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ABSTRACT

This booklet, one of a series developed by the Frederick County Board of Education, Frederick, Maryland, provides an instruction module for an individualized or flexible approach to secondary science teaching. Subjects and activities in this series of booklets are designed to supplement a basic curriculum or to form a total curriculum, and relate to practical process oriented science instruction rather than theory or module building. Included in each booklet is a student section with an introduction, performance objectives, and science activities which can be performed individually or as a class, and a teacher section containing notes on the science activities, resource lists, and references. This booklet is the third of a three part series on electricity and concentrates upon applications for electricity. The estimated time for completing the activities in this module is 2-3 weeks. (SL)

# Electricity : Part 3

# AIDS TO INDIVIDUALIZE THE TEACHING OF SCIENCE



# MINI-COURSE UNITS

BOARD OF EDUCATION OF FREDERICK COUNTY

1974

Marvin G. Spencer



GRAPHIC ARTS DEPARTMENT - F.H.

# ELECTRICITY: PART III

## APPLICATIONS FOR ELECTRICITY

Prepared by

Marvin Blickenstaff

Estimated Time for Completion

2-3 weeks

Frederick County Board of Education

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# Mini Courses for

# Physical Science, Biology, Science Survey, Chemistry and Physics

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1974

## FOREWORD

The writing of these instructional units represents Phase II of our science curriculum mini-course development. In Phase I, modules were written that involved the junior high disciplines, life, earth and physical science. Phase II involves senior high physical science, biology, chemistry, physics and science survey.

The rationale used in the selection of topics was to identify instructional areas somewhat difficult to teach and where limited resources exist. Efforts were made by the writers of the mini-courses to relate their subject to the practical, real world rather than deal primarily in theory and model building.

It is anticipated that a teacher could use these modules as a supplement to a basic curriculum that has already been outlined, or they could almost be used to make up a total curriculum for the entire year in a couple of disciplines. It is expected that the approach used by teachers will vary from school to school. Some may wish to use them to individualize instruction, while others may prefer to use an even-front approach.

Primarily, I hope these courses will help facilitate more process (hands on) oriented science instruction. Science teachers have at their disposal many "props" in the form of equipment and materials to help them make their instructional program real and interesting. You would be remiss not to take advantage of these aids.

It probably should be noted that one of our courses formerly called senior high physical science, has been changed to science survey. The intent being to broaden the content base and use a multi-discipline approach that involves the life, earth and physical sciences. It is recommended that relevant topics be identified within this broad domain that will result in a meaningful, high interest course for the non-academic student.

ALFRED THACKSTON, JR.
Assistant Superintendent for Instruction


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10
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CONTENTS

# ELECTRICITY: PART III

## APPLICATIONS FOR ELECTRICITY

When Aladdin rubbed his magic lamp, a powerful genie would appear and carry out Aladdin's every wish. There is no need for any of us to envy Aladdin the possession of his marvelous lamp. We, like Aladdin, can summon up a genie who will carry out our commands. This modern genie is called electricity; he can be called forth with the push of a button or the flick of a switch, and he can perform an amazing variety of services for us.

Electricity affects our lives daily in three major ways - light, heat and power. Electricity is not a true commodity. Electricity itself, although a form of energy, does not have very many uses. However, when we convert electricity into light, heat and power, its uses become almost endless.

With Edison's invention of the incandescent lamp in 1879, science and technology "began to see the light". Prior to that time, electricity was used, but Edison's impact of inventing the electric light bulb seemed to set off an explosion of discoveries and inventions which have improved the standard of living around the entire world.

The factors which make electricity so important are: it is readily available, it can be distributed very efficiently, and it can be changed very easily into other forms of energy. Modern living will demand more and more electricity for years to come. The very survival of mankind may well be determined by his ability to discover ways to produce and distribute electricity to all nations of the world. Electricity may be a technological force which will close the gap that exists between sociological differences in mankind - differences which have led to wars and other forms of international tensions. We can only speculate as to how an "equilization" of the standards of living brought about by the use of electricity could affect the stability and growth of civilization. Electricity is important at all levels of society - from global, to national, to the individual.

Now that you have seen the importance of electricity in the world, let's look at individuals. Part III of this series of mini-courses on electricity should impress upon you how important electricity is and how dependent each of us is upon it. We should not take it for granted.

In Part I and Part II of this series, you were introduced to some basic ideas which are needed in order for you to understand how we use electricity. Although electricity can be put to an almost endless number of uses, this mini-course will be divided into 14 major topics as shown in the table of contents. You will be expected to do topics A through E and any other topics your teacher directs you to do. YOU SHOULD NOT TRY TO DO THIS COURSE BEFORE DOING PARTS I AND II UNLESS YOU HAVE PERMISSION FROM YOUR TEACHER.

I. Required Section

A. Environmental Modification in the Home

In the home, we use electricity to provide a comfortable environment during changing seasons. Do activities a and b below.

OBJECTIVES

The student should be able to:

1. demonstrate the conversion of electricity to heat.

2. describe the function of a thermostat in controlling electrical flow which in turn controls heat flow.

ACTIVITIES

a. Do Laboratory Problem No. 1, "How Can Resistance be Useful in Electrical Appliances?" from workbook which accompanies Pathways in Science - Physics I, pages 3-6.

(1) Read pages 30-32 and 35-38 in Pathways text.

(2) Carry out lab as directed on mimeographed sheet which you will get from your teacher.

b. Watch your teacher demonstrate and then discuss the following as a class:

(1) TEACHER: Heat bimetallic strip in Bunsen flame and then cool it rapidly in water from a faucet. What did the bimetallic strip do while hot and while cold?

(2) Examine the thermostat (s) being passed around the room by your teacher; then discuss how a thermostat works.

(3) Look at the overhead transparency shown to the class by the teacher; then discuss why a thermostat works.

OBJECTIVE

The student should be able to:

3. describe one or more uses of electricity which enables us to control our home environments.

ACTIVITIES

Choose one topic from the list on the next page and write a report using the reference (s) stated and any other references you can find. Your teacher will give you the details about the exact form to use and how long to make your report.

a. Air conditioning (heating and cooling) your home - Modern Science, Holt, Rinehart & Winston, pages 262-263 and Potomac Edison pamphlets called Utilize Your Electrical Energy Efficiently and Economize, and What You Always Wanted to Know About Electric Heating and Cooling.

b. Humidifying and dehumidifying our homes with electricity - Potomac Edison pamphlet called Utilize Your Electrical Energy Efficiently and Economize.

c. Air purification of our homes using electricity: removal of dust, microorganisms, and allergens - Pathways - Physics I, pages 49-50, and Challenges to Science, McGraw Hill, pages 283-284. See your teacher for additional pamphlets.

B. Light

OBJECTIVE

The student should be able to:

4. demonstrate and describe how electricity can be converted into light energy.

ACTIVITY

Lab - Converting Electrical Energy into Light

Materials: matches, tongs, magnesium ribbon, camera with flash (note: film is not required for camera), tungsten or nichrome wire, power supply (12 volts), clear (unfrosted light bulb) and socket, variable transformer

Procedures:

1. Teacher demonstrates procedure one: Hold strip of magnesium ribbon with tongs and ignite with match. Observe briefly and not directly. Record results.
2. Examine an unused flash bulb and record its appearance.
3. Discharge the flash bulb using the camera. Re-examine the bulb and record its appearance. How does the light of the flash bulb compare with the light in procedure 1?
4. Attach a tungsten or nichrome wire to a 12 volt power supply for several seconds. Record any results you can notice. Hint: Feel the wire if you do not see a change.
5. Turn on a clear (unfrosted) light bulb that is in a circuit which contains a variable current. Change the amount of current and notice the change in the bulb filament. Record your results. DO NOT LOOK AT THE BRIGHT FILAMENT FOR MORE THAN A FRACTION OF A SECOND.

Interpretations:
1. How was light produced in procedure #1?
2. Was electricity converted into light in step #3? Explain your answer.
3. Why was copper wire not used in step #4?
4. Why are most light bulbs frosted?

Conclusion: How is electricity converted to light?

ACTIVITY

Choose one topic from the list below and write a report using the references stated and any other references you can find. Your teacher will give you the details about the form to use and how long to make your report.

a. Compare and contrast incandescent and fluorescent lighting; tell how each converts electricity into light - Potomac Edison pamphlet, Utilize Your Electrical Energy Efficiently and Economize and World Book, Volume E, pages 130-132 (1972).

b. Explain how other types of light sources convert electricity into light, i.e., sodium vapor, mercury vapor, neon signs, etc. - World Book, Volume E, pages 130-132 (1972).

C. Motors

OBJECTIVE

The student should be able to:

5. assemble and describe the operation of a simple electric motor.

ACTIVITY

Lab - Do the lab as described on pages 12-19 in the enclosed booklets, How to Build 5 Useful Electrical Devices, Thomas A. Edison Foundation or A Simple Motor, National Electrical Contractors.

OBJECTIVE

The student should be able to:

6. describe how a specific device (appliance or tool) uses an electric motor to do work in our daily lives.

ACTIVITY

Choose one topic from the list below and write a report using the reference(s) stated and any other references you can find. Your teacher will give you details about the form to use and how long to make your report. Explain how electricity is used through motors in one of the following devices: vacuum cleaner, electric razor, drill, mixer, power saw, automobile starting motor, clothes or hair dryer, washing machine, can opener, door opener, etc. How does the device you chose make work easier for you? - pamphlet from Potomac Edison, Utilize Your Electrical Energy, etc. and World Book, Volume A, pages 534-536, also Volume E, page 119, 123, and pages 134-137 (1972).

D. Communication

OBJECTIVES

The student should be able to:

7. describe the electromagnetic action in a door bell.

8. demonstrate how to connect a doorbell in a parallel circuit with two switches and then compare this circuit with the wiring in private homes.

ACTIVITIES

a. Read paragraph #6, page 99 of Pathways - Physics 1.

b. Hook up (connect) a doorbell to a source of electricity and examine its moving parts while it is ringing. Explain how electricity can make a doorbell ring.

c. Do experiment #2 on pages 6-7 in Electrical and Chemical Experiments, a booklet from Thomas Edison Foundation.

OBJECTIVES

The student should be able to:

9. assemble a model telegraph (key and sounder) from the provided materials.

10. attach two model telegraphs (key and sounder) in a circuit and send several letters (or a message) using the International Morse Code.

ACTIVITIES

a. Read pages 96-99 in Pathways - Physics 1.

b. Build a model telegraph as shown on page 98 of Pathways. You may also use A Simple Electric Buzzer and Code Key as a reference which your teacher will supply to you.

Materials: 4 x 4 inch block of wood (1 inch thick), large nail, strips of sheet metal, sheet metal shears, wire, dry cells or power supply

c. Attach your model telegraph with another team's model telegraph and send messages. Hint: Hook up telegraph models in parallel which you learned about in objective 8.

OBJECTIVE

The student should be able to:

11. list and describe at least one way electricity can be used in communication.

ACTIVITY

Choose one topic from the list below and write a report using the references stated and any other references you can find. Your teacher will tell you the form to use and how long to make your report. Explain how electricity is used in the device you choose and then tell how the device works.

a. Telephones and intercoms - several pamphlets from local telephone company, The C & P Telephone Company of Maryland

b. Radio - booklet, Edison Inventions and Related Projects, Thomas Edison Foundation and Focus on Physical Science, Charles E. Merrill Publishing Company, pages 339-340. Include in your report the theory of AM and FM radio. World Book, Volume R, pages 80-89 (1972) should help you understand more about radio.

c. Electronic components: Tell how the following function in the control of electricity.

   (1) diodes, triodes, and multielectrode tubes
   (2) solid state electronic components
      (a) N and P type transistors
      (b) piezoelectric crystals
      (c) integrated circuits and microminiaturization
      (d) other components

   Use the different pamphlets provided by Potomac Edison Company and C & P Telephone Company. The following texts also provide information: Focus, Charles E. Merrill Publishing Company, pages 396-406; Modern Science, Holt, Rinehart & Winston, pages 291-297; and Challenges to Science, McGraw Hill, pages 337-340.

d. Explain the theory of color and black and white television - Focus, Charles E. Merrill Publishing Company, pages 406-409, and Modern Science, Holt, Rinehart & Winston, pages 295-296. Several pamphlets from the local electric and telephone company will also provide information.

e. Radar and sonar - Explain the operation of these two electrically powered devices. World Book, Volume R, pages 64-73 (1972), Modern Science, Holt, Rinehart and Winston, pages 294-295.

f. Lasers and masers - Explain the operation of these two electrically powered devices. World Book, Volume L, pages 80-80d and Volume M, page 204; Modern Science, Holt, Rinehart & Winston, pages 295-296; and Challenges to Science, McGraw Hill, pages 53-54 should give you the information you will need. Pamphlets will also be provided by your teacher.

E. Transportation

You will recall in Section C that you made an electric motor and discussed its operation. Transportation is related to electricity because electric motors can be placed in mobile vehicles. The following topics should help you understand the importance and widespread use of electricity in the field of transportation.

OBJECTIVES

The student should be able to:

12. describe at least one way electricity is used in transportation.

13. describe the relationship between the energy crisis and the use of electricity in transportation.

ACTIVITY

Choose one of the following topics and write a report which explains the operation of that particular form of transportation. Explain how electricity is related to the energy crisis as related to the area of transportation.

a. Electric automobiles - World Book, Volume E, page 119 (1972)

b. Trains - World Book, Volume E, page 143 (1972)

c. Buses and street cars - World Book, Volume So-Sz, page 734 (1972)

d. Traffic control - World Book, Volume T, page 291 (1972)

e. Electric rockets or ion engines - World Book, Volume R, page 360-360a (1972)

Note: Other printed materials will also be available on some but not all the above topics. Your teacher will tell you how to write your report and how long to make it.

THIS IS THE END OF THE REQUIRED PART OF THIS MINI-COURSE. YOUR TEACHER MAY ALLOW YOU TO CONTINUE DOING MORE. IF NOT, YOU SHOULD SKIP TO SECTION O WHICH IS THE REVIEW. SOME OF THE TERMS IN THE CRYPTOGRAM AND CROSSWORD PUZZLE WILL BE DIFFICULT; THEREFORE, YOUR TEACHER MAY WANT YOU TO OMIT THIS PART OF THE MINI-COURSE ALSO.

IF YOU CONTINUE TO DO MORE OF THIS MINI-COURSE, YOU WILL BE EXPECTED TO FIND YOUR OWN REFERENCES (INFORMATION). IF YOU DO ANY EXPERIMENTS WITH ELECTRICITY WHICH ARE DANGEROUS, YOU WILL BE REQUIRED TO HAVE PERMISSION FROM YOUR PARENTS. AS IN THE FIRST PART OF THIS MINI-COURSE, YOU ARE EXPECTED TO LEARN MORE ABOUT THE MANY USES OF ELECTRICITY. YOU SHOULD DO ONLY THOSE TOPICS THAT INTEREST YOU. YOU ARE NOT EXPECTED TO COMPLETE ALL OF THIS MINI-COURSE.

IT IS SUGGESTED THAT YOU SELECT ONLY TWO OR THREE ACTIVITIES FROM THE OPTIONAL SECTION TO COMPLETE THIS MINI-COURSE.

II. Optional Section

F. Computers

OBJECTIVES

The student should be able to:

14. describe how electricity has made possible the field of computer technology.

ACTIVITY

Write one report from the list below using the format given to you by your teacher.

a. digital computers
b. analog computers
c. make a display which depicts the theory of computer technology
d. build a simple digital computer (working model)

G. Research

OBJECTIVE

The student should be able to:

15. list and explain some technology that would not be possible without electricity.

ACTIVITY

Write one report from the list below using the format suggested by your teacher. One of these topics lends itself to experimentation in original research or for making demonstrations to your class - the oscilloscope.

a. electron microscope
b. ion microscope
c. radio-telescopes
d. atomic particle accelerators
e. oscilloscopes
f. super conductors

OBJECTIVE

The student should be able to:

16. list and explain some technology concerning the production of electricity as a possible solution to the energy crisis.

ACTIVITY

Write a report using the format required by your teacher. Select one topic from the list on the next page.

a. solar cells
b. fuel cells
c. nuclear power plants
d. magnetohydronamics (MHD)
e. bioelectricity
f. geothermal energy transfer
g. harnessing energy of thunderstorms

OBJECTIVE

The student should be able to:

17. describe the transmission of electricity as it is related to the concept of entropy - entrophy of energy.

ACTIVITY

Write a report on the efficiency of transmission of electrical power through the use of voltage manipulation. Your teacher will give you the format to use. Note: Check the pamphlets made available by your teacher.

II. Medicine

OBJECTIVE

The student should be able to:

18. list and describe some of the medical technology which is possible through the use of electricity.

ACTIVITY

Choose one of the topics from the list below and write a report as directed by your teacher.

a. x-rays
   (1) dentistry
   (2) Roentgenology
   (3) genetic modification
b. diathermy
c. pacemakers
d. behavior modification - brain stimulation, etc.
e. biomonitoring
   (1) electrocardiographs
   (2) electroencephalographs
   (3) temperature
   (4) etc.

I. Industry

OBJECTIVE

The student should be able to:

19. list and describe some of the technology of industry which is related to electricity.

ACTIVITY

Write one report from the list that follows. Your teacher will tell you the format and length. If you choose to do topic c from the list, you should do the experiment first and then write your report.

a. pollution control - dust and smoke effluents
b. metallurgy
c. electroplating - begin by doing lab found in Electrical Experiments You Can Do, from Thomas Edison Foundation, pages 22-27
d. prospecting
e. electromagnets
f. thyratrons
g. mercury pool rectifiers
h. electrotyping
i. arc welding
j. etc. (get teacher approval if you choose any other industrial use of electricity)

J. Safety

OBJECTIVE

The student should be able to:

20. list and describe how technology related to electricity has made life safer in at least one way.

ACTIVITY

From the list of topics below, write one report using the format suggested by your teacher. If you choose either topic c or topic f, do the experiment first and then write the report.

a. lightning rods and grounding of appliances
b. fire alarms
c. burglar alarms - begin by doing lab found in How to Build 5 Useful Electrical Devices, a pamphlet from Thomas Edison Foundation, pages 28-30
d. crime detection - polygraph
e. geiger counter and civil defense
f. lock - begin by doing the experiment found in How to Build 5 Useful Electrical Devices, a pamphlet from Thomas Edison Foundation, pages 6-9

K. Entertainment

OBJECTIVE

The student should be able to:

21. list and describe several technological developments in the entertainment field which are related to electricity.

ACTIVITY

Write one report using the format given you by your teacher after selecting one of the topics from the list below.

a. movies
b. toys
c. tape recorders
d. phonograph systems
   (1) hi-fi
   (2) stereo
   (3) quadraphonics
   (4) etc.
e. electronic music

L. History of Electricity

OBJECTIVE

The student should be able to:

22. describe the development of some discovery or invention by a well-known scientist or inventor in the field of electricity.

ACTIVITY

Write a report on one of the following persons using the format required by your teacher.

a. Franklin, Benjamin
b. Galvani, Luigi
c. Volta, Alessandra
d. Orested, Hans Christian
e. Ampere, Andre
f. Ohm, Georg Simon
g. Faraday, Michael
h. Henry, Joseph
i. Maxwell, James
j. Hertz, Heinrich
k. Thompson, Joseph
l. Fleming, John A.
m. DeFrost, Lee
n. Edison, Thomas
o. Marconi, Guglielmo
p. Westinghouse, George
q. Tesla, Nikola
r. any other, with teacher approval

M. Careers

OBJECTIVE

The student should be able to:

23. list and describe at least one career related to the field of electricity, either in research or technology.

ACTIVITY

Write one report using the format suggested by your teacher. The report must describe some career or vocation in the field of electricity (research or technology). Get your teacher's approval before you begin. Your

first task will be to decide the exact title or job description, then gather information. You can get help from your school's guidance department. Check your school's library for a book titled Directory of Occupational Titles. You might want to interview a person who has a particular job and find out all you can about their work. There should be at least one kind of pamphlet available from your teacher. Tapes are also available from Potomac Edison Company.

N. Miscellaneous

OBJECTIVE

The student should be able to:

24. describe a use of electricity which is difficult to catagorize using the topics of this mini-course.

ACTIVITY

Write one report after choosing one of the topics below. Your teacher will prescribe the format you are to use.

a. microwave cooking
b. electrocution of convicted persons
c. electric eye
d. any other topic which your teacher will approve

O. Review

OBJECTIVE

The student should be able to complete those objectives he/she attempted in this mini-course.

ACTIVITIES

a. Cryptogram - provided by your teacher
b. Crossword puzzle - provided by your teacher

This mini-course is intended to be flexible in its use. Since the applications we make of electricity range from the very simple to the very complex, simple activities have been included which all students should be required to do. Then OPTIONAL activities (see section F through N in the table of contents) have been included. You, the teacher, will provide guidance for your students in selecting from the optional activity list. Since each school is unique in its resources and student population, a particular activity may not be possible at your school. Hopefully, only a minimal number of your students will be disappointed because they cannot find resources for a chosen activity.

Again, each school, class, and teacher is unique. You will need to make very clear to all students what is expected of them when doing optional activities. Here are some guidelines: (1) Make sure the students are capable of completing the activity they choose; (2) Be sure that resources and materials are available; (3) A time limit should be agreed upon by students and teachers; (4) You should check on progress to avoid wasted time and effort by students; (5) The students should understand how they will be graded on optional activities; (6) Avoid gifted students choosing simple, non-challenging activities; (7) If completed activities are to be shared with the class as reports, demonstrations, exhibits, etc., be sure that the presentation is a learning experience - not an "ego builder" for the presenter and a "time killer" for the rest of the class; (8) Decide whether optional activities will be done in school or for home work or a combination of both.

OPTIONAL activities will be listed as possible topics for research. This research may take the form of pure research or simply a review of the available literature. The latter option is suggested for all but the very talented. Certainly you will need to supervise original research since there may be danger involved when inexperienced students work with electricity. A suggestion you may want to consider is to have parental approval (perhaps involvement) when a project has dangerous implications. Make this experience be meaningful as a science activity as well as a meaningful experience in self-expression. You may want to involve the English department with some students and consider their project as a joint activity.

This kit contains copies of five pamphlets from the Thomas Edison Foundation. These pamphlets contain other activities which can be used to supplement the ones included in this mini-course. Pamphlets from other commercial sources are also available in this kit. Hopefully, your school will have additional literature.

YOU MAY WANT TO INTRODUCE THIS MINI-COURSE WITH A FILM. Either or both films listed below are suggested: Exploring Electromagnetic Energy, F807 from the Board of Education (14 minutes), and Eager Minds from The Potomac Edison Company (27 minutes).

A. Environmental Modification in the Home

a. You will need to duplicate Lab No. 1 from Pathways Workbook - Physics 1, pages 3-6.

b. If your school does not have a "home type" thermostat for this activity, you may substitute an automobile thermostat. Explain that the auto thermostat does not control electricity but does operate on the same principle - opening and closing a flow.

B. Light

a. Remind students to avoid looking directly at the burning magnesium. Use the Milliken transparency #1 from the book, Electricity, for review.

C. Motors

If you have commercial motor models (St. Louis), you may use them in this lab. You would then modify the directions as stated in the pamphlet. Transparency and ditto master #18 from Magnetism and Electricity, Milliken book, will help you review the operation of motors. Another transparency #35, A Simple Electric Motor (included in this kit), will also help review motors.

D. Communication

Part c of this section involves circuitry using switches in parallel. You should use a doorbell instead of a light bulb as stated in the reference booklet. There is a transparency titled Doorbell, included in this kit which should help review activities a, b, and c.

If your school has a commercial telegraph set, you may want to have it set-up over a period of time and allow groups of students to visit and use it between other activities.

For students who are especially interested in electronics but do not have the means of obtaining tubes, transistors, etc., you might try to get a "sample supply" for their inspection. Old radios and TVs provide most of the components you will need as samples.

E. Transportation

The class should have ample opportunity to discuss objective 13. It would be important to have "up-to-date" information available for the discussion.

THIS IS THE END OF THE REQUIRED PORTION OF ELECTRICITY: PART III. Most classes will stop at the conclusion of section E, Transportation. However, advanced classes or certain individuals in heterogenously grouped classes may be (should be) encouraged to do some, if not all, the remaining sections. This could be done as extra credit. Since students will be doing this as collateral work, they should be exposed to the task of locating their own references. You will need to provide the literature or allow them to go to your resource center (library). It is suggested that your main objective for these students is to learn science; and that a secondary objective is to use the skills in research as taught by their English department. For students who have references at home, these optional activities can be done at home. If references are made available in your classroom, it should be in quantities commensurate with demand. The same books listed in Part I and Part II of the mini-course contain some information. World Book Encyclopedia (1972 edition) is listed and pages are mentioned.

Since sections F through N are optional, the only comment needed is; the teacher should review each student or team of students in order to determine the level of competency they attained in performing the stated objective(s). NOTE: SEVERAL FILMS ARE AVAILABLE FOR SOME OF THE TOPICS F THROUGH N AND THEY ARE MENTIONED BELOW.

F. Computers - Thinking Machines (20 minutes), Potomac Edison

G. Research

H. Medicine

I. Industry

J. Safety - Just Plug It In (24 minutes), and Electric Power and Common Sense (30 minutes) are available from Potomac Edison

K. Entertainment - Discovering Electronic Music, F958 (23 minutes) is available from the Board of Education

L. History of Electricity - The Story of Electricity (13½ minutes) and Edison, Persistent Genius (16 minutes), both are available from Potomac Edison

M. Careers - Seven 35 mm filmstrips with 3 3/4 ips tapes (reel tapes) are available from Potomac Edison as follows:

Chemical Engineering (23 minutes)
Civil Engineering (26 minutes)
Computer Science (21 minutes)
Electrical Engineering (26 minutes).
Industrial Engineering (25 minutes)
Materials, Science and Engineering (26½ minutes)
Mechanical Engineering (21½ minutes)

N. Miscellaneous

O. Review - You will need to duplicate both the cryptogram and the crossword puzzle. If you have not used any of the optional materials, it probably would be a good idea to omit this type of review since a great percentage of the vocabulary is drawn from the optional part of this mini-course.

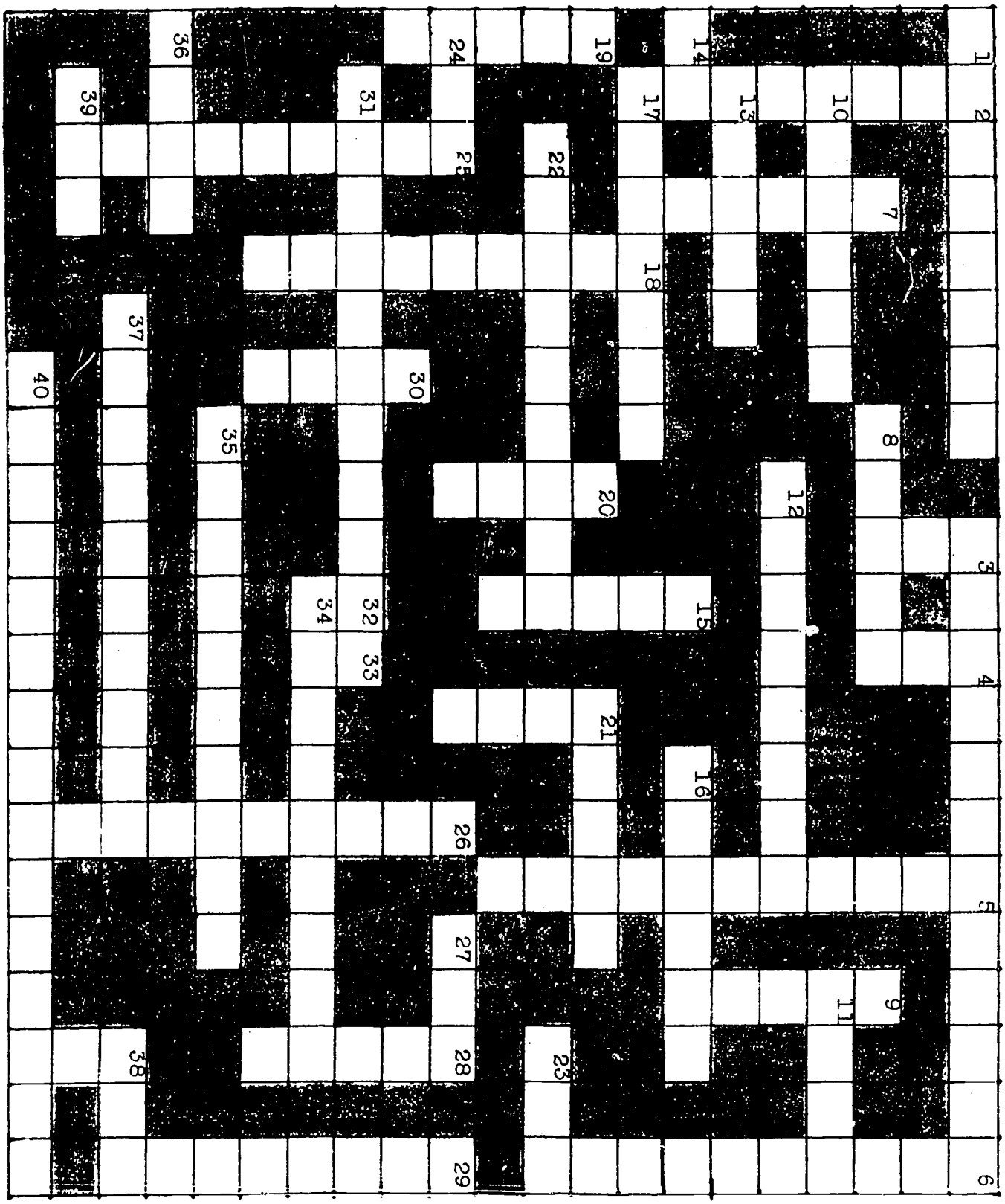
# CRYPTOGRAM

| B | I | N | T | E | G | R | A | T | E | D | C | I | R | C | U | I | T | A | E | H |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | P | O | S | C | T | M | A | N | O | R | D | Y | H | O | T | E | N | G | A | M |
| D | E | N | T | E | R | T | A | I | N | M | E | N | T | M | M | X | R | A | Y | T |
| F | Y | R | R | E | K | A | " | E | C | A | P | T | E | L | E | G | R | A | P | H |
| G | F | A | A | C | N | P | X | S | G | H | C | N | T | C | D | R | C | I | O | E |
| H | L | P | N | P | L | E | N | O | F | J | O | E | O | L | I | A | D | R | L | R |
| K | U | P | S | F | A | L | I | L | H | K | M | M | V | R | C | D | R | C | Y | T |
| K | O | L | P | G | S | E | L | A | I | L | P | N | W | O | I | A | E | O | G | Z |
| T | R | I | O | D | E | C | K | R | S | U | U | O | X | T | N | R | F | N | R | S |
| R | E | A | R | H | R | T | N | C | T | M | T | R | Y | O | E | B | G | D | A | E |
| A | S | N | T | J | M | R | A | E | O | N | E | I | S | M | N | H | N | I | P | P |
| N | C | C | A | K | Y | O | R | L | R | D | R | V | Z | K | P | O | H | T | H | O |
| S | E | E | T | L | T | P | F | L | Y | I | P | N | R | A | I | Z | J | I | R | C |
| I | N | N | I | T | E | L | E | P | H | O | N | E | R | T | O | T | K | O | Q | S |
| S | T | O | O | A | F | A | W | Y | W | D | S | G | A | J | E | Y | B | N | P | O |
| T | M | S | N | T | A | T | V | E | D | E | O | C | B | L | P | X | I | I | Y | R |
| O | M | I | B | S | S | I | R | Z | A | N | I | S | E | H | Q | W | M | N | R | C |
| R | A | D | I | O | R | N | T | R | O | N | Q | V | C | G | R | V | E | G | T | I |
| R | S | E | ? | M | E | G | C | H | U | M | I | D | I | S | T | A | T | N | S | M |
| E | E | S | Y | R | E | H | P | M | C | S | P | R | D | F | S | T | A | M | U | N |
| S | R | T | X | E | R | Q | M | F | I | R | E | A | L | A | R | M | L | L | D | O |
| A | L | V | W | H | A | O | E | O | T | N | E | C | S | E | D | N | A | C | N | I |
| L | I | G | H | T | C | R | N | B | M | E | T | S | Y | S | Y | R | A | N | I | B |

## Word List

light
motor
communication
transportation
computer
research
medicine
industry
safety
entertainment
history
career
bimetal
thermostat
heat
appliance
air conditioning
environment
humidistat
incandescent
fluorescent
Edison
telegraph
telephone
radio
television
phonograph
transistor
diode
triode
integrated circuit
laser
maser
radar
sonar
computer
binary system
ion microscope
solar cell
magnetohydronamics
power
pacemaker
x-ray
electroplating
fire alarm
polygraph
Franklin
Hertz

CROSSWORD PUZZLE



CROSSWORD CLUES

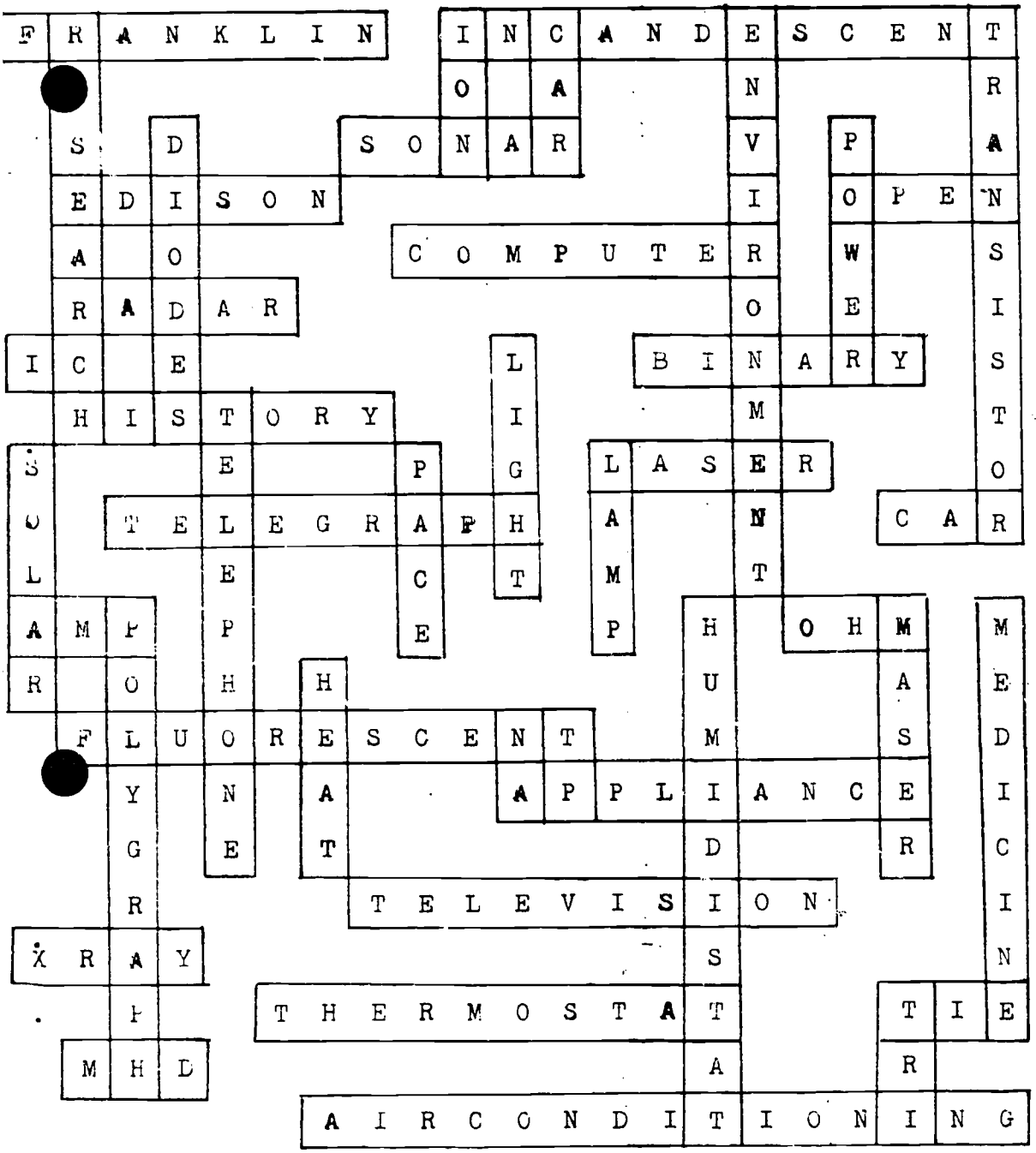
ACROSS

1 scientist who "discovered" a connection between lightning and electricity using a kite
3 type of light bulb with heated filament
8 sound detection and ranging
10 inventor of incandescent light bulb
11 a type of circuit which has no current flowing
12 mechanical or electronic device which can solve proble.s; a calculator
13 a device which can determine speed, distance, and direction using radio waves
14 abbreviation for integrated circuit
16 system of counting of numbers; base of two - used by one type of computer
17 record of the past
21 electronic device which produces monochromatic light
22 electronic device which can send messages over wire in the form of dots and dashes
23 abbreviation for career
24 abbreviation for the term which is the unit of electric current
27 unit of electric resistance
30 form of energy; condition of being hot
31 tubular lamp filled with mercury vapor and coated with material which produces light when electricity is applied
34 electronic device which performs daily tasks
35 TV (one word)
36 very short electromagnetic waves used to detect bone damage and cavities in teeth
37 electronic device which maintains a constant temperature by turning on or off a source of heat
38 to bind together; as attaching two wires
39 abbreviation for magnetohydronamic
40 electrically powered device which can heat or cool air - usually used to cool air in our homes, etc.

DOWN

2 look for; to do experiments
3 _____ microscope; most powerful magnifying instrument
4 electric _____; vehicle which will help solve air pollution problem
5 your surroundings
6 solid state substitute for vacuum tubes
7 vacuum tube with two electrodes
9 rate of doing work or using energy
15 a form of energy used for sight; given off by luminous objects
18 electronic device which can carry sound through wires in the form of electronic waves
19 referring to the sun; _____ battery, a device takes radiant energy and converts it into electricity
20 _____ maker, a device which is used to regulate heart beat
21 electronic device which produces light
25 lie detector
26 electronic device which regulates the amount of water vapor in the air
28 electronic device which produces a very intense beam of radio waves
29 branch of science which deals with the treatment of disease
32 abbreviation for no amperage
33 top without the "o"
38 prefix meaning three or the abbreviation for triode

CROSSWORD PUZZLE SOLUTION



OBJECTIVES

The student should be able to:

1. demonstrate the conversion of electricity to heat.
2. describe the function of a thermostat in controlling electrical flow which in turn controls heat flow.
3. describe one or more uses of electricity which enables us to control our home environments.
4. demonstrate and describe how electricity can be converted into light energy.
5. assemble and describe the operation of a simple electric motor.
6. describe how a specific device (appliance or tool) uses an electric motor to do work in our daily lives.
7. describe the electromagnetic action in a door bell.
8. demonstrate how to connect a door bell in a parallel circuit with two switches and then compare this circuit with the wiring in private homes.
9. assemble a model telegraph (key and sounder) from the provided materials.
10. attach two model telegraphs (key and sounder) in a circuit and send several letters (or a message) using the International Morse Code.
11. list and describe at least one way electricity can be used in communication.
12. describe at least one way electricity is used in transportation.
13. describe the relationship between the energy crisis and the use of electricity in transportation.
14. describe how electricity has made possible the field of computer technology.
15. list and explain some technology that would not be possible without electricity.
16. list and explain some technology concerning the production of electricity as a possible solution to the energy crisis.
17. describe the transmission of electricity as it is related to the concept of entropy - entropy of energy.
18. list and describe some of the medical technology which is possible through the use of electricity.
19. list and describe some of the technology of industry which is related to electricity.
20. list and describe how technology related to electricity has made life safer in at least one way.
21. list and describe several technological developments in the entertainment field which are related to electricity.
22. describe the development of some discovery or invention by a well-known scientist or inventor in the field of electricity.
23. list and describe at least one career related to the field of electricity, either in research or technology.
24. describe a use of electricity which is difficult to catagorize using the topics of this mini-course.

RESOURCES

World Book Encyclopedia, Field Enterprises, 1972 edition (pages are listed)
Electricity (transparency book), Milliken Publishing Company, 1969

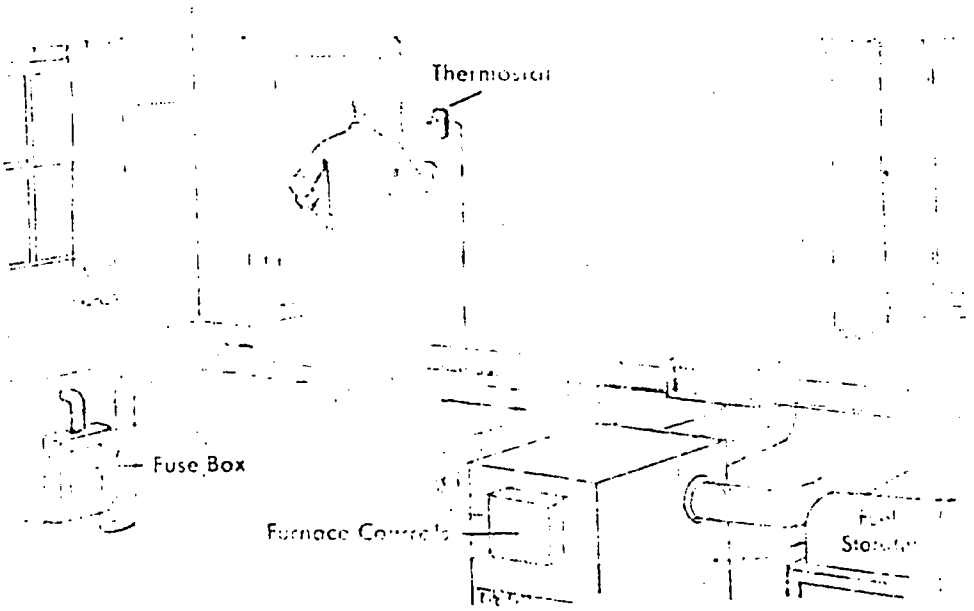
Magnetism and Electricity (transparency book), Milliken Publishing Co., 1969
Pathways in Science - Physics I (text), Globe Book Company, 1968
Pathways in Science - Physics I (workbook), Globe Book Company, 1968
Edison Experiments (booklet), Thomas Edison Foundation, 1969
How to Build 5 Useful Electrical Devices (booklet), Thomas Edison Foundation, 1969
Electrical Experiments You Can Do (booklet), Thomas Edison Foundation, 1969
Electrical and Chemical Experiments (booklet), Thomas Edison Foundation, 1969
Edison Inventions and Related Projects (booklet), Thomas Edison Foundation, 1969
Booklets and pamphlets from Potomac Edison Company
Booklets and pamphlets from C & P Telephone Company of Maryland
Booklets and pamphlets from other companies

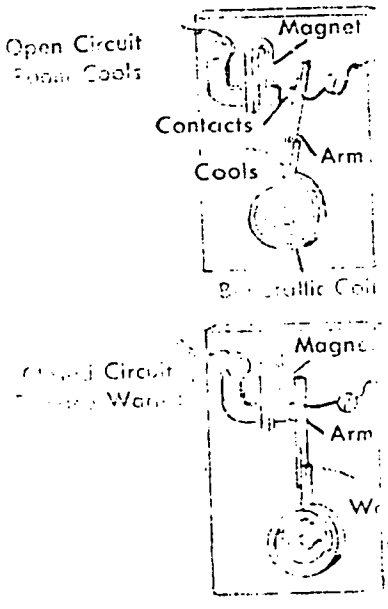
16 mm FILMS

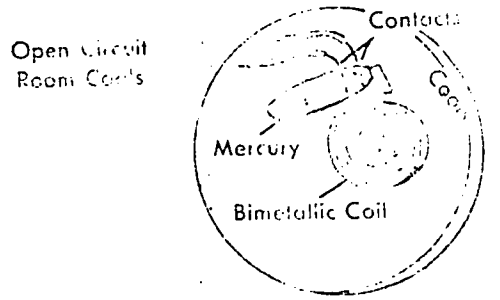
| | | |
|---|---|---|
| F807 | Exploring Electromagnetic Energy - Board of Education | 14 min. |
| F958 | Discovering Electronic Music - Board of Education | 23 min. |
| | Just Plug It In - Potomac Edison | 24 min. |
| | Eager Minds - Potomac Edison | 27 min. |
| | Electric Power and Common Sense - Potomac Edison | 30 min. |
| | Thinking Machines - Potomac Edison | 20 min. |
| | Story of Electricity - Potomac Edison | 13 min. |
| | Edison, Persistent Genius - Potomac Edison | 16 min. |

35 mm SLIDEFILMS (with tapes)

| | |
|---|---|
| Chemical Engineering - Potomac Edison | 23 min. |
| Civil Engineering - Potomac Edison | 26 min. |
| Computer Science - Potomac Edison | 21 min. |
| Electrical Engineering - Potomac Edison | 26 min. |
| Industrial Engineering - Potomac Edison | 25 min. |
| Materials Science and Engineering - Potomac Edison | 26 min. |
| Mechanical Engineering - Potomac Edison | 21 min. |

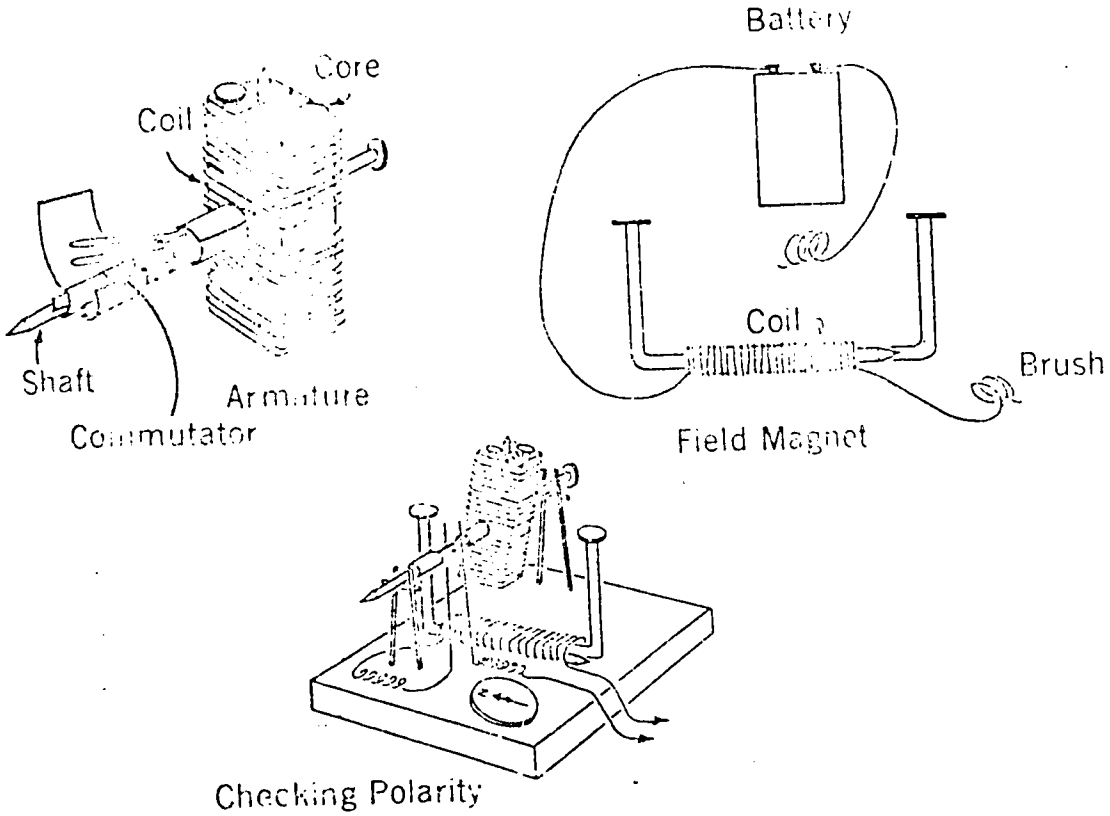








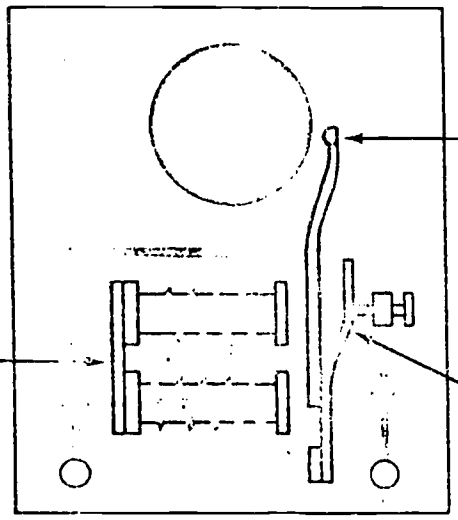

## A SIMPLE ELECTRIC MOTOR

(a) What happens to the field coil when electric current flows through it? Does the polarity of the field coil change as the armature turns?

(b) What happens to the armature when current flows through its coils? How is the direction of current through the armature coils reversed? What happens to the polarity of the armature every half turn?

(c) Why does the armature continue to turn instead of stopping when unlike poles approach each other?

(30) Diagram of electric doorbell




FROM DOOR BUTTON

FROM CURRENT SOURCE

TO CURRENT SOURCE

Evaluation Form for Teachers

Name of mini-course _____

| Evaluation Questions | Yes | No | Comments |
|---|---|---|---|
| 1. Did this unit accomplish its objectives with your students? | | | |
| 2. Did you add any of your own activities? If so, please include with the return of this form. | | | |
| 3. Did you add any films that other teachers would find useful? Please mention source. | | | |
| 4. Were the student instructions clear? | | | |
| 5. Was there enough information in the teacher's section? | | | |
| 6. Do you plan to use this unit again? | | | |

7. Which level of student used this unit? _____

8. How did you use this unit - class, small group, individual? _____

_____

PLEASE RETURN TO SCIENCE SUPERVISOR'S OFFICE AS SOON AS YOU COMPLETE THE COURSE.

# SCIENCE MINI-COURSES

| | Prepared by |
|---|---|
| **PHYSICAL SCIENCE** | |
| ELECTRICITY: Part 1<br>(Types of Generation of Electricity) | Marvin Blickenstaff |
| ELECTRICITY: Part 2<br>(The Control and Measurement of Electricity | Marvin Blickenstaff |
| ELECTRICITY: Part 3<br>(Applications for Electricity) | Marvin Blickenstaff |
| CAN YOU HEAR MY VIBES?<br>(A Mini-course on Sound) | Charles Buffington |
| LENSES AND THEIR USES | Beverly Stonestreet |
| WHAT IS IT?<br>Identification of an Unknown Chemical Substance | Jane Tritt |
| **BIOLOGY** | |
| A VERY COMPLEX MOLECULE:<br>D.N.A. The Substance that Carries Heredity | Paul Cook |
| Controlling the CODE OF LIFE | Paul Cook |
| Paleo Biology – BONES: Clues to Mankind's Past | Janet Owens |
| A Field Study in HUMAN ECOLOGY | Janet Owens |
| Basic Principles of GENETICS | Sharon Sheffield |
| HUMAN GENETICS – Mendel's Laws Applied to You | Sharon Sheffield |
| **SCIENCE SURVEY** | |
| WEATHER Instruments | John Fradiska |
| TOPOGRAPHIC Maps | John Geist and John Fradiska |
| **CHEMISTRY** | |
| WATER | Ross Foltz |
| **PHYSICS** | |
| PHYSICAL OPTICS | Walt Brilhart |