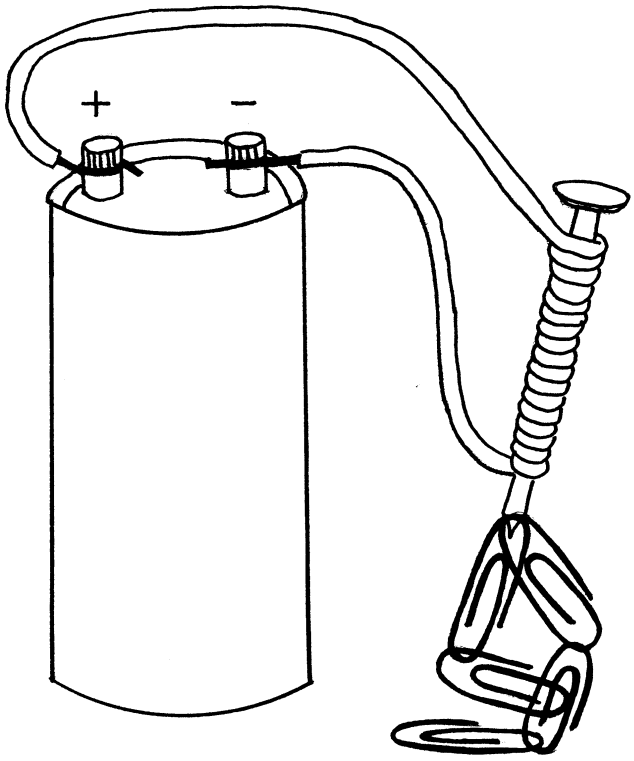
Electromagnetism

Teacher's Guide
Grades 5-9



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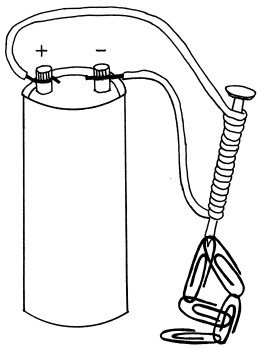

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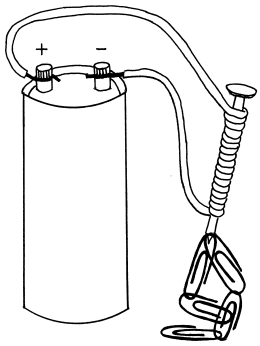

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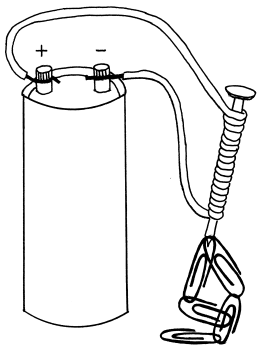

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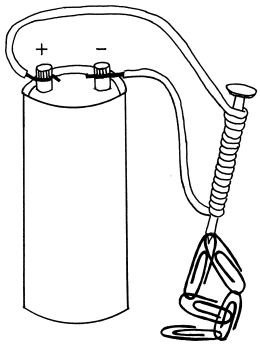


A Message from our Company . . .

Dear Educator:

Thank you for your interest in the educational videos produced by the *Visual Learning Company*. We are a Vermont-based, family owned and operated business specializing in the production of quality science educational videos and materials.

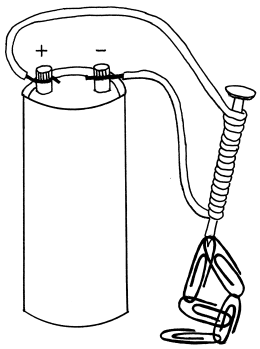
We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, while his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher and to earn a Ph.D. in education, and lead Stephanie to work on science education programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome



National Standards Correlations

National Science Education Standards

(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Science as Inquiry - Content Standard A:

As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Physical Science - Content Standard B:

As a result of their activities in grades 5-8, all students should develop an understanding of:

- Transfer of Energy

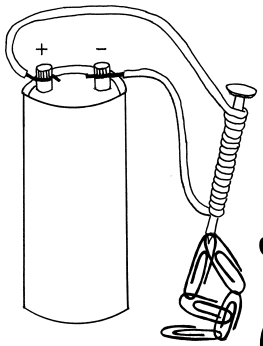
Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - Forces of Nature (4G)

By the end of the 8th grade, students should know that:

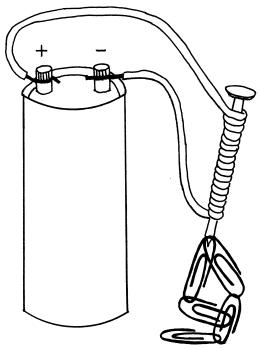
- Electric currents and magnets can exert a force on each other.



Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students should be able to do the following:

- Define the term *electromagnetism*;
- Understand that electric current flowing through a wire can produce a magnetic field;
- Create a workable electromagnet with a wire, battery, and iron nail;
- List examples of everyday applications of electromagnets;
- Describe how an electric motor converts electrical energy to mechanical energy;
- Define the process of electromagnetic induction;
- Explain the use of galvanometers;
- Describe how a generator converts mechanical energy to electrical energy;
- Explain the difference between direct current and alternating current and list the sources of each; and
- Explain and demonstrate how transformers function.



Assessment

Preliminary Test:

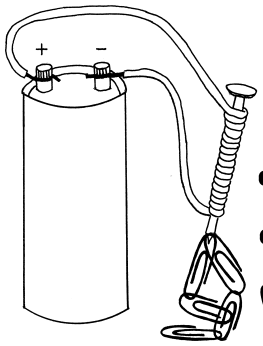
The Preliminary Test, provided in the Student Master section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress on the objectives stated on the previous pages.

Video Review:

The two-part Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. The first part contains questions titled "You Decide" that can be answered during the video. The second series consists of ten video review questions to be answered at the conclusion of the video.

Post-Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.



Introducing the Video

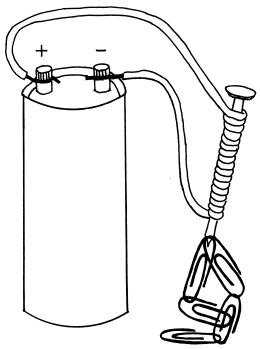
To introduce this video, we recommend that you do a quick classroom demonstration. Loop a 10-inch piece of wire from the positive electrode of a battery to the negative electrode (6-Volt batteries work well). Ask students if they see any movement around the wire while you do this. Once you have connected the wire, again ask them if they see any movement. Explain to the students that even though they do not see anything, a strong magnetic force exists around the wire. To demonstrate this, slowly slide a compass under the wire. The moving compass needle is evidence of the magnetic force. Tell students to watch the video closely to learn more about the relationship between electricity and magnetism.

Video Viewing Suggestions

You may want to photocopy and distribute the provided Student Master "Video Review". You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may decide to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.



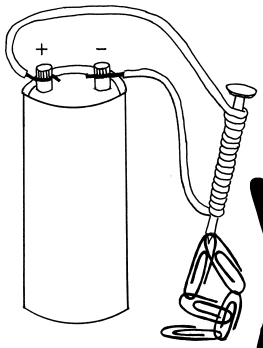
Student Assessments and Activities

Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

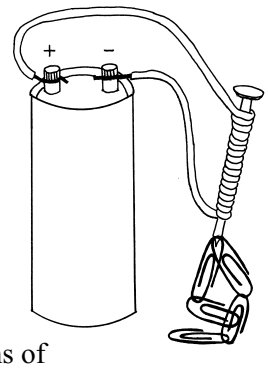
Student Activity Masters:

- Constructing an Electromagnet
- Electromagnetic Inventors
- Motors and Generators
- Electric Current Lab
- Power Outage Activity
- Vocabulary of *Electromagnetism*



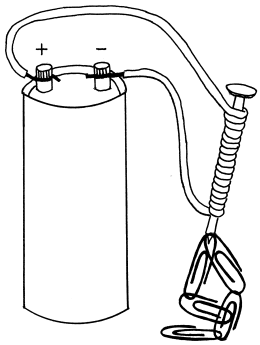
Video Script
Electromagnetism

1. One of the greatest inventions of our time is the electric motor.
2. You may not realize it, but we use electric motors everyday.
3. Electric motors are found in common household appliances, such as this refrigerator…
4. …and in blenders.
5. Electric motors are also found in toys, such as this remote control car…
6. …and in this toy train engine.
7. And electric motors, believe it or not, are also used to power large amusement park rides.
8. An electric motor is used to power ski lifts.
9. And an electric motor spins the grinding wheel of this powerful machine.
10. Electric motors operate as a result of the force of electromagnetism.
11. During the next few minutes, we are going to take a look at electromagnets and how they are used to make our lives easier.
12. We are also going to take a look at some other ways electromagnets have been applied in some everyday electronic devices.
13. **Graphic Transition- Electromagnetism**
14. When you think of electricity, you may think of lightning…
15. ...or of the electricity used in your home to illuminate light bulbs.
16. And when you think of magnets, you probably think of bar magnets…
17. …or horseshoe magnets.
18. But chances are you haven't thought about the relationship between electricity and magnetism.
19. Surprisingly, this simple electric wire exhibits a magnetic force.
20. This is demonstrated by moving the compass close to this wire.
21. You Decide! What will happen to the compass needle when it approaches the wire?
22. As you can see, the magnetic compass needle moves when it's drawn toward the magnetic field of the electric wire.
23. This relationship between electricity and magnetism is called electromagnetism.
24. **Graphic Transition- Electric Current and Magnetism**
25. In the mid 1800's, a Dutch scientist by the name of Hans Oersted made some important discoveries about electricity and magnetism.
26. He found that when a compass is held close to a wire, the magnetic needle of the compass moves when electricity passes through the wire.
27. And when the current direction is reversed, the needle of the compass moves in the opposite direction.
28. Oersted concluded that electric current flowing through a wire produces a magnetic field…
29. …and that the lines of magnetic force are in circular shape around the wire.
30. Oersted also discovered that if a wire is twisted into loops or coils, called a solenoid, the magnetic force becomes greater.
31. The strength of the magnetic field in a solenoid can be greatly increased by placing an iron object, such as a nail, inside the coils.



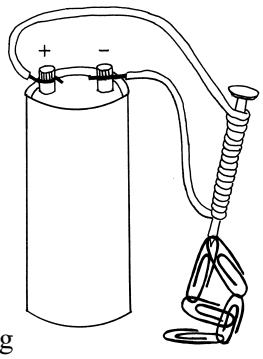
Script

32. When electricity flows through the coils, it magnetizes the iron by aligning the domains of the iron.
33. This forms an electromagnet, creating a magnetic field that is hundreds of times stronger than the strength of the field produced by a solenoid alone.
34. The electromagnet looses its strength when the current stops flowing through the wire.
35. This makes electromagnets strong temporary magnets.
36. A great example of the use of electromagnets as temporary magnets is in this scrap yard.
37. This large disk suspended from the crane is an electromagnet. When a strong current is passed through the electromagnet, pieces of iron-based metal are attracted to it and can be moved.
38. But when the current is shut off, the electromagnet loses its magnetic properties causing the metal to fall.
39. **Graphic transition- Electric Motors**
40. As I mentioned earlier, we use electric motors everyday.
41. This electric pencil sharpener is propelled by a small electric motor…
42. ...and this saw is propelled by an even bigger electric motor.
43. You Decide! What is an electric motor? An electric motor is a machine that changes electric energy into mechanical energy.
44. This is a small electric motor. Most electric motors generally have the following parts.
45. This loop or coil of wire is called the armature.
46. The armature is attached to a shaft that spins between the poles of a magnet as seen here.
47. As electric current flows through the coiled wire, the magnet pushes one side of the coil up and the other side down.
48. This causes a drive shaft to spin, serving as the power source for...
49. ...devices such as this fan …
50. ...and this saw blade.
51. **Graphic transition- Galvanometers**
52. You Decide! What is this instrument?
53. This instrument is a galvanometer. It utilizes electromagnetism to measure small currents.
54. Galvanometers consist of a coil of wire wrapped around a piece of iron that is connected to a needle.
55. This loop or coil of wire spins between the poles of a magnet, as seen here.
56. When connected to a circuit, the current flows through the wire of the magnetic field, causing the needle of the galvanometer to move.
57. The greater the current, the more the needle moves.
58. Galvanometers are the tools used in ohmmeters…
59. ...and voltmeters, seen here,...
60. ...to measure voltage in a circuit.
61. Following Oersted's discovery that magnetism can be produced from electricity, scientists began to attempt to produce electricity from magnetism.
62. In the early 1830's, an English scientist by the name of Michael Faraday...
63. ...and an American scientist by the name of Joseph Henry attempted to produce electricity from magnetism.



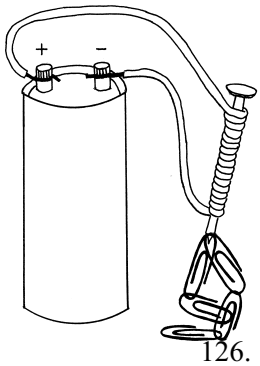
Script

64. While experimenting, they discovered that a steady magnetic field did not produce an electric current.
65. But when a magnetic field changes or moves, a current is produced.
66. Electromagnetic induction is the process by which electric current is produced by a changing magnetic field.
67. Electric current created by a changing magnetic field is called an induced current.
68. When an induced current is created, it does not matter whether the magnetic field moves, as seen here, or…
69. ...whether the circuit moves.
70. In each case, an electric current is produced when a circuit experiences a change in a magnetic field.
71. The process of electromagnetic induction is very important in the creation of electric current from electric generators.
72. **Graphic transitions – Electricity from Magnetism**
73. This map outlines the electric grid of a large geographic area that supports nearly 200 thousand people with electricity.
74. In nearly all cases, electrical generators are responsible for producing electricity.
75. Generators vary in size from small ones that produce enough electricity for a home,...
76. ...to large ones, such as these, that can produce enough electricity for a small city.
77. Generators convert mechanical energy to electrical energy.
78. There are a variety of forms of mechanical energy used as power sources.
79. In the early days of electrical power, moving water was the dominant power source.
80. Dams, such as this one, were built to impound water that was used to generate electricity.
81. In most modern electric plants, high pressure steam turns turbines.
82. Steam is produced by heating water from energy sources such as…
83. ...coal, gas, oil or…
84. ...enriched uranium utilized in nuclear power plants.
85. This is a model of a generator powered by water. The water turns the turbine,...
86. ...which in turn spins the crankshaft that is...
87. ...connected to this wheel of magnets.
88. Surrounding the electromagnets are coils of wire.
89. As the magnets rapidly spin, the electromagnets induce a current in the surrounding coil of wire.
90. Large Turbines, such as this one, work on the same principle, providing us with electricity we use in....
91. ...our schools and homes.
92. **Graphic Transition – Direct and alternating currents**
93. You decide! Even though both this portable CD player and this stationary CD player produce music, how are they electrically different?
94. This portable CD player is powered by electricity produced from batteries.
95. But this CD player is powered by a different type of electric current that is produced by an electric generator in power plants….
96. ...and then is delivered to our homes.



Script

97. The type of electric current we receive at school and at home is referred to as alternating current.
98. Alternating current reverses or alternates its direction in a pattern.
99. Electric generators produce alternating currents that reverse direction 120 times every second.
100. But when devices such as batteries supply electrical current, they provide direct current derived from chemical energy.
101. In direct current, the current flows in one direction through a wire.
102. **Graphic Transition- Transformers**
103. Perhaps you have noticed objects like these on a telephone pole in your neighborhood. This structure is called a transformer.
104. Transformers are also found in many electronic devices, such as inside computers...
105. ...and on battery chargers.
106. A transformer has the ability to increase or decrease the voltage of an alternating current.
107. Let's take the example of transformers found on telephone poles.
108. The electric wires these men are working with contain alternating current of a very high voltage.
109. If the high voltage on these wires were used by appliances in your home, the appliances would be destroyed.
110. This is where transformers come in.
111. This step-down transformer reduces the high voltage in the wire to 120 volts, which is the voltage found in most of the wiring in our homes.
112. A single transformer is composed of two coils of wire referred to as a primary coil and a secondary coil.
113. The coils are wrapped around a metal structure. In the diagram of a step-down transformer, a large amount of voltage flows into the primary coil and only 120 volts flow out of the secondary coil. Notice how the secondary coils have fewer loops of wire than the primary coils.
114. When an alternating current enters the primary coil, a magnetic field is created and a current flows in a secondary coil via electromagnetic induction.
115. In this diagram of a step-up transformer, a smaller amount of voltage enters the primary coil…
116. ...and a larger amount of voltage exits the secondary coil.
117. Step-up transformers are commonly used in television sets to increase the voltage to as much as 20,000 volts!
118. **Graphic transition – Summing Up**
119. During the past few minutes, we have explored the relationships between electric current and magnetism.
120. We studied how electromagnets are created,...
121. ...as well as some of the uses of electromagnets.
122. We also took a look at how electric motors work ….
123. ...and how galvanometers function.
124. We explored the process of electromagnetic induction and how it's used to create electricity from generators.



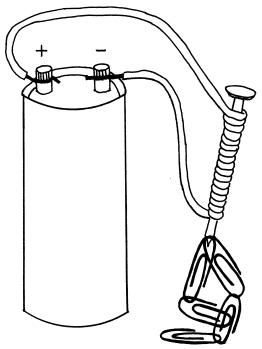
Script

126. Finally, we learned how transformers step up or step down voltage, making it useful for different devices.
127. So, the next time you use an electric motor,….
128. ...or use electricity in your home,...
129. ...or look at a telephone pole,...
130. ...think about the principles of electricity and electromagnetism we've discussed. You just might look at the role electricity plays in your life a little differently.

Video Quiz

Fill in the correct word when you hear this tone. _____. Good luck and let's get started.

1. Electric current flowing through a wire produces a _____ field.
2. A _____ is a coil of wire with many loops.
3. An electromagnet consists of electric wire coiled around a piece of _____.
4. An electric motor changes electrical energy into _____ energy.
5. _____ are used to measure electric currents.
6. Electric current can be created by _____ a magnetic field.
7. Generators convert mechanical energy to _____ energy.
8. Electromagnetic _____ involves the production of electric current from a changing magnetic field.
9. Electric generators produce _____ current.
10. A _____ has the ability to step up or step down the voltage of an alternating current.



Answers to Student Activities

Preliminary Test

1. electromagnetism
2. magnetic
3. solenoid
4. mechanical
5. electrical
6. electricity
7. galvanometer
8. water
9. direct
10. transformer
11. False
12. True
13. False
14. False
15. True
16. False
17. True
18. True
19. True
20. False

Video Review

You Decide:

A. The compass needle moves when it is drawn toward the magnetic field of the electric wire.

B. An electric motor is a machine that changes electrical energy into mechanical energy.

C. The instrument is a galvanometer. It utilizes electromagnetism to measure small currents.

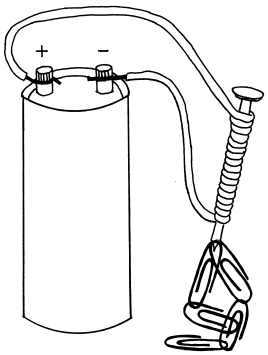
D. The portable CD player is powered by direct current electricity (from batteries), while the stationary CD player is powered by alternating current.

Video Quiz:

1. magnetic
2. solenoid
3. iron
4. mechanical
5. galvanometers
6. changing
7. electrical
8. induction
9. alternating
10. transformer

Post Test

1. True
2. False
3. True
4. True
5. False
6. False
7. True
8. False
9. True
10. False
11. solenoid
12. electrical
13. galvanometer
14. transformer
15. direct
16. water
17. electromagnetism
18. mechanical
19. electricity
20. magnetic



Answers to Student Activities

Constructing an Electromagnet

The nail wrapped with wire creates an electromagnet. As the number of loops in the current-carrying wire increases, the magnetic field of each is added together and the magnet becomes stronger. The battery produces current. The insulation would have blocked conduction of the current into the wire.

Electromagnetic Inventors

Oersted: established the relationship between electricity and magnetism, which states that a current-carrying wire produces a magnetic field.
Faraday and Henry: discovered electromagnetic induction - the production of electricity from a changing magnetic field.
Ampere: developed the electrodynamic theory.
Tesla: discovered the alternating current electrical supply system.

Electric Motors and Generators

Answers will vary.

Electric Current Lab

The needle will move left or right of zero, depending on whether the magnet enters or exits the coil of wire. The speed of the moving needle depends on the speed of the moving magnet. When fewer coils are used, a smaller reading on the galvanometer is produced.

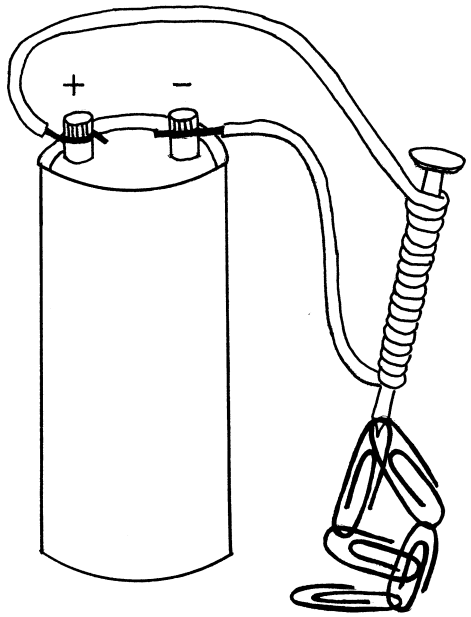
Power Outage Activity

1. a. none
   b. house 1
   c. houses 1,2,3
   d. houses 2,3,4,5
   e. houses 2,3
   f. none
2. A,B,C,D

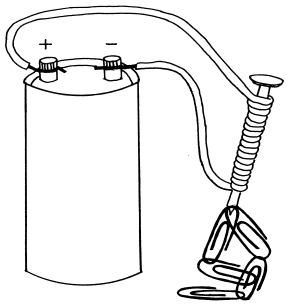
Vocabulary of Electromagnetism

1. solenoid, e
2. electric motor, a
3. generator, b
4. transformer, j
5. induced current, i
6. electromagnetism, d
7. galvanometer, f
8. electromagnet, g
9. electromagnetic induction, h
10. electronics, c

Assessment and Student Activity Masters



Name_____



Preliminary Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. _____ is the relationship between electricity and magnetism.

2. A _____ field is produced when an electric current flows through a wire.

3. A _____ is a coiled wire with many loops.

4. An electric motor changes electrical energy into _____ energy.

5. A generator changes mechanical energy into _____ energy.

6. A changing magnetic field produces _____.

7. The instrument used to measure small currents by utilizing electromagnetism is called a _____.

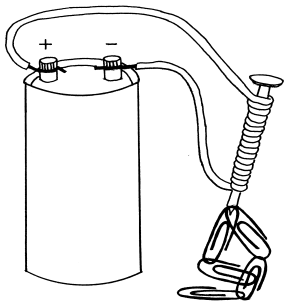
8. _____ was the dominant power source in the early days of electrical power.

9. Batteries produce a _____ current.

10. A _____ increases or decreases voltage.

direct	electromagnetism
magnetic	mechanical
water	transformer
electricity	electrical
solenoid	indirect
galvanometer	ampere

Name_____



Preliminary Test

Directions: Decide whether the answer is True (T) or False (F).

11. An electric pencil sharpener is propelled by an electric generator. T F

12. Electricity can be produced from magnetism. T F

13. A current flows in one direction in an alternating current. T F

14. A step-down transformer increases low voltage to high voltage. T F

15. Electric generators are responsible for producing the majority of the electricity we use. T F

16. Electromagnets are strong permanent magnets. T F

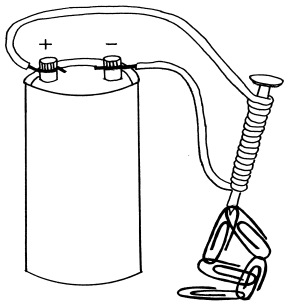
17. Televisions use step-up transformers to increase household voltage to as much as 20,000 volts. T F

18. An electric wire produces a magnetic field. T F

19. Electromagnetic induction occurs when a changing magnetic field produces an electric current. T F

20. Electric motors produce the electricity used in homes and schools. T F

Name_____



Video Review

Directions: During the course of the program answer the "You Decide" questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

You Decide:

A. What will happen to the compass needle when it approaches the wire? Answer: _____

B. What is an electric motor? Answer: _____

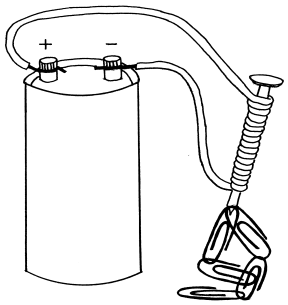
C. What is this instrument? Answer: _____

D. How are the CD players electrically different? Answer: _____

Video Quiz:

1. Electric current flowing through a wire produces a _____ field.
2. A _____ is a coil of wire with many loops.
3. An electromagnet consists of electric wire coiled around a piece of _____.
4. An electric motor changes electrical energy into _____ energy.
5. _____ are used to measure electric currents.
6. Electric current can be created by _____ a magnetic field.
7. Generators convert mechanical energy to _____ energy.
8. Electromagnetic _____ involves the production of electric current from a changing magnetic field.
9. Electric generators produce _____ current.
10. A _____ has the ability to step up or step down the voltage of an alternating current.

Name_____

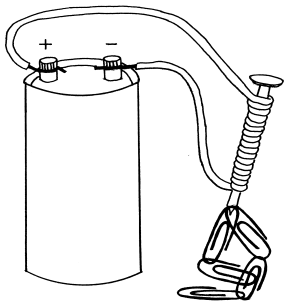


Post Test

Directions: Decide whether the answer is True (T) or False (F).

1. Televisions use step-up transformers to increase household voltage to as much as 20,000 volts. T F
2. A step-down transformer increases low voltage to high voltage. T F
3. An electric wire produces a magnetic field. T F
4. Electricity can be produced from magnetism. T F
5. An electric pencil sharpener is propelled by an electric generator. T F
6. Electric motors produce the electricity used in homes and schools. T F
7. Electric generators are responsible for producing the majority of the electricity we use. T F
8. Electromagnets are strong permanent magnets. T F
9. Electromagnetic induction occurs when a changing magnetic field produces an electric current. T F
10. A current flows in one direction in an alternating current. T F

Name_____



Post Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

11. A _____ is a coiled wire with many loops.

12. A generator changes mechanical energy into _____ energy.

13. The instrument used to measure small currents by utilizing electromagnetism is called a _____.

14. A _____ increases or decreases voltage.

15. Batteries produce a _____ current.

16. _____ was the dominant power source in the early days of electrical power.

17. _____ is the relationship between electricity and magnetism.

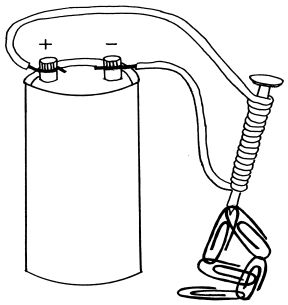
18. An electric motor changes electrical energy into _____ energy.

19. A changing magnetic field produces _____.

20. A _____ field is produced when an electric current flows through a wire.

transformer	electromagnetism
indirect	electricity
galvanometer	solenoid
mechanical	electrical
direct	magnetic
ampere	water

Name_____



Constructing an Electromagnet

Objective:
In this lab you will use household materials to construct an electromagnet.

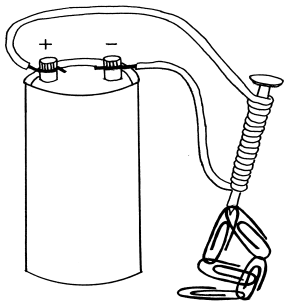
Background:
A Danish physicist named Hans Christian Oersted discovered the relationship between electricity and magnetism over 150 years ago. The study of this relationship became known as **electromagnetism**. Various experiments led Oersted to discover that an electric current flowing through a wire produces a magnetic field. He found that when a current-carrying wire is coiled, the force of the magnetic field increases. A coiled wire with many loops is called a **solenoid**. A solenoid exists in the center and at both ends of a strong magnetic field. The magnetic force of the solenoid may be strengthened by increasing the number of loops of wire and also by placing an iron-based material in its center. The solenoid magnetizes the iron, forming an **electromagnet**.

Materials:
6-Volt battery
Large nail
Insulated wire
Tape
Lightweight metal objects (paper clips, coins)

Procedure:
1. Remove small sections of insulation from the ends of the insulated wire.
2. Wrap the wire tightly around the nail five times.
3. Tape the ends of the insulated wire to each post on the battery.
4. Place some paper clips on your table. Touch the nail to these objects. What happens to the objects?
5. Record the number of objects the nail can attract. Detach the wire from the battery.
6. Repeat Steps 2-5, adding five loops with each trial. Create a data chart to record the number of paper clips held by the nail when wrapped with 5, 10, 15, and 20 loops of wire.

Conclusions:
What is created by wrapping the nail with wire? How is the number of wire loops around the nail related to the strength of the electromagnet? What is the role of the battery in this experiment? Why was the insulation removed from the ends of the wire?

Name_____



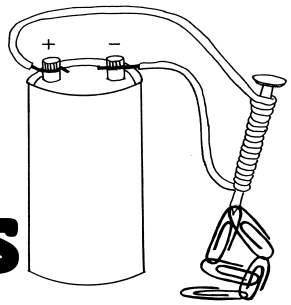
Electromagnetic Inventors

Background:
Do you ever wonder who was responsible for discovering many of the scientific principles by which we live? Several scientists have worked very hard in the past to give us the scientific knowledge we have today. Numerous scientists worked together to determine the relationship between electricity and magnetism, now known as the field of electromagnetism. Five of these scientists made very significant findings. These scientists are Hans Christian Oersted, Andre Ampere, Michael Faraday, Joseph Henry, and Nikola Tesla. Without the discoveries of these people, the field of electromagnetism would not be what it is today!

Directions: Use the Internet and other reference materials to research each of these scientists. Using the information you find, fill in the chart below. Write a short paragraph about each scientist, highlighting major events in their lives and their work. Gather as a class and discuss your findings.

Scientist	Significant Discovery
Hans Christian Oersted	
Andre Ampere	
Michael Faraday	
Joseph Henry	
Nikola Tesla	

Name_____



Motors and Generators

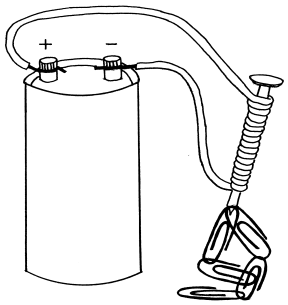
Electric Generator:
An electric generator converts mechanical energy into electrical energy. In a generator that produces electricity for our homes, an outside force, such as moving water, rotates a wire loop encased in magnets to produce an electric current.

Electric Motor:
An electric motor converts electrical energy into mechanical energy. For example, a fan uses an electric current to operate a motor that spins the blades.

Using your knowledge of electric generators and electric motors, find examples of appliances or devices which utilize electric motors or electric generators. Fill in the chart below. List the device or appliance and decide whether it uses an electric motor or generator. In the last column, state the energy source and describe how this energy is used.

Device/ Appliance	Motor or Generator?	Source and Use of Energy
Fan	Motor	Source - electric current Use - to operate a motor that spins the fan's blades.

Name_____



Electric Current Lab

Objective:
In this lab you will produce an electric current with only a magnet and a coil of wire.

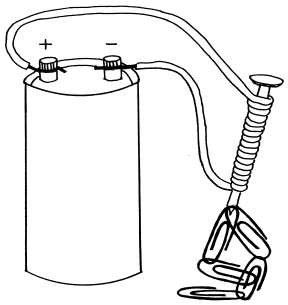
Background:
In 1820, Hans Christian Oersted discovered that he could create a magnet by passing a current through a wire. This observation later led to the assumption that an electric current could be produced by reversing the process and moving a magnet through a coil of wire. This discovery prompted the invention of electric motors, which power common household appliances such as blenders and fans. This small, yet important discovery opened the doors to the modern world of electricity.

Materials:
30 cm of thin, insulated wire
Scissors
Galvanometer
Bar magnet

Procedure:
1. Use the scissors to scrape the insulation off both ends of the wire.
2. Coil the wire to make about 10 loops.
3. Attach the two bare ends of the wire to the galvanometer.
4. Watch the galvanometer as you insert the bar magnet through one end of the coil. Observe what happens. Record the measurement of the galvanometer.
5. Be creative! Move the magnet faster, slower, and outside of the coil. What happens?
6. Find the least possible amount of coils that are able to cause the galvanometer to move.

Conclusions:
Describe the readings of the galvanometer. Does the needle always move in the same direction? Does it always move at the same speed? What happens when fewer coils are used?

Name_____



Power Outage Activity

Objective:
In this activity you will discover how power outages and restorations occur in your neighborhood.

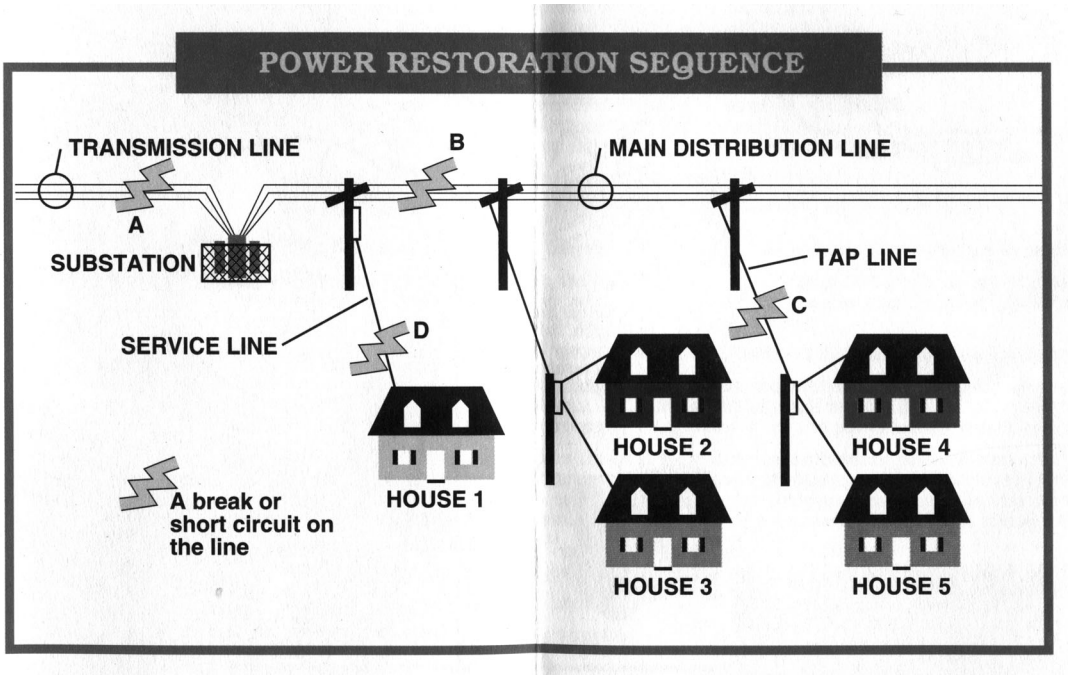
Background:
Have you ever wondered why your home loses electricity during a bad storm? During times of high wind, trees fall on power lines, causing them to break. Winter storms often cause ice to build up on the lines, weighing them down to the point of breakage. During a thunderstorm, lightning may hit a transformer, rendering it incapable of delivering electricity to our homes. Whether or not your home loses electricity is determined by where the break or short circuit occurs on the power line.

Directions:
Use the diagram below to answer the following questions.

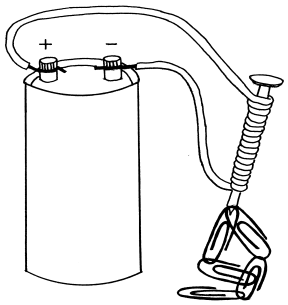
1. List which houses will not lose their electricity if the break occurs at:

a. point A
b. point B
c. point C
d. point D
e. points C & D
f. points B & D

2. After a power outage, your power company begins the power restoration process by repairing the power lines that reach the largest number of people. It then works on the lines that reach the least amount of people. Knowing this, put the break or short circuit points in order to represent the power restoration sequence.



Name_____



Vocabulary of *Electromagnetism*

Directions: Unscramble the following vocabulary words and match each word with its correct definition.

___ 1. dinoelso

___ 2. critecel oomtr

___ 3. oartneegr

___ 4. mrofresnart

___ 5. cudedin rrtneuc

___ 6. msticeelmortagne

___ 7. vlgaonmaeetr

___ 8. gnetatroeemcl

___ 9. ceelmaeticgntro nndioitcu

___ 10. trcleeniocs

a. device that converts electrical energy into mechanical energy

b. device that converts mechanical energy into electrical energy

c. study of the release, behavior, and control of electrons as it relates to use in helpful devices

d. relationship between electricity and magnetism

e. long coil of wire with many loops

f. instrument used to detect small currents

g. solenoid containing a magnetic material

h. process by which a current is produced by a changing magnetic field

i. electric current produced by a changing magnetic field

j. device that increases or decreases the voltage of an alternating current