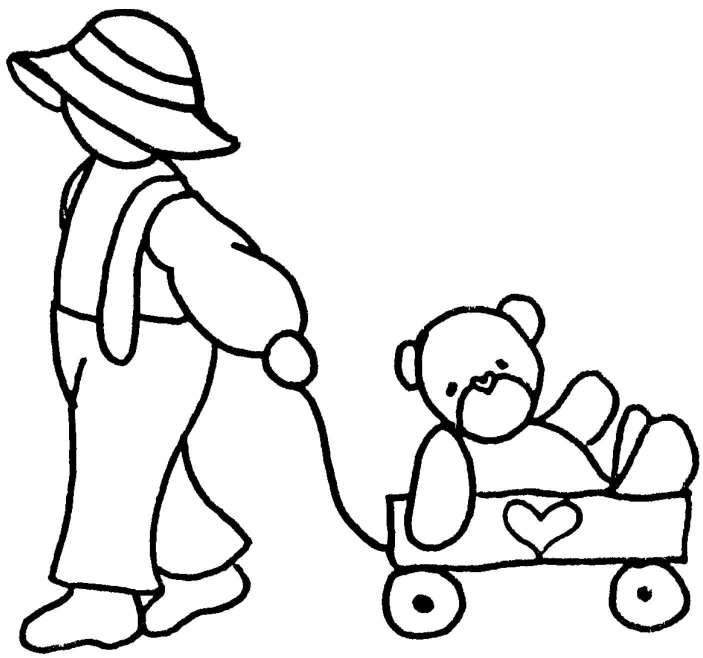
Applied Science

Our Technological World

FOURTH GRADE

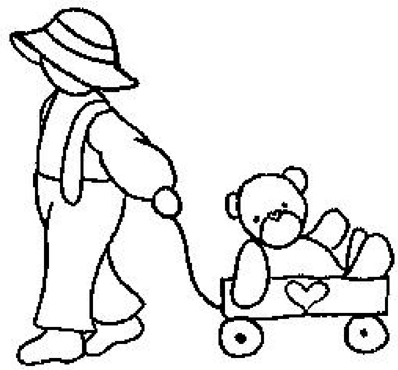
TECHNOLOGY



3 WEEKS
LESSON PLANS AND
ACTIVITIES

APPLIED SCIENCE
OVERVIEW OF FOURTH GRADE

SCIENCE AND MATH



WEEK 1.
PRE: *Exploring conceptual science.*
LAB: *Predicting volume.*
POST: *Measuring linear and curved surfaces.*
WEEK 2.
PRE: *Collecting and analyzing data.*
LAB: *Comparing qualitative and quantitative data.*
POST: *Exploring optical illusions.*
WEEK 3.
PRE: *Comparing and contrasting the subfields of science.*
LAB: *Investigating human senses by collecting data.*
POST: *Comparing and contrasting inventors and scientists.*

PHYSICS

WEEK 4.
PRE: *Comparing electricity and magnetism.*
LAB: *Designing an electric circuit.*
POST: *Investigating the historical development of electricity.*
WEEK 5.
PRE: *Exploring magnetism.*
LAB: *Describing the force produced by a magnet.*
POST: *Exploring the uses of magnetism.*

TECHNOLOGY

WEEK 6.
PRE: *Investigating the electronic industry.*
LAB: *Constructing circuit boards.*
POST: *Comparing parallel and series circuits.*
WEEK 7.
PRE: *Investigating electromagnetism.*
LAB: *Designing an electromagnet.*
POST: *Exploring electrical power.*

BUILT ENVIRONMENT

WEEK 8.
PRE: *Exploring communications.*
LAB: *Discovering methods of communication.*
POST: *Exploring the uses of electromagnets.*

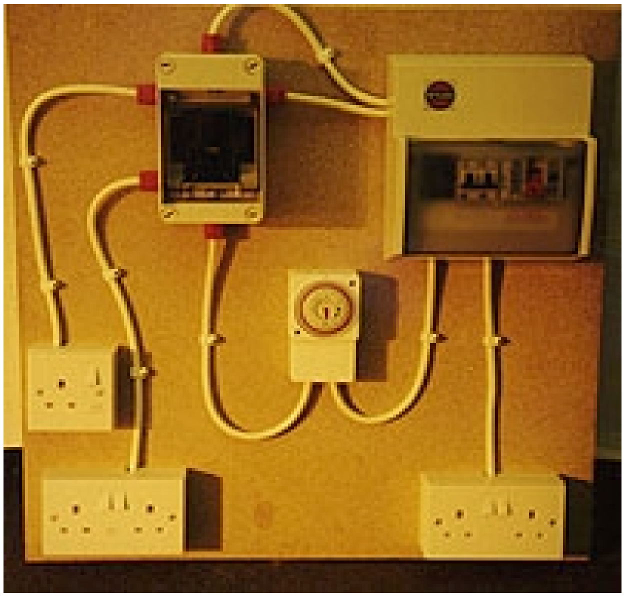
APPLIED SCIENCE - TECHNOLOGY (4A)

Students look at the electronic industry.

PRE LAB

OBJECTIVE:

1. Investigating the electronic industry.
2. Exploring semi-conductors.



VOCABULARY:

circuit
conductor
electronics
semi-conductor

MATERIALS:

computer chips
microscope
Internet
worksheet

BACKGROUND:

Emphasize that the study of electricity and magnetism revolutionized the world. Have students think about life without electricity. Ask them what would work without electricity. They will be surprised to see a very small list. In the next few labs, students will learn how magnetism, added to principles of electricity, has shaped our modern society. Students should be very familiar with the word "electronics". Electronics is the branch of science and engineering concerned with the theory, design, and use of devices utilizing electron emission or absorption. Electronics includes all aspects of photoelectric cells, transistors, circuits, cathode-ray tubes, electron tubes, oscilloscopes, electron microscopes, broadcasting, radio, television, telephone, and many other industries.

In 1883, Thomas Edison was studying a weakness in the filament of his newly developed incandescent lamp. He placed a strip of metal in the bulb and connected it to a battery. When the bulb was lighted, he found that electrons flowed from the filament to the metal strip even though there was no conductor between them. Edison did not continue to explore this phenomenon which later became known as the "Edison Effect". This can be attributed as the beginning of "electronics." Shortly after the beginning of this century, however, other scientists did perform experiments to learn more about the Edison effect. Foremost among them were an Englishmen, Sir John Fleming, and an American, Dr. Lee De Forest.

PROCEDURE:

1. Make sure students realize that electronics deals with the movement of free electrons through semi-conductor materials which conduct electricity better than insulators (non-conductors) but not as well as conductors. Show students a complete chip board and tell them this is why it is called the " semi-conductor industry."

2. If you have computer chips available, have students look under the microscope and see all the electrical circuits that are on that one chip.

3. The main characteristic of all semiconductors is the resistance to allow electrons to flow. The reason for this is the crystalline structure of the material. The semiconductor industry must understand the crystal structure of the materials they use as semiconductors in order to predict how the electrons will flow to produce an electrical current. The common semiconductors are germanium and silicon, and to a smaller extent selenium and tellurium. In California, the infamous "Silicon Valley" is named for the most widely used semiconductor in computers.

4. Use the worksheet to have students write an essay on the electronics industry. If you live near a “technology area” you may want to emphasize that area. Otherwise you can have the students do a search on the Internet on different electronics company from chip makers, to computer manufacturers, or any other subjects they come up with. They may want to ask their parents or neighbors about this industry. If you have a parent in the industry, invite them to give a talk.

ELECTRONICS INDUSTRY

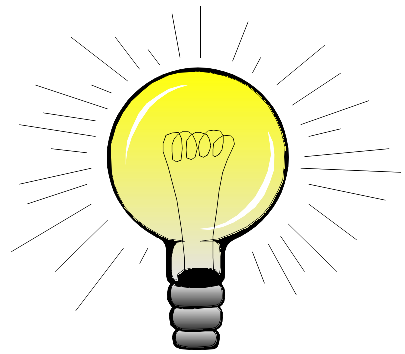
APPLIED SCIENCE - TECHNOLOGY (4A)

LAB

Students make their own circuit boards.

OBJECTIVE:

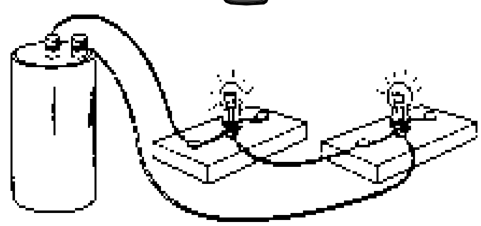
1. Constructing circuit boards.
2. Discovering uses of electricity.



VOCABULARY:

circuit
conductor
electron

MATERIALS:



cardboard
wire
wire stripper
10 paper clips
alligator clips
two 1 1.2 volt dry cell
a flashlight bulb and bulb holder

BACKGROUND:

An electric current is the flow of electric charge which transports energy from one place to another. It is measured in amperes, where 1 ampere is the flow of 6 1/4 billion-billion electrons (or protons) per second. However, no current exists unless there is a complete pathway or circuit through which electrons may flow. The flow of electricity through a circuit can be stopped by breaking or opening the circuit with a switch. By closing the circuit the flow of electricity can be restored.

Students will get a "simple" look at how electricity works by making a "quiz board." A quiz board not only illustrates a simple circuit but also gives students experience working with electric circuits. This is a simple example of how to make an electronic game board. Their finished product will allow them to ask questions that are wired into the correct answer. When the person matches the answer with the question, a bulb will light up telling them it is the correct match.

PROCEDURE:

1. Holding the cardboard lengthwise, attach 5 paper clips about an inch apart along the left side. Attach the remaining 5 paper clips to the right side in a direct line with the

corresponding clips on the left. Number the clips 1-10 (see diagram).

2. Hook the alligator clip to one of the paper clips on the left side of the cardboard and match it to a paper clip on the right side. Remember to mix up the sequence when making a quiz board. If using wires, make sure to scrape off the insulation. Connect the wires from a left paper clip to a right paper clip. Make sure the connections are firm. Devise a list of 5 questions. Write them on small slips of paper and put them under each of the 5 paper clips on the left side of the cardboard. Write the answers to the questions on 5 other slips of paper and put them under the corresponding paper clip on the right side. The circuit will be completed with the correct question/answer combination.

3. To complete the circuit, set up the light bulb and the battery as in the diagram. Read the first question and try to make a connection. Connect the alligator clips from the paper clip with the question to a paper clip with the correct answer. If the correct connection is made between the question and answer, the bulb lights up.

4. This circuit board illustrates that through planning using logic, you can derive answers. This elemental circuitry is at the base of advanced circuitry.

APPLIED SCIENCE - TECHNOLOGY (4A)

PROBLEM: Can electrical circuits be used to gain information?

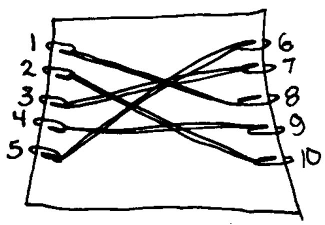
PREDICTION:____

PROCEDURE:

Holding the cardboard lengthwise, attach 5 paper clips about an inch apart along the left side. Then attach 5 paper clips to the right side in a direct line with the corresponding paper clips on the left. Number the clips 1-10, as in the diagram. Follow the "circuit" diagram below.

Using alligator clips, attach one clip to the paper clip on the question side and then one on the answer side. Devise 5 questions and their answers. Record them below. Put the questions and answers on the appropriate "circuit" so the bulb will light when the correct circuit is completed.

Circuit Diagram (example)



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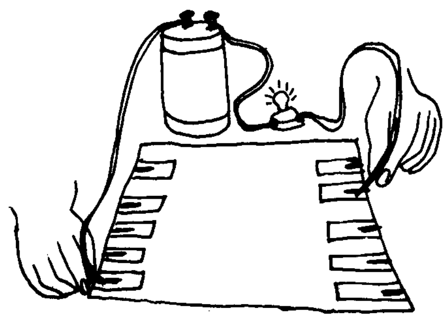


front

QUESTION	ANSWERS
1.	
2.	
3.	
4.	
5.	

Have another set of partners take a "quiz" on your circuit board.
What happens when they get the correct answer?______________________________
Why does this happen?____

CONCLUSIONS: How does a quiz board illustrate how electricity can help gain knowledge?____

APPLIED SCIENCE - TECHNOLOGY (4A)

POST LAB

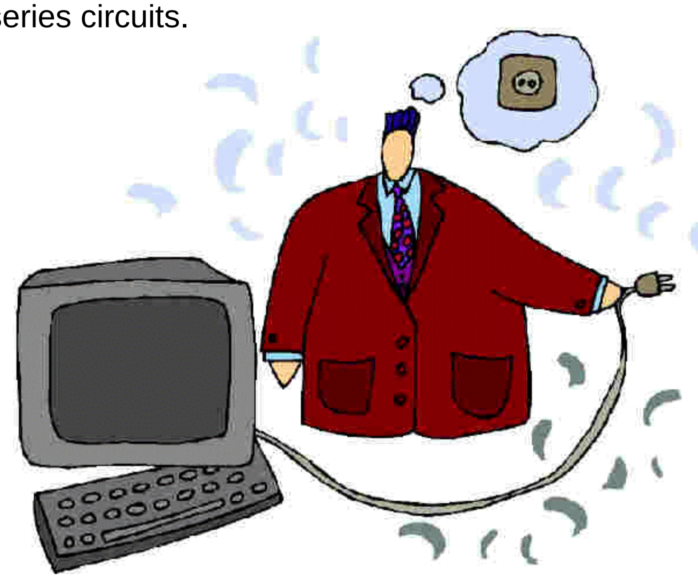
Students look at the electric circuits at home.

OBJECTIVE:

1. Comparing parallel and series circuits.
2. Designing parallel and series circuits.

VOCABULARY:

circuit
current
parallel
series
static



MATERIALS:

light bulbs
wire
lamp bulbs

BACKGROUND:

Students should be aware of the importance of an electric circuit, especially in their everyday life. However, the circuits that they experimented with are not quite the same circuits that they use in their home. There are two types of current electricity, series and parallel. This was introduced in the third grade activities.

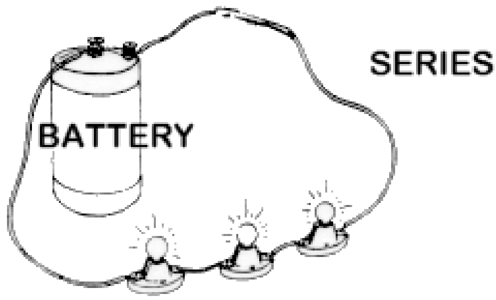
When a simple series is connected, a single pathway is formed through which current flows. A parallel circuit, forms branches, each of which is a separate path for the flow of electrons. Both series and parallel connection have their own distinctive characteristics.

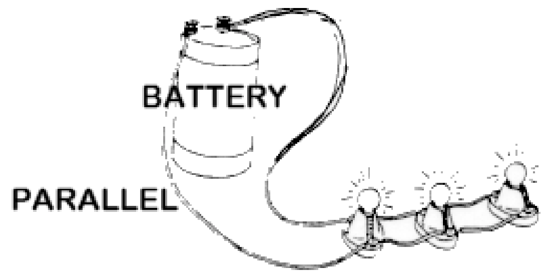
In a series circuit, when one of the bulbs or one of the wires is left open or is broken, the entire circuit ceases. The break opens the circuit. Less expensive Christmas lights are usually of this type, and you have to search for the defective bulb. A parallel circuit is designed so that if one branch is defective, the flow of electricity will not be broken to the other branches.

PROCEDURE:

1. Using the alligator clips, lamp holders, and lamps, erect a series and parallel circuit as in the diagrams below. The more bulbs you put on the series circuit, the more voltage you will need. Go over the difference between the circuits. Point out that the lights

get dimmer on a series circuit, the lights are all illuminated the same on a parallel circuit.



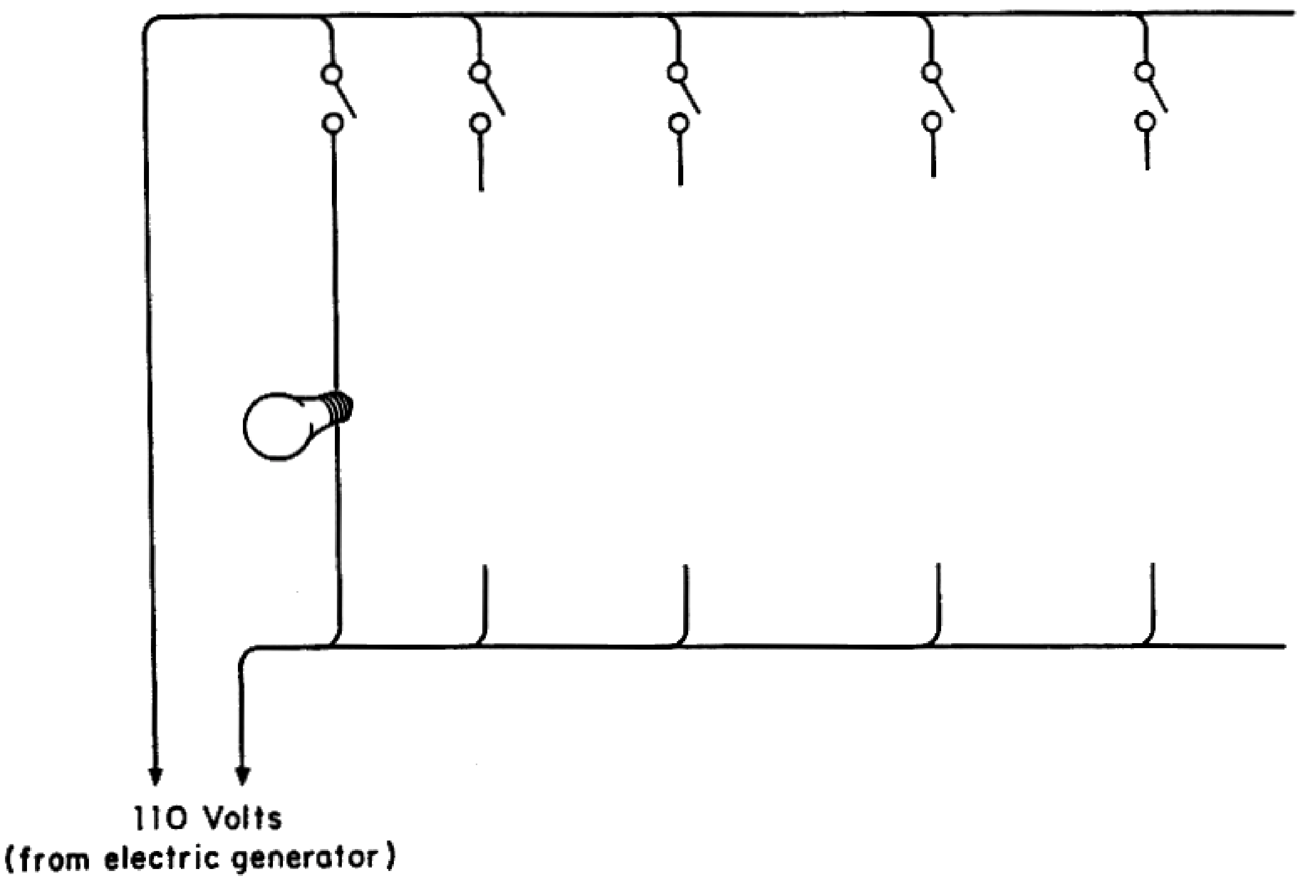


2. Ask students why simple circuits might not be appropriate in their house. Give them clues. Are the appliances all on the same wire? If they are, what happens when one is turned off? Is the circuit broken? If it is broken, will a circuit work? If available, show 2 types of Christmas lights (the ones that will light up even if one is out is a parallel circuit; the ones that won't light up if one is out is a series circuit). Demonstrate by removing the bulbs and see what happens. If it is parallel the lights will stay on, if it is series all the lights will go out.

3. Ask students which one they would want in their house. Discuss that the circuit board they made was a simple series circuit. Almost all electrical circuits in homes are parallel. Use the enclosed worksheet to emphasize that parallel circuits are used in our home. Students can add appliances on the picture to represent their house. Have them write a paragraph of the different uses of electricity in their house.

APPLIED SCIENCE - TECHNOLOGY (4A) POST

DRAW THE APPLIANCES THAT REQUIRE ELECTRICITY IN YOUR HOUSE.



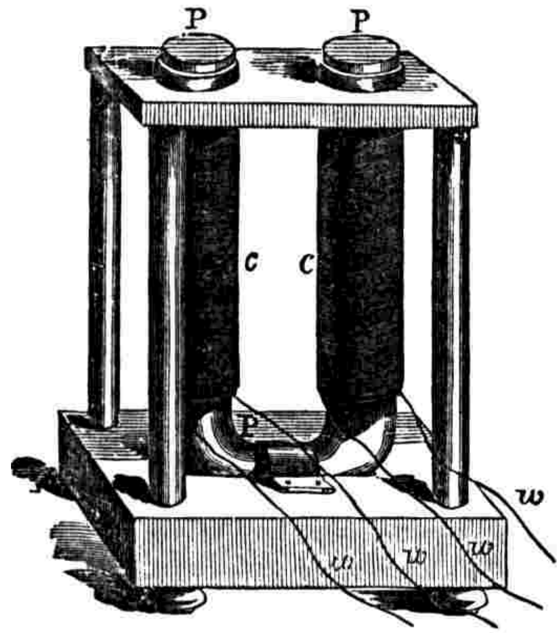
APPLIED SCIENCE - TECHNOLOGY (4B)

PRE LAB

Students use a worksheet to explore magnetism and electricity.

OBJECTIVE:

1. Comparing magnetism and electricity.
2. Investigating electromagnetism.



VOCABULARY:

electricity
electromagnetism
magnetic field
magnetism

MATERIALS:

worksheet
magnet (demonstration)

BACKGROUND:

How are electricity and magnetism related? This was a problem that many researchers in the early 1800's were trying to discover. Michael Faraday discovered how to convert magnetism into electricity in 1831. This bookbinder learned to read the books he was binding and became fascinated with chemistry and physics. Sir Humphry Davy of the England Royal Institute was impressed when Faraday presented Davy with a book of notes that Faraday made of Davy's lectures. Faraday later succeeded Day as Director of the Royal Institute.

Faraday coined the words electrode, anode, cathode, electrolyte, and ions which are used to this day. Faraday developed a continuous mechanical motion produced by electrical current (a motor) in 1821. He also developed the first electric generator, and realized that light is an electromagnetic in nature because it can be deflected by polarized light with a magnet.

PROCEDURE:

1. This exercise illustrates Faraday's Law which states that "the induced voltage in a coil is numerically equal to the product of the number of loops and the rate at which the magnetic field changes within those loops". This can be used to demonstrate the practical side of multiplication.

2. When electricity flows through a wire, the electricity produces a magnetic field.

By inserting a core of iron or steel, the magnetism is intensified. The wire coil wound around a core is called an electromagnet when it completes a circuit. Electromagnets are temporary, but used in transistor radios, doorbells and electric motors. Students will be making an electromagnet in lab. The worksheet will help them to understand why you need to increase the number of coils around a wire.

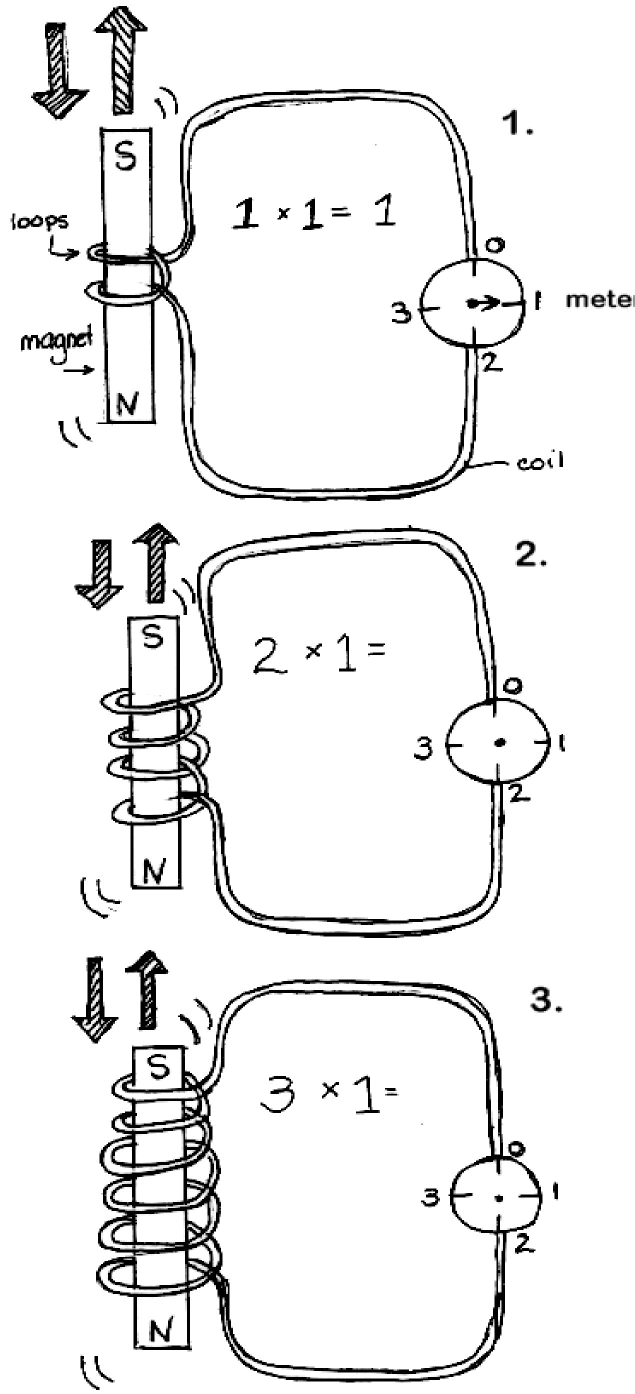
3. Use the worksheet to go through the process of increasing the strength. An electric current can also be made to flow in a wire by simply moving a magnet in or out of a coil of wire. This is called "electromagnetic induction". You could illustrate this with your students with a similar set up as the worksheet, but it is sometimes difficult to see if you do not have the correct meter.

4. ANSWERS:
   1. one
   2. two
   3. three

ELECTROMAGNETISM

When a magnet is placed into a coil having twice the number of loops as in picture 1, twice as much energy is produced. Show this on the meter of picture 2.

If a magnet is place into a coil with three times as many loops, then three times as much energy is produced. Show this on the meter of picture 3. It is also three times harder to push the magnet into the loops.



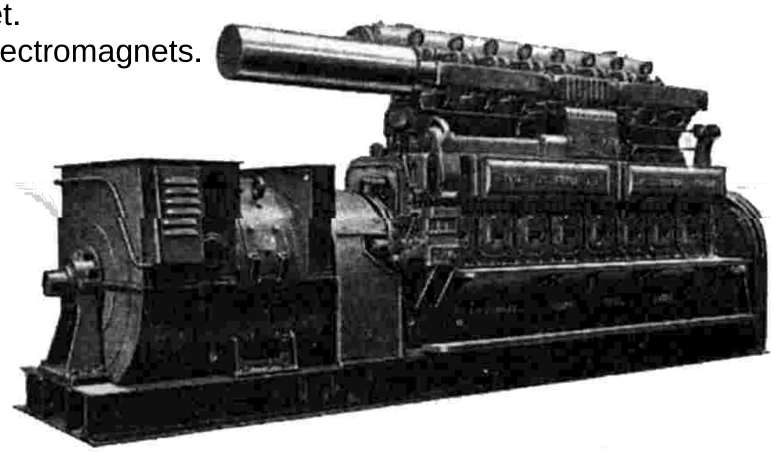
APPLIED SCIENCE - TECHNOLOGY (4B)

LAB

> Students make an electromagnet.

OBJECTIVE:

1. Designing an electromagnet.
2. Discovering the power of electromagnets.



VOCABULARY:

electricity
electromagnet
electromagnetism
magnet
magnetic field

MATERIALS:

battery holder (1 per group)
D batteries (2 for each battery holder)
alligator clips (2 per group)
20 gauge wire (enough to make coils)
large nail (steel)

BACKGROUND:

An electromagnet is a magnet that employs electric currents to generate its magnetic field. In 1825, W. Sturgeon described an electromagnet that allowed a 7 oz. iron bar to pick up a 9 pound iron mass. When the electrical connection was broken, the weight immediately fell. In 1829, H.C. Oersted discovered that an electric current could turn a magnetized needle. Also in that year, D.F.J. Arago and Sir Humphry Davy picked up iron filings by an electrified wire on steel needles. This however, was not an electromagnet.

Electromagnets are temporary magnets that can be turned on and off just by removing one of the connections to a battery. They can be made very strong by wrapping more coils around the electromagnet. They are found in doorbells, door chimes, telephone receivers, telegraphs, relays, loudspeakers, electric clocks, fans, refrigerators, washing machines, generators, circuit breakers, and many other electrical items.

PROCEDURE:

1. This experiment shows students that a more powerful magnet can be made by increasing the number of coils around the bar while still using the same energy source (in this case a total of 3 volts).

2. Follow the directions on the worksheet. Electromagnets can concentrate "energy" to make a powerful magnet. These electromagnets are temporary. You may want to extend this lab by joining two battery packs (a total of 6 volts). The electromagnet will also get stronger. The number of coils and the original voltage can create different electromagnet strengths.

3. Make sure the insulation on the ends of the wires is scraped off. The answers to the lab sheet are dependant on how the students do the activity. Make sure the coils on the electromagnet are wound tightly. The wire must have contact with the nail.

4. ANSWERS:
NOTE: When the students make an electromagnet in this fashion, the wire will become very warm.
1. The number of paperclips will depend on how tight the coils are and the type of paperclips. 2. The paperclips fall. 3. More than in number 1; 4. No; 5. More than 3; 6. There should be a little magnetism left. 7. Maybe 1 for a short period of time. CONCLUSIONS: The force is stronger.

APPLIED SCIENCE - TECHNOLOGY (4B)

PROBLEM: Can you vary the strength of an electromagnet?

PREDICTION:____

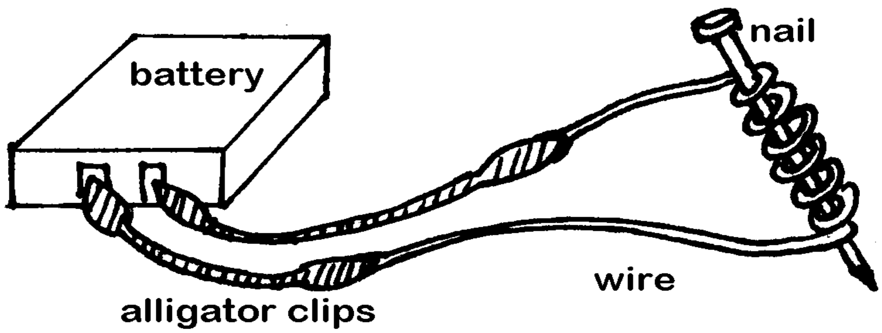
____

MATERIALS: Two 1.2 volt batteries, battery holder, large nail, 2 pieces of insulated electrical wire, paperclips

PROCEDURE:

EXPERIMENT 1: Work in pairs to assemble your electromagnet.

A. Wrap about 10 coils of the wire tightly around the nail.
B. Attach each end (stripped of insulation) to the battery. (see diagram)
C. Test if the electromagnet works.



1. How many paperclips can you pick up?_________________________________
(clips should be end to end so the test is the same)
2. Remove one of the wires from the battery, what happens?

____

EXPERIMENT 2: MAKING A STRONGER ELECTROMAGNET

A. Double the number of coils around the nail to a total of 20 coils.
3. How many paperclips can you pick up now?______________________________
4. Is that double the above number? ____________________________________
5. If you triple the number of coils, how many paper clips can you lift?

____

B. Remove the nail from the wire coil.
6. Does the coil of wire still act as an electromagnet?___________
7. How many paperclips can you pick up now?__________
8. Any other observation_______________________________

CONCLUSIONS: What happens when you make more coils on the nail?

APPLIED SCIENCE - TECHNOLOGY (4B)

POST

Students learn about utility companies.

OBJECTIVE:

1. Exploring electrical power.
2. Investigating conservation of energy.

VOCABULARY:

conservation
utility

MATERIALS:

literature from local utility companies
Internet

BACKGROUND:

The United States is the leader in both its installed generating capacity and its electric energy production compared to most countries in the world. Private electric utilities are regulated by state commissions or city governments depending on the state. Various state laws control exactly how much profit a utility can make so electric power can be provided at a reasonable rate for all concerned. If electricity was expensive in this country, people would be more aware of the cost of keeping even a light bulb burning.

Electric generation is created by two major means: water and fuel consumption. Energy turns turbines which then convert the movement into electricity. Transfer of electricity can be accomplished through power lines. This country has an extensive network of power lines to bring electricity to even the most remote part.

The United States also has federal power production. The best known is the Tennessee Valley Authority (TVA) that is controlled by the Department of Energy (DOE). This is the largest single electric power system in the world. It develops the Tennessee River and its tributaries and generates and distributes electric power to the surrounding area. Another large project is the Bonneville Power Administration which control water on the Columbia River in Oregon and Washington. The Bureau of Land Reclamation and the Army Corp of Engineers have also been involved in developing cheap power for different regions of the country. Hoover Dam is a federal project that creates power from the Colorado River. Many dams around the country were developed for this very purpose.

PROCEDURE:

1. Have students learn about their local utility. The electric bill usually contains

information about the utility and students may want to write to them to find out more information. Discover how and by what methods the utility produces their energy.

2. Have students conduct an Internet search on their local electrical company that supplies energy. For instance in New York, the utility would be called Con Edison and in California it is called Pacific Gas and Electric. There are new companies that have formed to increase competition for electricity.

2. There are electrical wires all around. Students see them day in and day out, but many don't know their significance. Have students select a topic to research about electricity. For example the conservation of electricity or just background information on the source of the local energy. Electrical generation and methods of conserving this precious commodity should be a way of life for students, not something that is taken for granted.