VanCleave,68-69)

Beakman's Electric Motor

(Teacher Will Model First)

Materials:

· 1 D cell Alkaline battery
· 1 wide rubber band
· 2 large paper clips
· 1 rectangular ceramic magnet
· Heavy gauge magnet wire (the kind with red enamel insulation, not plastic coated)
· 1 toilet paper tube
· Fine sandpaper

· Optional: Glue, small block of wood for base.

Procedures:

1) Starting about 3 inches from the end of the wire, wrap it 7 times around the toilet paper tube. Remove the tube. Cut the wire leaving a 3 inch tail opposite the original starting point. Wrap the two tails around the coil so that the coil is held together and the two tails extend perpendicular to the coil.
2) On one tail, use fine sandpaper to completely remove the insulation from the wire. Leave about ¼ inch of insulation on the end and where the wire meets to coil. On the other tail, lay the coil down flat and lightly sand off the insulation from the top half of the wire only. Again leave ¼ inch of full insulation on the end and where the wire meets the coil.
3) Get two paper clips that your teacher has previously bent into a V shape with looped ends.

4) Use the rubber band to hold the loops end to the terminals of the D cell battery.

5) Stick the ceramic magnet on the side of the battery .
6) Place the coil in the cradle formed by the right ends of the paper clips. You may have to give it a gentle push to get it started, but it should begin to spin rapidly. If it doesn't spin, check to make sure that all of the insulation has been removed from the wire ends. If it spins erratically, make sure that the tail on the coil are centered on the sides of the coil. Note that the motor is "in phase" only when it is held horizontally.

Explanation: When the un- insulated parts of the coil make contact with the paper clips, current flows through the coil, make it into an electromagnet. Since magnets attract, the coil attempts to align itself with the ceramic magnet. However, when the coil turns to face the magnet contact is broken (because the insulation on one tail is now preventing current flow). Inertia causes the coil to continue around. When the coil makes a nearly complete spin, contact is re established and the process repeats(Palmer,2-5)

Generator

(Teacher Will Model First)

Material:

· Wire cutters

· Ruler
· 2 7yards(7m) pieces of insulated 20 gauge wire or smaller wire
· Duct tape
· Quart (liter) jar
· Baby food jar
· Compass
· Modeling clay
· Bar magnet
· Adult helper

Procedure:

1) Ask an adult to use the wire cutters to strip about 4 inches (10cm) of insulation fromthe ends of each piece of wire.
2) Coil one of the wire around the mouth of the quart(liter) jar. Twist the wire together to prevent it from unwinding, leaving about 18 inches(45cm) of each end of the wire free. Tape the wire coil to the jar to prevent it from slipping.
3) Coil the second wire around the mouth of the baby food jar. Twist the wire together, leaving about 18 inches(45cm) of each end of the wire free. Secure with tape.
4) Place the larger jar on its side on a wooden table.
5) Twist the bare wire from one jar to the bare wire from the other jar, forming to serparated connections.
6) Secure the compass inside the mouth of the larger jar with a small mound of clay.
7) Turn the jar until the coils of wire line up with the compass needle, which points north. Use a small mound of clay to secure the jar to the table so that it does not move.
8) Place the small jar as far apart as possible from the large jar.
9) Ask a helper to dip one end of the magnet in and out of the mouth of the small jar while you watch the compass needle.

Explanation:

The movement of a magnet inside the coils of wire generates an electric current. The electric current flows through the wire in one direction when the magnet is pushed into the coil, and in the opposite direction when the magnet is pulled out of the coil. This back and forth movement of an electric current in a conductor is called an alternating current. Since a magnetic field is produced around a current carrying wire, the magnetic field around the coil of wire circling the compass is what causes the compass needle to be deflected. The alternating current results in a change in the direction of the magnetic field around the wire, which results in the back and forth movement of the needle. (VanCleave,80-82)

Culminating Activity

After the content of the unit is complete and all the experiments have been done, we will review the reports on the chosen appliances and connect them to the different experiments we performed. Next, we will look at the development of each appliace chosen over the years. Finally we will attempt to forsee the future. Each student will make a model or draw a picture of the futuristic version of the appliance that they researched. All futuristic versions will include an explanation of how it will work. Models and drawing will be displayed in the classroom.

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http://www.geocities.com/~ledow/badges1d.html.

This web site consist of nine pages of experiments dealing with electricity ranging from static to electromagnets.

"Weber Electric Supply Inc", Electricity Tester Project, http://www.weberelectricsupply.com/pjct.html. This web site consist of two pages. It has instructions on how to build an electricity tester. VanCleave, Janice. Electricity: mind boggling experiments you can turn into science fair projects. New York: John Wiley & Sons, Inc., 1994. The 20 topics in this book suggest many possible problems to solve. Each topic has one "cookbook" experiment - follow the recipe and the result is guaranteed. Approximate metric equivalents have been given after English measurements. Rawsthorne, David, "The History of Electricity", The History of Electricity, http://www.codecheck.com/pp_elect.html, (19 Feb.,1996). This web site consist of four pages. It contains brief biographical sketch of key scientist in the electrical arena. Zubrowski, Bernie. Blinkers and Buzzers Building and Experimenting with Electricity and Magnetism. New York: A Beech Tree Paperback Book, 1991. You can start your own investigations by fooling around with experiments in this book. The Projects all use simple, inexpensive and easily obtainable materials. As you play and experiment with these models, you will discover some of the basic properties of electricity. Bibliography is also appropriate for students reading and viewing.

STUDENT READING LIST

Pearce, W.E. and Aaron E. Klein. Transistors and Circuits: Electronics for Young Experimenters. New York: Doubleday & Co., 1971. This book has many construction projects that start out very simple but become very challenging. A fair number do require access to power tools and special materials not readily available. Sooten, Harry. Experiments with Static Electricity. New York: Grosset & Dunlap and Hestle Books, 1969. Using very simple materials, the experiments in this book help the reader understand the properties of static electricity.

Cook, James, A and the Thomas Alva Edison Foundation. The Thomas Edison Book of Easy and Incredible Experiments. New York: Dodd Mead & Co., 1988.

This book has lots of simple science projects related to the discoveries of Edison, some of which do not involve electricity. One section gives experiments on alternative energy sources.

ACTIVITY LIST

Activities in this unit include various experiments that deal with different areas in electricity. The experiments range from static electricity to a generator. All experiments are noted and found in the bibliography. In addition to the experiments I am including a few activities from the web the sites are listed below.

Link 2 Learn - That's Electric - http://l2l,ea.psu.edu/success/lessons/lesson4/lscc2-l.html Let the internet take your students on a virtual museum tour to answer some questions about electricity. Learning Power, from Southern Company - Power for Life Course Guide - http://www.southernco.com/sne/learningpower/Pages/9_pll_pal.asp This site is contains activities and instruction for a five - hour course on electricity for upper elementary (grade 3 - 5) and middle school (grade 6 - 8)