State of Iowa
1964

SCIENCE

FOR IOWA SCHOOLS

Grades K-3

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Iowa Cooperative Curriculum Development Program

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4-6

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FOREWORD

Increased interest and rapid advances, that have recently taken place in science make it necessary to re-evaluate and redesign our curriculum.

Science for Iowa Schools, K-3, is the first part of a K-12 science program developed by committees composed of members, with varied backgrounds, who represent all educational levels.

Use of this material in schools will provide a strong foundation in the lower grades so that science at the junior and senior high school levels may be more concentrated and up-to-date. It will also help to avoid the gaps in continuity and the overlapping of units, which has been prevalent in the past.

PAUL F. JOHNSTON
State Superintendent of Public Instruction

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Introduction

Elementary school science is thought to be of recent origin. A science program as presented here began to emerge in the 1930's but its origin is found in some of the earliest writings for children. This early literature whose main purpose was vocabulary building was written for tutors and parents as reading materials for children being taught at home.[1] In the last quarter of the century interest in science increased because of new technological developments which emphasized science. Late in this period was the first attempt to present an elementary school science curriculum and the philosophy of teaching it began to change. The nature study approach was still the most widely accepted but some educators believed that the purpose of the science program should be to develop an understanding of the universe as well as emphasize scientific techniques as a method of problem solving.

The Thirty-first Yearbook [2] assembled and interpreted materials which appeared from the late 19th century through 1930. This gave direction to much of the work in science education and has influenced the thinking of curriculum workers and those concerned with teacher training. During the period since the 1930's science programs have grown like "Topsy" and there is general agreement among scientists and educators that these programs need to be evaluated and reexamined. Oppenheimer [3] estimates that the available amount of tested scientific information doubles every ten years. Therefore, science programs need regular periodic evaluation and revision if they are to be kept current.

Jacobson and Tannenbaum [4] summarize this need for revision by listing the following reasons:

1. The rapid development of knowledge in many fields of science has made it important to extend the range and modernize the content of elementary science.
2. To develop science experiences consistent with the nature of science—.
3. The growing importance of science and technology in our culture makes the establishment of more sophisticated elementary school science programs mandatory.
4. The development of integrated K-12 science programs makes it important to examine the special contributions to be made in elementary school science is discussed here because of its important relationship to that which is planned for the secondary school.

The new science curriculum for Iowa has been developed by a committee whose background and experience is varied enough so that all educational levels are represented. The actual production of curriculum materials was by experienced classroom teachers together with content specialists.

This curriculum has been planned and developed so it will have continuity, kindergarten through grade 12; emphasize development of concept by experimentation; emphasize breadth and depth rather than the continuous spiral approach; take into consideration that young children can understand more science than adults have believed possible; include health, thus eliminating the need to include this in high school biology; include enrichment provisions at all levels; and provide ample opportunity for pupils to become directly involved in science through carefully planned activities.

The subject matter of this guide has been placed at a lower grade level than has been typically found in classrooms. Much has been written about this lower grade placement and a good general summary is given in *Modern Elementary School Science*.[5] In general, our children "know more science" because they have access to many more sources of scientific information than their predecessors. For this reason science programs need to be redesigned to take advantage of these new sources of information as well as the richer science background of the child.

The approach to be followed in teaching science in the elementary grades should be one of providing problem-solving situations, one of which will involve all of a given class and encourage thinking and reasoning with concepts considered rather than "facts-for-facts-sake." Emphasis is on the application of the concepts taught to develop an understanding of the environment, learning methods of inquiry, and ways to find and verify knowledge. Ideally, this approach will necessitate the multiple text (or reference) approach.

It is no longer necessary to list the reasons for teaching science because science is so much a part of the day-to-day living and the importance of science is obvious. It should be emphasized, however, that science is more than a collection of facts because it is a means of solving problems and an aid to understanding and interpreting the environment. Science might be thought of as a part of the humanities because it deals with the accomplishments of man. If the curriculum set forth here only teaches students to think, much

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[1] Ora E. Underhill, *Origins and Development of Elementary School Science* (Chicago: Scott, Foresman and Company, 1941).

[2] National Society for the Study of Education, *A Program for Teaching Science*, Thirty-First Yearbook - Part I (Bloomington, Illinois: Public School Publishing Company, 1932).

[3] Robert Oppenheimer, *Science and Our Times Bulletin of the Atomic Scientists*, XII, No. 7 (September, 1956), 237.

[4] Willard J. Jacobson and Harold E. Tannenbaum, *Modern Elementary School Science*, Science Manpower Project Monograph (New York 27, New York; Bureau of Publications, Teachers College, Columbia University, 1961).

[5] *Ibid.*, P. 4.

will have been accomplished. Thus, critical thinking should be developed so that by the end of the sixth grade the children should have experiences which would increase their understanding of basic concepts in the areas of the universe, earth, physical and chemical forces, living things, and man's place in a changing environment.

This curriculum is meant to provide resource materials and aids for schools who are developing their own science programs rather than to be used as a prescribed curriculum. All local science programs should not be discarded because of this new curriculum but should be evaluated and revised if necessary. An effort has been made to plan a science program with the following approaches in mind:

1. The science program should be teacher-directed rather than teacher-dominated.
2. Provisions have been made to provide for teaching greater depth at a given topic at one time rather than the "continuous spiral" approach. In the primary grades, the first impression might be of the "continuous spiral" approach but each facet of a given topic at a given grade has been considered at greater depth and detail than is usual.
3. The average child should not be forgotten —therefore the program outlined here is planned for the greatest number of children. There are suggestions for special projects and helps for the gifted child. The teacher can tailor experiments for the slow learner from the materials herein presented.
4. Means of stimulating a greater interest in science without allowing it to dominate the total curriculum should be provided.

Careful consideration has been given to the development of content areas, kindergarten through grade twelve, in greater depth. Although this is a K-12 program, its articulation is based on the assumption that not all content contained here for a given grade or topic can be taught at one time because of insufficient time. This curriculum is not designed to be followed rigidly page-by-page but it is hoped that it be of great help to schools who must plan a science program which will fit the local situation. Therefore, no attempt has been made to prescribe specific time allotments for any of the areas. This is left to the planning of the teachers because of the variation in ability of the children.

When any new program is introduced, there is need to provide aids and helps to orient the teachers to it. Many aids will be provided by The State Department of Public Instruction such as:

Specific help concerning NDEA,

General information and suggestions for specific consultants,

Workshops and institutes for supervisors and teachers, and

Publications available.

There are also many opportunities for individual professional growth with which most teachers are familiar such as institutes sponsored by the National Science Foundation; television programs such as Continental Classroom and College of the Air; extension courses and programs; and many Saturday class programs held at the various Iowa colleges and universities. The Iowa Science Teachers Association in cooperation with the Iowa junior colleges sponsors a special workshop each fall as well as a special annual science teachers meeting. Finally, the professional libraries of each school should not be forgotten because most of them contain helpful books and periodicals. Many schools are encouraging professional growth of their faculties by making provisions for the teachers to attend professional meetings and conferences, as well as to serve on state and national committees whose purposes are related to professional growth and curriculum development.

Suggestions For Evaluation In Science Units

Teachers are aware of the need for evaluation of their efforts in any area because of the necessity to know whether the children have grown and developed as expected in a carefully planned program. Furthermore, the entire science program must be evaluated if the extent to which it has fulfilled its purpose is to be known.

There are many ways to evaluate the growth and development of the students as well as the entire program. The most effective evaluation would be a total of many techniques such as pupil interest, carry over to other grades or subjects as well as to the home, written examinations and standardized tests, field trips, fairs, and performance in competition with students from other programs. All of these will be used in an effort to evaluate this program so it may be revised to be a more effective program and to keep pace with new developments in science.

In any thorough teaching situation evaluation is an ongoing process. If teaching can be defined as "stimulating and directing mental, emotional and physical activity to the end that learning takes place"; then evaluation should be a study of that teaching and its effects upon the learner. A good evaluation reflects the objectives of the experiences concerned and can only partially be covered by means of pencil and paper tests. Much of the more valuable measurement will be in the form of subjective teacher judgment based on day-by-day observations.

There are at least three phases of evaluation which need to be considered:

(1) The teacher's self-analysis

(2) The learner's self-analysis

(3) The teacher's analysis of the learner, his learning, and the learning situation

I. The good teacher looks at himself and his teaching. He asks such questions as the following:

A. What am I doing to help myself grow as a teacher?

1. Do I have a well-balanced concept of myself as an individual?
2. Am I enjoying social and cultural activities which divert my attention from the strenuous demands of teaching?
3. Am I creative in my quest for new methods and procedures?
4. Am I enriching my background of knowledge so as to be better prepared to teach and to enjoy teaching this particular unit?
5. Am I increasing my list of resources which will help make the job easier, more pleasant and more effective?

B. What am I doing to improve the socio-environmental status of my classrooms?

1. Do I set an example for my pupils in neatness and courtesy?
2. How attractive and comfortable is my classroom?
3. Is the atmosphere of my classroom educational — a laboratory where activities are constantly giving birth to learning?
4. Am I providing firm yet kindly discipline which will help each child feel more secure?

C. How adequate and thorough is my approach to the teaching process?

1. Did I inventory the children's understandings before teaching this unit?
2. Do I constantly build new knowledge on the children's past learnings and experiences?
3. Are all of the children participating in activities which will provide for them the greatest growth?
4. In selecting activities, do I consider each child's needs, interests, and abilities?
5. Am I limiting children to academic activities only?
6. Are all activities well enough organized to be meaningful to the pupils involved?
7. Do I include children's suggestions in my long range planning?
8. Have I tried out new methods and procedures?
9. Do I encourage the children to plan and then evaluate their own work?
10. Am I furthering learning through every possible avenue: auditory, visual, manual?
11. Have I located adequate resources and supplementary materials so as to teach effectively?
12. Have I been concerned with the understandings children gain rather than finishing a book?
13. Does the children's work reflect my own planning and carefully made assignments?
14. Do I use tests effectively as an aid in evaluating pupil growth and development?

II. The learinging must also be evaluated, for where there is no learning there has been no teaching. A good teacher asks questions like the following in regard to her children. She will also lead each child to ask these questions about his own progress. As the child grows he should develop the skill of self-appraisal. This tendency can be fostered by means such as:

A. Insist that each child check his own written work before handing it in.

B. Have the class prepare a list of standards or check-questions by which a child can check his performance.

C. Encourage the habit of listening appraisingly to the performance of others.

D. Instill a desire to read and listen to good literature.

III. Help the child realize that each lesson is an opportunity to learn or practice skills which help him work more effectively. Help him gain a consciousness of the fact that there are right ways of speaking, writing, solving problems, and that the right way will help him learn and express himself better.

A. How are his social skills developing?

1. Does he try to get along with others?
2. Does he respect the rights of others?
3. Is he courteous, thoughtful, and helpful toward others?
4. Does he have things to say that are interesting to others?
5. Can he listen politely?
6. Is he giving proper consideration to the opinions of others?

B. How are his communication skills developing?

1. Does he contribute sufficiently so as to arouse a need for communication?
2. Is his vocabulary keeping pace with his desire to express?
3. Is he gaining interesting ideas which he

can share through participation in group enterprises, independent reading and study?

4. Can he structure sentences in correct and varied forms both orally and in written work?
5. Is he expressing himself as he is able?
6. Is he able to organize ideas for oral and written reports?
7. Does he listen attentively?
8. Is there improvement in the quality of his written and oral contributions?

C. How are his work-study habits and attitudes developing?

1. Has he been able to recognize his own errors and weaknesses? Has he sought help in these areas?
2. Does he set up standards for himself and take pride in improving the quality of his work?
3. Does he respect good work and patiently seek answers to the problems with which the class is faced?
4. Is he forming good study habits and skill in using such tools as the dictionary, encyclopedia, index, table of contents, glossary?
5. Does he recognize the importance of the basic skills of reading, communication, computation, and manipulation before certain experiences can be undertaken?
6. Is he learning to use books effectively to serve his practical needs?
7. Does he handle books, tools, materials, and apparatus carefully, safely, and without waste?

D. How well is he mastering the basic body of knowledge?

1. Has he acquired a sufficient body of knowledge to be able to attack the problem of the unit intelligently?
2. Has he acquired the essential basic facts of the content area?
3. Has he mastered an adequate technical vocabulary?
4. Does he understand the scientific principles involved in each activity?
5. Is he learning to see and appreciate cause and effect relationships?
6. Does he show appreciation of those who have historically labored to make present scientific achievements possible?
7. As a result of this study has he developed a hobby or recreational interest?
8. Does he understand and use the scientific method in seeking to solve other problems?
   a. Can he observe phenomena accurately and identify a significant problem?
   b. Can he recognize a logical hypothesis in seeking solutions to problems?
   c. Are his methods of gathering information acceptable?
   d. In testing a hypothesis is he able to think through and evaluate evidence observed?
   e. Can he draw tentative conclusions and still be willing to discard them when shown to be wrong by comparative studies?
9. Is he accepting responsibility and gaining in independence?
10. Does he show increased love of nature?
11. Does he practice acceptable rules of safety, health, and citizenship?

A complete, alphabetized list of references will be found in the bibliography.

Kindergarten

UNIT ONE

The Sky

I. Objectives

A. To increase awareness of the objects observable in the sky

B. To increase awareness of the changes occurring constantly in the sky

C. To begin recognition of the vastness of space

D. To improve in ability to make accurate observations with particular attention to the sky

E. To speculate as to the nature of the objects observable in the sky

II. Initiatory Activities (Motivation)

The awareness of the sky will be associated with weather and other atmospheric conditions. One way to begin this study would be to encourage thinking as to what is in the sky. This encouragement may be in the form of an oral sharing of ideas or asking for pictures of the sky to be painted. These pictures may then be studied for similarities and differences. Pictures may be collected and displayed showing night skies, day skies, cloudy skies, rainbows, and other such conditions. Efforts should be made to direct the observations of the children toward contrasting astronomical objects in the sky and atmospheric objects and conditions. Artificial satellites have directed the attention of all of us to the sky. This attention and interest applies to the kindergarten level and may be used in introducing this study.

III. Developmental Activities

Basic Concept:

The sun gives light.

(Vocabulary: sun, sunlight, light, sunshine)

1. On a partly cloudy day, ask the children to notice the differences in the light that comes into the room at various times. Discuss why these differences occur.
2. Have the children consider where the light comes from that is in the room during the day. Without the use of artificial lighting, compare differences in amount of light in different parts of the room, at different times of the day, on different days. Compare the light in a room having north windows with one having south windows.

Basic Concepts:

Light from the sun can go through some things. Light from the sun cannot go through some things.

(Vocabulary: shadow)

1. Have the children hold various kinds of objects in front of their eyes and look toward the sun. (They should not look directly at the sun.) They should try such kinds of materials as clear glass objects, frosted glass, wood, metal, and plastic. They should reach decisions as to what kinds of materials let the most light through, least through, none through.
2. Compare amount of light that comes through different kinds and colors of window shades. Consider what kinds of window shades are used when films are shown in the classroom.
3. Make shadow pictures using sunlight and various objects.
4. Try making silhouettes with sunlight as the source of light.

5. As an enrichment activity, use a light meter to compare light intensity in different parts of room.

Basic Concept:

The size and shape of a shadow in sunlight changes.

(Vocabulary: morning, noon, afternoon)

1. Keep a record of how the shadow of an object, such as the flagpole in the schoolyard, changes during the day and from day to day. Encourage children to suggest ways for keeping these records and try out the most promising. Such records, of course, will have to be some kind of pictorial record.
2. From the records above, explain how shadows do differ during the day and from day to day.
3. Read the poem, "My Shadow," by R. L. Stevenson. Discuss changes in shadows described in poem.
4. Have children "guess" what time of the day it is in pictures by noticing the shadows.

Basic Concept:

Sunlight can sometimes make a rainbow.

(Vocabulary: rainbow, red, orange, yellow, green, blue, violet)

1. Display pictures of rainbows.
2. Have children share experiences as to when they remember seeing rainbows.
3. Experiment with placing shallow glass dishes of water in the direct rays of the sunlight coming into the room. This will form bands of colored light on walls, ceiling, or floor. Identify colors.
4. A hose or lawn sprinkler on the school ground can be adjusted to give a spray which will make a rainbow in sunlight if one looks toward it in a certain direction.
5. Paint pictures that include rainbows in them.

Basic Concept:

Sunlight gives heat.

(Vocabulary: heat, temperature, thermometer)

1. Hold a magnifying glass (reading glass) in sunlight and focus the bright spot of light it produces on someone's hand. Where does the heat come from? (Teacher: *Caution, do not hold too long.*)
2. Discuss how careless handling of such glasses in sunlight might start a fire.
3. Fill two similar containers with water. Place one in direct sunlight; place the other out of direct sunlight or in a shadow. Compare the "feel" of the water in the two containers.
4. Place a thermometer in direct sunlight. Notice what happens to the liquid in the thermometer. In order for this experience to contribute to the understanding of the concept, children should already recognize that the liquid in a thermometer "goes up" as the temperature increases.
5. Compare the temperatures of various things when placed in sunlight and when placed out of sunlight. (See activity 3.)

Basic Concept:

Sunlight helps plants grow.

(Vocabulary: seed, green, plant, growth)

1. Plant bean seeds, or other quick germinating seeds, in three similar containers. After they have sprouted and started to grow, place one plant where it receives light, another where there is little light, and the third in the dark. Compare the growth of the three plants.
2. Pictures may be drawn to record results of the plant experiment and to show the final result.
3. Take a walk to observe what kinds of plants grow in direct sunlight and what kinds grow where there are always shadows.

Basic Concepts:

The moon looks like the sun in the sky.

The moon is not as bright as the sun.

(Vocabulary: moon, brightness)

1. Have the children express their ideas as to the likenesses and differences of the sun and the moon.
2. Compare the apparent size of objects when they are close to us and when they are far away. Relate this to the comparative appearance and actual sizes of the sun and the moon.

3. For the study of moonlight, repeat some of the experiences that were used in studying sunlight. Share results of these experiences and make contrasts between sunlight and moonlight.

Basic Concept:

The moon changes shape from night to night.

(Vocabulary: crescent moon, quarter moon, full moon, month)

1. Keep a class pictorial calendar record of the shape of the moon as observed from night to night. Each child can also be encouraged to keep such a record.
2. Give names to the various shapes of the moon and use them in describing the regular change in shape.
3. Keep a record to show that the position of the moon varies from night to night.
4. Display pictures with the moon in a variety of shapes.
5. Include the moon in pictures and drawings that are made during art work.

Basic Concepts:

There is about a month between two full moons. Sometimes we can see the moon during the day.

These two concepts may be considered in the keeping and study of the record suggested above.

Basic Concept:

Stars appear to twinkle in the sky.

(Vocabulary: stars, twinkle)

Observe stars at night and discuss how they appear to us.

Basic Concept:

Stars make "pictures" in the sky called constellations.

(Vocabulary: constellations, Big Dipper, Little Dipper)

1. Show pictures of commonly recognized star constellations.
2. Look for the Big Dipper and the Little Dipper in the sky at night.
3. Some may be interested in looking for other constellations and learning their names. Others to consider might include Cassiopeia, Orion, and Draco.
4. Draw and paint pictures with stars in them.

Basic Concept:

Clouds sometimes keep us from seeing sun, moon, and stars.

(Vocabulary: cloud)

1. Perhaps someone in the room has flown in an airplane on a cloudy day. They may be able to share their experience with the rest by telling how they went through the clouds into the sunshine.
2. Observations on partly cloudy days will show clouds between us and the sun.

Basic Concept:

Clouds differ in color and shape.

1. Make observations and paint cloud pictures.
2. Make models of clouds with cotton and paints.
3. Collect and display cloud pictures.
4. Try to see pictures of things in the cloud formations.

Basic Concepts:

Some clouds bring rain; some clouds bring snow.

(Vocabulary: rain, snow, wind, storm clouds, fair-weather clouds)

1. Keep a sky-condition calendar in the room. This would be like a weather calendar, but attention would be directed to differences in clouds.
2. "Guess" from cloud pictures whether it is going to rain or not.
3. Compare pictures of rain clouds and snow clouds.

Basic Concept:

The wind moves clouds.

Take a walk on a day when clouds are moving rapidly through the sky. Pay particular attention to the sky and clouds. Perhaps it can be noticed that some clouds move faster than others. Sometimes different clouds may be moving in different directions.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Revised edition. Pp. 141-186; 199-203; 215-220.
2. Burnett, R. Will. *Teaching Science in*

the Elementary School. Pp. 363-399.

3. Craig, Gerald S. *Science for the Elementary-School Teacher.* New edition. Pp. 189-226.
4. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
5. Hubler, Clark. *Working With Children in Science.* Pp. 201-233.
6. Navarra, John G. and Joseph Zaffaroni. *Science Today for the Elementary-School Teacher.* Pp. 249-294.

Pupil References (To be used for pictures and for teacher to read to pupils)

1. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 2.* Pp. 11-12.
2. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 3.* Pp. 18-25.
3. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 2.* Pp. 62-67.
4. Blough, Glenn O. *After the Sun Goes Down.*
5. Blough, Glenn O. *Wait for the Sunshine.*
6. Bond, Austin D. and others. *Looking at Science.* Pp. 2-23.
7. Craig, Gerald S. and Bernice C. Bryan. *Science Near You.* Pp. 50-55; 77-80.
8. Dowling, Thomas I. and others. *The New I Wonder Why.* Pp. 83-94.
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15. Memling, Carl. *What's in the Dark?*
16. Royland, Phyllis. *It is Night.*
17. Schneider, Herman and Nina. *How Big is Big?*
18. Schneider, Herman and Nina. *You Among the Stars.*
19. Smith, Victor C. and Katherine Clarke. *Science Along the Way.* Pp. 47-66.
20. Tresselt, Alvin R. *Sun Up.*
21. Thorn, Samuel A. and Jeanne Brouillette. *Let's Go.* Pp. 15-18.
22. Thurber, Walter A. *Exploring Science, One.* Pp. 146-157.
23. Zim, Herbert. *Lightning and Thunder.*
24. Zolotow, Charlotte. *Storm Book.*

Films

(Appropriate parts of the following may be used, or they may be used with only part of the group.)

The Big Sun and Our Earth. (Coronet Films), 11 min.

Filmstrips

1. *Night and Day* (Encyclopaedia Britannica Films, Inc.), 47 frames
2. *The Night Sky* (Encyclopaedia Britannica Films, Inc.), 49 frames (Enrichment for a few)
3. *The Sky Above Our Earth* (Society for Visual Education, Inc.), 38 frames

UNIT TWO

Pets

I. Objectives

A. To increase awareness of the variety of living organisms

B. To improve ability to make accurate observations in looking for similarities and differences among living things

C. To begin development of the concept that living things adapt and adjust to the conditions of their natural environment

D. To begin development of the concept of interrelatedness among living things

E. To develop a sense of responsibility built upon the provision of the recognized needs of plants and animals kept at home and at school

II. Initiatory Activities (Motivation)

This particular unit is designed to be broader than just the study of pets. It is to be a study of living things. The approach suggested is to begin with pets as examples of living things and to move from this to characteristics of living things, differences among living things, and consideration of plants as well as animals.

An introduction to this unit could be a pet show. The planning phase could begin with discussions of pets. Children can describe their pets. Some stories and pictures of pets can be used in the classroom. As interest is developed, suggestions as to the possibility of a "pet day" may be made. Plans should be made for what to observe and what to do on the part of all children because it may be that not all will have pets to bring to the show.

III. Developmental Activities

Basic Concept:
A good pet is one that is easy to care for and is interesting for study or play.
(Vocabulary: pet, animal)

1. Plan and hold a pet show at school. It may be just an activity for the one room, or it may be an entire school project with a parade and all the fanfare of a circus. However, it should be preceded by careful preparation with attention being directed to concepts to learn about living things.
2. Have pet owners describe care needed by their pets. Consider what would happen if pet did not receive that care.
3. Be especially alert for examples of unusual pets. Consider whether toads, snakes, insects, and other animals could be pets.
4. Draw pictures and make models of pets.
5. When pets are at school, have children group pets that are alike. Pay particular attention to the different groups and look for differences and similarities among groups.

Basic Concept:
Some animals should not be raised as pets.

1. A wild bird may be available for observation in the community. Compare behavior of a wild bird with that of a canary or parakeet that has been bred to captivity. If a wild bird is not available, recall with group how frightened a wild bird is when it gets into a building and cannot find its way out.
2. Name and locate pictures of wild animals and of animals that would make good pets.

3. Establish bird feeding stations and bird homes on the school ground. (Use this to show how animals may be studied and enjoyed without keeping them in captivity.)
4. Invite conservation officer to school to explain why many wild animals do not make good pets.
5. Make plans for the keeping of a variety of living animals in the classroom. Visit a pet shop, if possible, to observe needs and interesting behavior of various pets. (Aquarium and terrarium life, caged life. Some animals such as rabbits might be allowed to run free in the room.)

Basic Concepts:
Animals are alike in a number of ways. Most of them move about. None of them can make their own food.

(Vocabulary: movement, food, likeness, alike)

1. Provide many pictures of a wide variety of animals. Have children group these. Look for likenesses and differences.
2. On field trips look for movement of animals—creeping, running, flying, hopping, and other means of locomotion.
3. A trip to a farm should be a part of this unit. On this trip observe food eaten by animals. What does a cow eat? A chicken?
4. Look for pictures of animals that eat other animals.

Basic Concepts:
Animals are different in a number of ways. They may differ in the food they eat. They may differ in the places they live.

(Vocabulary: difference, terrarium)

1. Likenesses and differences should be considered together.
   Activities suggested above will also apply to this concept.
2. Picture groupings of pets and animals can be based upon differences. Have children point out differences.
3. Compare food requirements of various pets.
4. Play games with animal pictures in which children tell where the animal lives.
5. Play games with animal pictures in which children tell what the animal eats.
6. Suggest reasons certain animals can live in some places while others cannot, i.e., fish in water; snakes under rocks.
7. Different kinds of terraria may be set up; i.e., desert terrarium; woodland terrarium. Study differences in animals that can live in these terraria. (See references for directions.)

Basic Concept:
All animals need food and water.

1. Care for the living animals in the classroom.
2. Recall and discuss trip to pet shop.
3. On visit to farm, have farmer tell what his animals need to live.

Basic Concept:
Every animal has its own kind of home.

1. Point out homes of animals on a neighborhood walk, i.e., ant nest; bird nest; doghouse; spiderweb. A trip to a wood lot or a grassy lot will provide opportunities to see many other homes.
2. Pictures of animal homes may be matched with pictures of animals.

Basic Concept:
Some kinds of animals are easier to train than others.

(Vocabulary: train, trick)

1. Have children discuss and demonstrate tricks of pets.
2. Consider differences among pets as to tricks they can do.
3. Consider possible training of the different animals.

Basic Concepts:
Some animals are born alive; some are hatched from eggs.

(Vocabulary: born, hatch, egg)

1. It would be well to have a pregnant mammal in the classroom sometime during the year. (A white rat, guinea pig, hamster, or a white mouse would be satisfactory.) Pet shops may be able to supply animals that will have

young about the time desired. Build discussions around care of the mother, expectancy of the young, care of the young when they arrive.
2. Guppies in the aquarium may be used as sources of observation and discussion. (The eggs of goldfish are difficult to observe.)
3. Bring into class frog or toad eggs with water in which they are collected. Aerate with air pump if possible. Watch development. Egg yolk and lettuce are good foods. Use natural pond or river water if possible. (Check references for information.)
4. A setting hen may be kept in classroom as a source for observation and discussion.

Basic Concept:
Plants, like pets, are interesting to study and care for and they provide enjoyment.
1. Discuss value of plants found on a field trip in relationship to plants in the classroom.

Basic Concept:
Plants are living things.
(Vocabulary: living, nonliving)
1. Compare care given the plants in the classroom and garden with that given pets.
2. Discuss what makes a plant a living thing. (Consider growth, requirements for life, reproduction.)
3. Discuss how plants differ from animals.
4. Take a walk to see living plants, dead plants, and nonliving materials. (Consider what differences there are between living things and nonliving things.)

Basic Concept:
Plants need certain conditions in order to grow.
(Vocabulary: seed, grow)
1. Plant seeds in containers in a number of different conditions (no water, no light, too much water). Record observations. Note effects of different conditions upon germination.
2. Place growing plants in a variety of different conditions as was done with germinating seeds above. Note effects of different conditions upon growth. Make records.
3. Care for the plants in the classroom.
4. A greenhouse operator may be invited to describe the kind of care greenhouse plants need; or take a trip to a greenhouse to observe kind of care given plants.

Basic Concept:
Plants give us food and beauty.
(Vocabulary: food, flower)
1. Display pictures of flowers. Look for variety of color and shape.
2. Have children describe foods they had for lunch or breakfast. List food they had that came from plants.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Revised edition. Pp. 231-307.
2. Burnett, R. Will. *Teaching Science in the Elementary School.* Pp. 438-496.
3. Chrystie, Frances N. *Pets.*
4. Craig, Gerald S. *Science for the Elementary-School Teacher.* New edition Pp. 461-655.
5. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
6. Hubler, Clark. *Working With Children in Science.* Pp. 276-318.
7. Navarra, John G. and Joseph Zaffroni. *Science Today for the Elementary-School Teacher.* Pp. 396-436.

Pupil References

(To be used for pictures and for teacher to read to pupils.)

1. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 1.* Pp. 1-7.
2. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 2.* Pp. 1-6.
3. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 3.* Pp. 1-17.
4. Barnard, J. Darrell and others. *A Uni-*

fied Program in Science, Health, and Safety, Book 1. Pp. 40-45; 104-107.
5. Bates, Barbara. *The Real Book About Pets.*
6. Beauchamp, Wilbur L. *Science Is Fun.* Pp. 53-107.
7. Beauchamp, Wilbur L. and others. *Science Is Learning.* Pp. 81-123.
8. Beauchamp, Wilbur L. and others. *Science. is Wondering-* (Charts)
9. Blough, Glenn O. *The Pet Show.*
10. Bond, Austin D. and others. *Getting Ready.* Pp. 12-49.
11. Bond, Austin D. and others. *Looking at Science.* Pp. 60-91.
12. Craig, Gerald S. and others. *Science Around You.* Primer K-2nd. Pp. 16-29; 38-43.
13. Craig, Gerald S. and others. *Science Near You.* Pp. 10-23; 70-94.
14. D'Aulaire, Ingri and Edgar. *Animals Everywhere.*
15. Dickinson, Alice. *The First Book of Plants.*
16. Dowling, Thomas I. and others. *The New I Wonder Why.* Pp. 21-60.
17. Frasier, George W. and others. *Singer Science for You.* Pp. 40-46; 90-109; 134-157.
18. Greenberg, Sylvia S. and Edith L. Raskin. *Home-Made Zoo.*
19. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 1.* Pp. 1-30.
20. Knox, Warren and others. *The Wonderworld of Science, Book 1.* Revised. Pp. 3-24; 77-116.
21. Krauss, Ruth. *The Carrot Seed.*
22. Podendorf, Illa. *The True Book of Animal Babies.*
23. Podendorf, Illa. *The True Book of Pets.*
24. Schneider, Herman and Nina. *Science for Work and Play.* Pp. 102-132; 136-137.
25. Selsam, Millicent E. *Play With Plants.*
26. Smith, Victor C. and Katherine Clarke. *Science Along the Way.* Pp. 7-45; 103-125.
27. Thorn, Samuel A. and Irene Harbeck. *Let's Find Out.* Pp. 23-28; 33-36; 43-90; 97-106.
28. Thorn, Samuel A. and Jeanne Brouillette. *Let's Go.* Pp. 7-14; 27-43.
29. Thorn, Samuel A. and Jeanne Brouillette. *Let's Try.* Pp. 6-33; 56-59.
30. Thurber, Walter A. *Exploring Science, One.* Pp. 4-15; 30-39; 110-119.
31. Weil, Ann. *Animal Families.*
32. Williams, Garth. *Baby Animals.*
33. Woolley, Catherine. *Schoolroom Zoo.*
34. Zim, Herbert. *Goldfish.*

Films

1. *Animal Homes* (Churchill-Wexler Film Productions), 11 min.
2. *Aquarium Wonderland* (Pat Dowling Pictures), 10 min.
3. *Care of Pets* (Encyclopaedia Britannica Films, Inc.), 11 min.
4. *From Seeds to Plants* (Gateway Productions, Inc.), 10 min.
5. *Little Garden* (Instructional Films, Inc.), 11 min.
6. *Our Animal Neighbors* (Coronet Films), 11 min.
7. *Wonder of Plant Growth* (Churchill-Wexler Film Productions), 11 min.

Filmstrips

1. *Our Aquarium* (Eye Gate House, Inc.), 23 frames
2. *Plants Grow* (The Jam Handy Organization)

UNIT
THREE

Toys and Machines

I. Objectives

A. To increase awareness of the variety of useful machines about us

B. To begin recognition of the law of conservation of energy—machines require energy to work

C. To develop an appreciation of man's ingenuity in the development of machines

D. To develop a beginning vocabulary for use in describing the operation of our toys and machines

E. To encourage imaginative ideas for new types of toys and machines

II. Initiatory Activities (Motivation)

Children of today live so closely with machines that it may be necessary to call special attention to the variety of mechanical devices we have available with which to work and play. An approach might be to start a display of toys and machines on the science table. The teacher may suggest to the children that they try to discover how the toy or machine works. This suggestion may limit the things one leaves on display since valuable toys and machines may not work after they are examined by many children. Attention may be directed to advantages of using machines and to the types of energy used to make machines work.

III. Developmental Activities

Basic Concept:

Toys and machines are made to "go" by such things as electric motors, gas engines, springs, and animals, including man.

(Vocabulary: machine, motor, engine, spring, electricity)

1. Make a collection of toys. Group them according to what makes them go.
2. Collect and display pictures of machines doing work. Group them according to what makes them go.
3. Take an excursion through the school building looking for machines that require electricity to operate.
4. Have children continue their search at home for machines that use electricity. Have them try to identify what makes the machines they use at home go when electricity is not needed.
5. Challenge children to find a toy or machine that works "all by itself." If any are suggested, other children and the teacher should point out what is needed to keep the machines working.

Basic Concept:

Wheels make things move easier.

(Vocabulary: wheel, wagon, axle, wheelbarrow)

1. Take a walk in the neighborhood looking for all the wheels that can be found on toys and machines.
2. Develop a situation in which a heavy box of blocks is to be moved. Consider with children how the box can be moved. Point out that many, if not all, of the suggestions offered involve wheels. Try out some of the suggestions. Bring wagons, carts, and a wheelbarrow to school, if possible.
3. Compare the number of children required to slide a heavy load with the number required to pull it in a wagon.
4. Provide opportunity for making toys or models of machines with wheels.
5. Organize bulletin board displays about machines with wheels showing different ideas about wheels.

6. Compare sizes of wheels on different toys and machines. Try to decide why different sizes of wheels are used on different devices.
7. Have children tell others the ways in which they used wheels the day before.

Basic Concept:
Machines make work easier.

1. Give a child a piece of cloth and tell him to divide it into two pieces. Criticize the job done. Ask him to suggest how it could be done easier. (Emphasize that scissors are machines.)
2. Present other problem situations, such as driving a nail, pulling a nail, sharpening pencils, cutting metal, and consider machines that make the job easier. For example, have children try to drive a nail without a hammer. Compare with use of hammer.
3. Name and draw pictures of machines.
4. Identify machines used in classroom.
5. Visit a shop and have uses of tools demonstrated. Both hand and machine tools should be considered.
6. Play a game in which one child pantomimes work being done with the help of a machine while the rest of the class tries to guess what work the child is doing, what machine he is using to help him, and how the machine helps him.

Basic Concept:
Machines move things faster than we could without them.
(Vocabulary: speed, slow, fast)

1. Compare time required to walk stairs with time required to ride elevator.
2. Run races with one child on a scooter and one child running on foot. Use other toys for races.
3. Have children describe machine races (auto, speedboat, sailboat, etc.) they have observed.

Basic Concept:
Machines move heavier things than we could move without them.
(Vocabulary: lift, light, load, large, plank, small, heavy)

1. Compare the effort needed to lift a box of blocks to the top of a low table with that required to slide it up a plank.
2. Suggest names of machines that have been observed lifting things.
3. Collect pictures and display them to show importance of lifting things in work.

Basic Concept:
Some of the kinds of devices used to lift heavy loads are pulleys, levers, and inclined planes.
(Vocabulary: pulley, lever, inclined plane)

1. If possible, visit a site where a building is being constructed. Watch for and point out all examples of things being lifted and lowered from one level to another. Identify names of simple machines involved; pulleys, inclined planes, and levers.
2. Have an older child from another classroom demonstrate pulleys and levers with toy construction sets.
3. Use levers, pulleys, and inclined planes to lift things in the classroom.
4. Observe the raising and lowering of the flag at the flagpole on the school ground. Consider advantages of using the pulley. Perhaps arrangements can be made to use the pulley system of the flagpole to lift small weights and have children compare ease of lifting by hand.
5. Slides and teeter-totters may be used to give individual experiences in lifting things.

Basic Concept:
Machines that move on land are different from those that move through water or through air.
(Vocabulary: streamlining)

1. Models of automobiles, ships, and airplanes may be displayed with children telling how they are alike and how they are different.
2. Prepare silhouettes of automobiles, wagons, ships, sailboats, airplanes, etc. Have children guess what the silhouette represents and suggest why they guessed as they did.

3. Make a paper airplane. Sail it across room. Try to sail a flat piece of paper across room.

Basic Concept:
We should be careful in our use of machines.

1. Have children tell of personal accidents they have had with machine or of accidents of others. Suggest how these accidents might have been avoided.
2. If excursions are taken to a shop and to a construction project, point out the many ways in which the workers are protected.

IV. Instructional Materials

Teacher References

1. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 1.* Pp. 13-16.
2. Baker, Arthur O.; Grace C. Maddux; and Helen B. Warren. *Down Your Street, 2.* Pp. 13-18.
3. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 1.* Pp. 24-25; 32; 83.
4. Barr, Jene. *Big Wheels! Little Wheels!*
5. Beauchamp, Wilbur L. and others. *Science Is Fun.* Pp. 35-52.
6. Beauchamp, Wilbur L. and others. *Science Is Learning.* Pp. 47-66.
7. Beauchamp, Wilbur L. and others. *Science Is Wondering* (Charts).
8. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 444-465.
9. Bond, Austin D. and others. *Getting Ready.* Pp. 50-57.
10. Bond, Austin D. and others. *Looking at Science.* Pp. 32-41.
11. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 681-715.
12. Craig, Gerald S. and others. *Science and You.* Pp. 44-49.
13. Craig, Gerald S. and others. *Science Near You.* Pp. 32-37.
14. Dowling, Thomas I. and others. *The New I Wonder Why.* Pp. 111-123.
15. Elting, Mary. *Machines at Work.*
16. Frasier, George W. and others. *Singer Science for You.* Pp. 55-63.
17. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
18. Israel, Marion. *Tractor on the Farm.*
19. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 1.* Pp. 125-151.
20. Lewellen, John. *The True Book of Toys at Work.*
21. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teacher.* Pp. 332-340.
22. Schlein, Mariam. *How Do You Travel?*
23. Schneider, Herman and Nina. *Science for Work and Play.* Pp. 138-145.
24. Thorn, Samuel A. and Irene Harbeck. *Let's Find Out.* Pp. 91-96.
25. Thorn, Samuel A. and Jeanne Brouillette. *Let's Try.* Pp. 41-45; 51-55.

UNIT FOUR

Seasonal Changes

I. Objectives

A. To increase awareness of the changes in the environment that accompany seasonal changes

B. To improve the ability to make accurate observations with particular reference to seasonal changes

C. To develop the concept that man and other organisms adapt and adjust to the conditions of their environment

D. To develop the idea that man can modify the conditions of his environment more than most organisms

E. To develop the idea of cycles in nature.

F. To use the experiences of others as a source of interest and knowledge

II. Initiatory Activities (Motivation)

This unit must be taught throughout the school year. Frequent reference to changes accompanying progression of the seasons should be made by the teacher and will be made by the children. Early in the year the attention of the children should be directed to comparisons of fall and activities with those they can remember of the summer. Many pictures can be made available to be displayed as illustrations of the differences between seasons. The children may be encouraged to share with the group how the change in seasons affects their daily experiences.

III. Developmental Activities

Basic Concept:

There are four seasons in Iowa.

(Vocabulary: seasons, autumn, summer, winter, fall, spring)

1. Name the seasons. Try to associate common events in the lives of children with the various seasons. Encourage the use of the names in proper sequence.
2. Select four children to represent the four seasons. Have each child pick a picture showing the season he represents from several pictures available. Decide whether correct pictures were picked. Have the four children stand in the order in which the seasons occur. Discuss with the group whether the order is correct. This may be repeated several times with other groups of four.
3. Have individual children identify the season in which their birthdays occur. Have them tell why they think it was the particular season they named. Similar identifications for holidays such as Halloween, Thanksgiving Day, Easter, and Christmas can be made.
4. Some children may be able to begin to associate a calendar and months with the seasons.

Basic Concept:

Seasons differ in temperature.

(Vocabulary: temperature, heat, thermometer, cold)

1. Discuss the meaning of temperature.
2. Show how a thermometer may be used to measure temperature. (Change in position of the liquid in a liquid-in-glass thermometer is the important thing to show.)
   Compare height of liquid in a thermometer when it is in ice water and when it is at room temperature.
3. Mount a thermometer outside a window at a level children can observe. Use a piece of library mending tape to

mark the daytime temperatures in the fall. It will vary from day to day, of course, but select a reading that is frequently observed in the fall. Using a different colored tape, mark a frequently observed winter temperature. Compare fall and winter temperatures. Do the same in the spring with a different colored piece of tape.

4. Encourage children to tell of experiences in which a particular temperature was of special significance. Relate experiences to particular seasons.

Basic Concept:
Seasons differ in weather.
(Vocabulary: weather, rain, snow)

1. Lead the children in a discussion as to what constitutes weather.
2. Develop a monthly calendar or chart for recording weather conditions from day to day. Use pictures or cartoons to represent different weather conditions. Compare the calendars from month to month. As the year progresses, make such comparisons as between September and January. Encourage children to be as specific as possible in expressing similarities and differences.
3. Read weather reports and have children guess the season.

Basic Concept:
Plants grow in some seasons; not in others.
(Vocabulary: plant, grow, bud)

1. Take a walk early in the fall around the schoolyard. Point out specific plants for the children to notice. Include a tree, a shrub, grass, "weeds." Emphasize with the children that these same plants will be observed several times during the year.
2. Take a walk during the winter to look at the same plants previously observed. Make a picture record of the children's descriptions of differences in the plants. Do the same in the spring.
3. Make a pictorial record of the rate of growth of a plant in the spring.
4. Bring forsythia or lilac branches into the classroom in early spring. Place them in water and observe changes in bud and flower. Use a magnifying glass for examination.

Basic Concept:
Some trees lose their leaves in autumn.
(Vocabulary: leaves, evergreen, buds)

1. Predict early in the fall which trees in the schoolyard and in neighboring yards are going to lose their leaves and which are not. Make a record. Check record weekly.
2. Collect colored leaves. Make collections with different schemes for classification such as color, shape, and size.
3. Look at buds of trees with a magnifying glass in winter and in spring.
4. Make picture records of trees losing their leaves in autumn and getting new ones in spring.
5. Guess which trees will lose all their leaves first and which will get all their leaves first in spring. Make a record to check whether guesses were correct.

Basic Concept:
Some plants bloom only in certain seasons.
(Vocabulary: bloom, flower)

1. Take a walk in the fall to observe and make pictorial records of the plants with flowers.
2. Take walks in the spring to observe and make pictorial records of the plants with flowers. Compare with fall records.
3. Make picture lists of spring flowers, fall flowers, and summer flowers.
4. Consider whether there are flowers that bloom outdoors throughout the growing season.

Basic Concepts:
Animals adjust to changes in temperature. Some animals hibernate during winter.
(Vocabulary: hibernate)

1. Collect and display pictures of animals that hibernate or animals in the state of hibernation.
2. It may be possible to secure a bat to show how it adjusts to temperature changes. Place the bat in a fruit jar with a screen wire cover or perforated

lid. Place jar in a refrigerator away from freezing compartment. Bring container into classroom and have children observe behavior of bat as his temperature increases. A toad or a garter snake may be used as a substitute animal. (Children should be warned that some animals could not live in such an experiment.)

Basic Concept:
Some animals change color from one season to another.
(Vocabulary: color, protection)

1. Collect and display pictures of animals in summer and in winter coats. (Such animals include some weasels and the snowshoe rabbit.)
2. Have children suggest advantages of animals changing color.

Basic Concept:
Work and play differ from one season to another.

1. Describe favorite play activities. Consider in what season we engage in these activities.
2. Bring in pictures of people at work and play. Classify in groups according to season.
3. Discuss why certain activities are carried on in particular seasons.

Basic Concept:
We wear different kinds of clothes in one seasons from what we do in others.

1. Dress dolls in different kinds and colors of clothing for different seasons. Consider why certain clothes are used.
2. Encourage children to describe their wardrobe for fall, for winter, and for spring.
3. Take photographs of the children in their fall clothes, winter clothes, spring clothes, and display in classroom. Compare.

Basic Concept:
Animals and plants adjust to different conditions of the different seasons.

This is a basic understanding that runs through all of the activities of this unit. Only a beginning awareness can be made at this age level.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Revised edition. Pp. 269-286.
2. Craig, Gerald S. *Science for the Elementary-School Teacher.* New edition. Pp. 514-519; 595-632.
3. Hone, Joseph and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*

Pupil References

(To be used for pictures and for teacher to read to pupils.)

Books

1. Adelson, Leone. *All Ready for Winter.*
2. Beauchamp, Wilbur L. and others. *Science Is Learning, Book 2.* Pp. 3-24.
3. Beauchamp, Wilbur L. and others. *Science Is Wondering.* (Charts).
5. Bond, Austin D. and others. *Getting Ready.* Pp. 4-11; 58-93.
5. Bond, Austin D. and others. *Looking at Science.* Pp. 60-66.
6. Craig, Gerald S. and others. *Science and You, Primer.* Pp. 50-57.
7. Darby, Gene. *What Is a Season?*
8. Frasier, George W. and others. *Singer Science for You.* Pp. 80-83.
9. Knox, Warren and others. *The Wonderworld of Science, Book One.* Revised. Pp. 75-96.
10. Lenski, Lois. *I Like Winter.*
11. Parker, Bertha M. *Fall Is Here.*
12. Parker, Bertha M. *Spring Is Here.*
13. Parker, Bertha M. *Summer Is Here.*
14. Podendorf, Illa. *True Book of Seasons.*
15. Schlein, Miriam. *Go With the Sun.*
16. Schneider, Herman and Nina. *Science for Work and Play, Book 1.* Pp. 30-31; 68-75

17. Smith, Victor C. and Katherine Clarke *Science Along the Way*. Pp. 103-125.
18. Thorn, Samuel A. and Irene Harbeck. *Let's Find Out*. Pp. 13-18; 23-28; 107-117.
19. Thurber, Walter A. *Exploring Science, One* Pp. 40-53; 132-145.

Films

(Appropriate parts of the following may be used, or they may be used with only part of the group.)

1. *Autumn on the Farm* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Children in Autumn* (Encyclopaedia Britannica Films, Inc.), 11 min.
3. *Children in Spring* (Encyclopaedia Britannica Films, Inc.), 11 min.
4. *Children in Summer* (Encyclopaedia Britannica Films, Inc.), 11 min.
5. *Children in Winter* (Encyclopaedia Britannica Films, Inc.), 11 min.

Filmstrips

1. *People Get Ready for Winter* (The Jam Handy Organization), 22 frames
2. *Plants Get Ready for Winter* (The Jam Handy Organization), 21 frames

Grade One

A complete, alphabetized list of references will be found in the bibliography. The appendix contains demonstrations and experiments for grade one.

UNIT ONE

The Universe: Sun, Moon, Stars

I. Objectives

A. To increase awareness and interest in the sun, the moon, and the stars

B. To appreciate that the sun is our greatest source of light

C. To begin the appreciation that colors are a direct result of light

D. To begin an understanding of the cause of night and day

E. To appreciate that the sun is very important to us

F. To begin an understanding of the influence of sun on seasons

G. To create an awareness of the movement of the moon

H. To develop an appreciation of comparative size

II. Initiatory Activities (Motivation)

Several appropriate books such as *Let's Read About Stars, The Sun and It's Family,* and *Beyond the Solar System* may be placed on a table or in a reading corner. A copy of a science book open to the proper pages should be included in the reading corner. In addition, articles from current magazines and encyclopedias as well as free materials that can be obtained from various firms should be included. A bulletin board on the universe would also be helpful.

Prior to starting the unit, ask the children to go out the night before and observe the sky. These observations can then be written down during class.

Appropriate films such as *"Looking at the Stars"* and *"The Stars In the Sky"* would also be a good motivating device.

III. Developmental Activities

Basic Concepts:

The sun is in different parts of the sky during the day. The sun appears to rise in the east and set in the west.

(Vocabulary: east, morning, noon, west, evening, sun, midday)

1. Observe the times of the day that the sun shines or does not shine in certain schoolroom windows. Explain observations.
2. Over a period of several days note the position of the sun at specific times. Make these observations of the sun through colored glass, smoked glass, or overexposed film. (Discuss the need for protecting the eyes from the glare of the sun. Do not look directly at the sun.)

Basic Concepts:

Shadows are long and short. Shadows are long when the sun is low in the sky. Shadows are short when the sun is high in the sky.

(Vocabulary: sunlight, length, shadows, long, shade, short)

1. Explain that we see the morning sun in the eastern sky and the afternoon sun in the western sky. Call attention to the midday or noon sun, high in the sky.
2. Produce shadows by blocking out the light.

a. With sunlight or an electric light, experiment with different materials that make shadows—books, tables, plants, people. Test other materials such as water, glass, or paper. (Establish that if the light passes through, there is not a shadow.)

b. Make shadow pictures.
c. Play shadow tag. (If your shadow is stepped on, you are "it.")
d. Skip, hop, run. Try to get away from your shadow.
e. Try to make a shadow in a shady place.

3. Select an object on the schoolyard. Note the length of the shadow at various times during the day. Explain.
4. Take the children outside in the morning. Stand one child in a given spot on a long piece of wrapping paper. Draw around the shadow. Repeat this procedure at noon and in the afternoon. Note length and location of the shadow. Record when it was longest and shortest. Observe and relate location of sun in the sky with each reading.
5. Stand a doll or another object on a flat surface. Hold a flashlight near it to show the shadow. Hold the light low and observe the long shadow. Raise the light above the object and observe the short shadow. Note also the position of the shadow in relation to the light. Compare this activity to the sun and its position in the sky.
6. Stories to read:
   a. Austin, Margot. *William's Shadow*. New York: William Morrow Company, 1954.
   b. Payne, Emmy. *Johnny's Groundhog's Shadow*. Boston: Houghton Mifflin Company, 1948.

Basic Concept:
Our greatest source of light is from the sun.

(Vocabulary: light, bright)

1. Discuss things that make light such as electric bulbs, candles, fire, lightning, sun, stars, flashlights. Make a list.
2. Take the children outdoors on a sunny day and shine a flashlight. Compare its light to that of the sun.
3. Raise the window shades on a bright, sunny day. Notice how bright the room is. Turn on the electric lights. Are electric lights as bright as the light from the sun?
4. Pull down all the shades in the classroom. Observe the difference in the light in the room with lights on and off.

Basic Concept:
Sunlight is made up of different colors.

(Vocabulary: sunlight, colors, rainbows, prism, separate)

1. Observe sunlight—discuss its color. (Observe that it looks white.)
2. Direct sunlight through a prism. (Explain that the sunlight has colors in it and the prism separates those colors so we can see them.)
3. The colors in sunlight can also be shown without a prism. Place a deep pan full of water in the sunlight. Hold a pocket mirror in a slanting position in the water. Let strong sunlight pass through the water and fall on the mirror. A series of colors will be reflected on the wall. Adjust mirror until you get the best results.
4. Discuss rainbows the children have seen. When did they see the rainbows, before or after the rain? Note other rainbows, oil on water, the corner of the aquarium, or a water spray. It should be noted that we see rainbows because colors in the light are being separated into water droplets which act as prisms.
5. Reproduce the colors made by the sunlight through a prism.
6. Mix colors with paint or crayons to make new colors.

Basic Concepts:
You cannot see the sun at night. It is daytime when our part of the earth faces the sun.

(Vocabulary: globe, light, earth, daytime, dark, nighttime)

1. Have the class imagine it is taking a very fast airplane trip traveling west at night. What would the class expect to see? (The sun shining on the other side of the earth.)
2. On a globe, place a pin or a small piece of clay representing a child standing in Iowa. Using a flashlight for the sun, shine it on the side of the globe

away from the figure. Note that the "child" cannot see the sun. (It is night.) Rotate the globe until the "child" is in the light. (Now the "child" can see the sun. It is day.)

3. Let the children dramatize the action of the sun and the earth. One group can be the sun. Another group formed in a circle (faces to the outside) can represent the world and children in other parts of the world. As the "world" turns, some will be in the daylight for they can see the sun; others will be in darkness and experiencing night.

Basic Concept:
The sun warms the earth.

(Vocabulary: heat, temperature, warm, thermometer, lower, higher)

1. Discuss things that give us heat, such as fire, candles, furnaces, radiators, and sun.
2. Tell of experiences with the sun's heat such as wilted flowers, sunburn, and baked soil.
3. Feel the ground in a sunny place, then feel the ground in the shade. Compare how they feel.
4. Place a metal object in the sun, another in the shade. Compare differences in temperatures.
5. Observe and record differences in the temperatures on a cloudy day and a sunny day. Explain results.
6. Place one thermometer in the sun, another in the shade. Compare the readings after a few minutes.
7. Place one dish of water in the sun, another in the shade. Measure temperature differences with a thermometer.
8. Build a snowman. Watch it melt.

Basic Concepts:
Living things depend on the sun. People and other animals depend on the light from the sun. People and other animals depend on the heat from the sun. Plants need the warmth of the sun to grow. Plants need the light from the sun to grow.

(Vocabulary: heat, measure, light, ruler, grow, inches)

1. Imagine what our world would be like without the sun. Let the children express their ideas.
2. Make a chart listing the many ways we use light (to tell colors, size, shape; to identify objects; to find the way to work, to school; to read; to play).
3. Have the children walk with their eyes closed. Explain what happens.
4. Blindfold a child. Lead him about the room. See if he can tell where he is and identify various objects. Have children explain relation of light to this activity.
5. Discuss the foods that people and other animals eat. How is the growth of these foods related to sunlight?
6. Observe plants that have been left outdoors during a frost. Compare them with plants that were moved into the house. Discuss covering garden plants in preparation for winter.
7. Place a potted plant in a cardboard box which has a small hole in the top to allow the light to enter. Observe and explain the results after a week. (Be sure to water the plant.)
8. Use two plants as nearly alike as possible. Place one in a dark place, the other in the sunlight. Both should be given the same amount of water. Compare the two plants after two weeks. What has caused the differences?
9. Plant a flower bulb in a cool, dark place. With a ruler, measure and record its weekly growth. After it has reached a height of four to six inches, take it out of the dark and place it in sunlight. Again keep a record of its weekly growth. Compare rate of growth before and after it was placed in the sun. Note other changes, such as color, which have occurred.
10. Observe the leaves of a plant on a window sill. Which way are they facing? Turn the plant 180°. What happens to the leaves? Record daily changes for one week.
11. Write experience stories of preceding experiments. Include the equipment used, conditions provided, objectives, results, observations, and the con-

clusions. (The children should provide the information for the teacher to record.)

Basic Concepts:

The length of day changes with the seasons. Autumn days grow shorter than summer days. Winter has the shortest days of the year. In spring the days grow longer. The longest days of the year occur in summer.

(Vocabulary: seasons, spring, shortest, autumn, summer, long, winter, shorter, longest, dark, light, morning, evening)

1. Keep a record of the length of the days throughout the year. Make comparisons. What causes these differences?
2. Compare autumn days with summer days.
3. Compare length of winter days with length of spring days.
4. Discuss changes which have occurred throughout the school year.

Basic Concept:

Sometimes the moon can be seen during the day.

(Vocabulary: crescent moon, half moon, quarter moon, full moon)

Take the children outside when the moon is visible during the day. Note its position in the sky, at specific times over a period of several days. At another time, observe the day sky when there is no moon. Why is there a moon?

Basic Concept:

The moon does not always appear to have the same shape.

1. Encourage the children to observe the moon at night. Let them tell and draw what they have seen. Keep a record of its shape over a period of several weeks. Identify the shapes with the proper names. Why does the shape of the moon differ?
2. Observe the moon when it is visible during the day. Keep a record of its shape for several days. Compare the shapes of the day moon with those of the night moon previously observed.
3. Paint one-half of a ball with yellow paint. Let a circle of children (facing outward) represent the children about the earth. Move about the earth with the ball. Let the children tell how much of the sunlit side of the moon they can see. Compare with previous observations of the day and night moons.

Basic Concept:

The moon looks bigger than the stars.

(Vocabulary: size, little, big, near, far)

1. Discuss the moon. Note the children's concepts of its size.
2. Develop the idea that things that are closer look bigger. (Hold a penny close to the eyes. It looks big. Let them see that same penny from across the room. It looks small because it is far away.) Relate this concept to the child's concept of the size of the moon. (The moon is not larger than the stars but it looks larger because it is closer to the earth.)
3. Compare the size of the moon to the earth and sun in an illustration.

Basic Concept:

Moonlight is reflected sunlight.

(Vocabulary: reflection)

1. Discuss what reflection means. Let the children tell of their experiences with reflected light in water, a window, and a mirror.
2. Show reflected light. Place a mirror in the sun. Move the reflection about the room. A pan of water placed in the sun will cast its reflection on the ceiling. Stir the water. The reflection will move. Move the pan to another sunny spot. Note that the reflected light moves to another place also.
3. Pretend that a mirror is the sun. Direct the reflection to a ball representing the moon.

Basic Concept:

The moon travels around the earth.

(Vocabulary: moon, earth, globe)

1. From previous observations, develop the concept that the moon is not stationary in the sky. (A diagram of the positions of the moon in pictures or on the blackboard will give a pictorial approach to the concept.)

2. Let the children pretend they are the moon and walk around a globe or another object representing the earth.
3. Use a small ball to represent the moon. Move it around the globe or another larger ball representing the earth.

Basic Concept:
The stars can be seen at night.
(Vocabulary: stars, night, shine, sky)

1. Observe and draw pictures of the night sky. (Let the children explain their drawings and note their conceptions.)
2. Discuss the stars observed in the night sky. Let the children tell of their observations as to quantity, size, and brightness of the stars. (Explain that most stars shine as our sun shines.)
3. Show pictures of the night sky. Discuss.

Basic Concept:
The sun is a star and stars are suns.
(Vocabulary: suns, stars)

Discuss the sun. (Refer to it as our own special star. Point out that it shines by its own light. Compare it to the other stars in the sky. They too are suns and give off their own light.)

Basic Concept:
The stars look little in the sky, but they are large.
(Vocabulary: near, big, far, little, size)

1. Hold a lighted flashlight close to the group. Note that it looks large. Move far away with the light. Note that the light looks smaller. Walk toward the group with the light. Develop the concept that things that are far away look small.
2. Observe the size of airplanes as they move into the distance.
3. Observe a large ball nearby. Have a child take the ball to the far edge of the playground. (It is still the same ball, but it looks small because it is so far away.)

Basic Concept:
There are planets in the sky.
(Vocabulary: planets, reflected light, satellites)

1. Some of the bright dots in the night sky look larger than others. These are called planets. They are different from the other stars, because they are closer and they are not suns.
2. Compare the light from planets to light from the moon. (The planets and the moon reflect light from the sun. Recall the shine of the man-made satellites they have seen in the sky. We can see them because the sun shines on them.)
3. Show pictures of planets. Discuss their size and distance from earth.
4. Encourage children to look at the night sky and to notice particularly very bright dots. Try to distinguish planets from sun. (The evening star is a planet.)

Basic Concept:
The "dipper," or polar constellations, are in the north sky.
(Vocabulary: dipper, constellations)

1. Encourage the children to have parents look at the night sky with them. Look for the "dippers." Let them tell and draw what they saw. Include size, shape, and direction.
2. Cut "star openings" in a shoe box. Insert an electric light bulb or flashlight. Darken the room and show the star patterns shining as they do in the sky. (If all outside light can be eliminated, a pin-sized opening will reflect on the ceiling. It will take a while for the eyes to adjust and to see the patterns.)
3. Show pictures of the dippers and other constellations.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How To Teach It.* Pp. 141-186.
2. Binder, Otto. *The Moon.*
3. Craig, Gerald S. *Science In the Elementary-School Program.* Pp. 19; 31-32; 52-53.
4. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 189-266; 790-799.
5. Gallant, Roy A. *Exploring the Moon.*
6. Gallant, Roy A. *Exploring the Sun.*

7. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
8. Hoss, Norman. *The How and Why Book of Stars.*
9. Hausman, Leon. *The Big Book of Stars.*
10. Lynde, Carleton J. *Science Experiences With Ten-Cent Store Equipment.* Pp. 104-112.
11. Navarra, John G. and Joseph Zaffroni. *Science Today for the Elementary-School Teacher.* Pp. 262-267; 272-291; 395-398; 403-408.
12. *Primary Guide Activities Instructional Aid for World Book Encylopedia.* Pp. 12-13; 42-47; 80-83.
13. Stoiko, Michael and Donald Cox. *Man In the Universe.*
14. Williams, Lou. *A Dipper Full of Stars.*
15. Zim, Herbert. *The Sun.*

Pupil References

(To be used for pictures and for teacher to read to pupils.)

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 1.* Pp. 33.
2. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 2.* Pp. 40-41; 51-52; 66.
3. Beauchamp, Wilbur L. *Science Is Exploring, Book 3.* Pp. 108-121.
4. Beauchamp, Wilbur L. *Science Is Learning, Book 2.* Pp. 22-23; 25-28; 67-79.
5. Blough, Glenn O. *How the Sun Helps Us.*
6. Blough, Glenn O. *Wait for the Sunshine.*
7. Craig, Gerald S. and others. *Science Around Me, Book 2.* Pp. 48-57.
8. Craig, Gerald S. and others. *Science Around You, Book 2.* Pp. 52-63.
9. Craig, Gerald S. and others. *Science Near You, Book 1.* Pp. 50-55.
10. Frasier, George W. and others. *Science Adventures, Book 3.* Pp. 86-91; 102-105; 107.
11. Frasier, George W. and others. *Science All the Year, Book 2.* Pp. 17-28; 30-34.
12. Frasier, George W. and others. *Science For You, Book 1.* Pp. 8-15; 86-89; 116-119.
13. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 1.* Pp. 57-58.
14. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 3.* Pp. 162-173.
15. Kettelkamp, Larry. *Shadows.*
16. Leaf, Munro. *Science Can Be Fun.* Pp. 3-13.
17. Paschel, Herbert P. *The First Book of Color.*
18. Podendorf, Illa. *The True Book of More Science Experiments.* Pp. 6-10.
19. Podendorf, Illa. *The True Book of Sun, Moon and Stars.*
20. Schlein, Miriam. *The Sun Looks Down.*
21. Schneider, Herman and Nina. *Follow the Sunset.*
22. Schneider, Herman and Nina. *How Big Is Big?*
23. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 78-83; 186.
24. Schneider, Herman and Nina. *Science for Work and Play, Book 1.* Pp. 32-35; 80-83.
25. Smith, Jeanette. *Sun, Moon and Stars.*
26. Ziner, Feenie and Elizabeth Thompson. *The True Book of Time.*

Films

(Appropriate parts of the following may be used, or they may be used with only part of the group.)

1. *Big Sun and Our Earth* (Coronet Films), 11 min.
2. *Light For Beginners* (Coronet Films), 11 min.
3. *What Do You See in The Sky?* (Coronet Films), 11 min.
4. *What Makes Day and Night?* (McGraw-Hill Book Co.), 8 min.

Filmstrips

1. *Daytime and Nighttime* (McGraw-Hill Book Co.), 45 frames
2. *Finding Out About Day and Night* (Society for Visual Education, Inc.), 26 frames
3. *Finding Out About the Sky* (Society for Visual Education, Inc.), 51 frames
4. *A Hot Day* (McGraw-Hill Book Co.), 37 frames

5. *Night and Day* (Encyclopaedia Britannica Films, Inc.), 50 frames
6. *The Night Sky* (Encyclopaedia Britannica Films, Inc.), 45 frames
7. *The Sky About You* (Society for Visual Education, Inc.)
8. *The Sky Above Our Earth* (Society for Visual Education, Inc.), 20 frames

UNIT TWO

Air

I. Objectives

A. To increase understanding of air and what it can do
B. To realize that air is very important to us
C. To provide experiences in experimentation as a method of finding out
D. To provide experiences in scientific observations, measurements, and drawing conclusions
E. To provide an opportunity to share a learning experience
F. To provide an opportunity to share knowledge and observations
G. To provide an opportunity to perform experiments and to construct devices which will help find answers

II. Initiatory Activities (Motivation)

A demonstration showing what air can do will capture the interest of first grade children. Show an empty glass and ask, "What is in this glass?" A probable answer will be "nothing." If there is nothing in it, we should have no trouble filling it with water. Turn the glass upside down and push it straight down into a large glass container of water Lift the glass part way out of the water. "Why didn't the water go into the glass?" "There must have been something in the glass to keep out the water." "What was it?" (A drop or two of water color paint in the container of water will tint it just enough so that the children can see clearly that no water has entered the glass.)

III. Developmental Activities

Basic Concept:
Air is real and takes up space.
(Vocabulary: experiment, air bubbles)

1. Place a piece of cloth in the bottom of a glass. Turn the glass upside down and push it straight down into a large glass container filled with water.
2. Float a small boat in a large glass container. Cover the boat with a glass and push it straight down into the water. Be sure the glass is large enough to allow the boat to move about freely.
3. Compare an air-filled balloon with a flat balloon.
4. Fill a balloon with air. Immerse it in a container of water. Slowly release the air. The bubbles show that the air came out of the balloon.

Questions: Can you see air? Have you noticed things at home that have air in them? How do you know air is all about us?

Basic Concepts:
Living things need air. People need air to live.
(Vocabulary: breathe, lungs, breathing holes)

Have the children observe their own breathing. Have them feel their ribs as they breathe deeply. Discuss their expanding lungs. Compare it to the expanding of a balloon or a paper bag as you inflate it.

Basic Concept:
Animals need air to breathe.

1. Observe and discuss the breathing of pets. Note their expanding lungs.
2. Note how the fish in the aquarium breathe.
3. Notice how fish come to the surface of the water to breathe when the water in the aquarium does not have enough air.

4. With a reading glass observe the breathing holes on the abdomen of a grasshopper.

Basic Concept:
Plants need air to live.

1. Discuss the air holes on the underside of a leaf.
2. Coat the entire underside of a bean leaf with vaseline. The air supply will be cut off and the leaf will die.
3. Plant some bean seeds in a pot of soil. At the same time, place some bean seeds in a jar of water. Note that some plants cannot get the air they need from water.

Questions: Why do you need air? Can people breathe under water? Do all animals need air? Why do we add water to the aquarium? What would happen if we took the fish out of the water? Do plants need air?

Basic Concept:
Fire needs air to burn.

(Vocabulary: burn)

1. Light two candles. Cover one with a glass. Allow the other to burn uncovered. Note that the glass-covered candle will go out when the air is used up.
2. Cover a burning candle with soil or water. (This can provide the opportunity to teach safety with fire. Always put out a campfire. Never run if clothing should catch on fire. Roll on the ground or wrap up in a rug.)
3. Light two candles. Cover one with a small glass—the other with a larger glass. Note that the candle under the larger glass burns longer because it has more air.
4. At Halloween time cut small openings in a jack-o-lantern. After the candle has been lighted, put the cover on. Note how dimly the candle burns. Then remove the cover—the candle will burn brightly when it can get more air.

Questions: What will put out fire? Why is it important to put out a campfire? How can you put out a fire quickly? Why does the candle under the larger glass burn longer? Why did the jack-o-lantern candle burn more brightly when the cover was removed?

Basic Concepts:
Moving air is called wind. You can feel wind.

(Vocabulary: wind, feel, force)

Fill a balloon with air. Release the air against the child's hand. Close eyes and feel the air. Wave your hand rapidly close to your face.

Basic Concept:
Wind makes things move.

1. Make paper pinwheels. Attach them to a stick. Blow on one to make it go. Run with one.
2. Make a kite. Sail it on a windy day.
3. Tie a string to a strip of paper. Run with it.
4. Blow a paper boat across a pan of water. The force of the wind makes it move.

Basic Concept:
Wind cannot be seen, but it can be observed by the things it does.

Observe dust, leaves, clouds, smoke, and flags moving in the wind. Discuss other observations.

Questions: Can you see the wind? How do you know the wind is blowing? Does the wind help us? (It turns windmills, keeps us cool or warm, and dries clothes.)

Basic Concepts:
There is water in air. Water evaporates into the air from lakes, rivers, oceans, sidewalks, and puddles.

(Vocabulary: evaporate, water vapor, clouds)

1. Place a small amount of water in a shallow dish on a window sill. Observe that it evaporates.
2. Allow a wet cloth to dry in the room.
3. Observe the evaporation of water from sidewalks and puddles after a rain, the washed chalkboard, and the aquarium. Use a red crayon to mark the day by day evaporation of water from the aquarium.

Basic Concept:
Water that is open to the air evaporates more quickly.

Place an equal amount of water in two

jars. Securely cover one jar. Allow the other to remain uncovered. Observe results of evaporation.

Basic Concept:
Heat makes water evaporate more quickly.

1. Place an equal amount of water in two shallow dishes. Place one in the sunlight or in a hot place; the other in a cool place. Record how long it takes for each one to evaporate.
2. Dry wet mittens on the room heating unit. Compare them with wet mittens that were left in coat pockets.
3. Boil water and note how quickly it evaporates.

Basic Concept:
When water in the air is cooled, you can see it.

1. Observe the water vapor on windows when the outside temperature changes. Eye glasses, water pipes, and dew also illustrate this change.
2. Fill one glass with warm water. Fill another glass with ice. Note the water on the outside of the ice-filled glass.

Basic Concept:
Clouds are water vapor in the air.

Make a cloud. Fill a strainer with ice. Place it in the steam from a teakettle. A cloud will form. Why?

Questions: How does water get into the air? How does water get out of the air? Does the sun help water evaporate? Why do we keep adding water to plants and aquariums? What should we do to keep paste or paint from drying? Why does the sidewalk dry faster in spring than in winter? Why does wash dry faster on a windy day? Why does an automatic dryer have hot air?

Basic Concepts:
Air can do work. Air can push in all directions (up, down, and sideways).

(Vocabulary: push, air pressure)

1. Immerse two glasses upside down in a container of water—one glass filled with water; the other filled with air. Carefully tip the air-filled glass under the water-filled glass. The air will push the water out of the glass.
2. Fill a drinking straw with water. Hold a finger over one end. (The air pushes up and keeps the water in the straw.) Remove the finger. The water will leave the straw. Why?
3. Fill a glass with water. Wet the rim slightly. Place a sturdy piece of cardboard over the glass. Place your hand on the cardboard and invert the glass. Remove your hand from the cardboard and invert the glass. Remove your hand from the cardboard. The cardboard will stay on because the air pushes up on it. Tip the glass sideways.
4. Place one end of a rubber tube in a water-filled glass. Turn the glass upside down in a container of water. Blow on the tube and push the water out of the glass.
5. Place a sheet of paper on your hand. Move your hand about quickly in a circular motion holding the palm sideways. The air will push and keep the paper on your palm.
6. Bring a bicycle pump to school. Try to hold a finger over the tube as you pump it. The push is called air pressure.
7. Make a parachute. Tie a string to each corner of a piece of cloth. Tie a weight to the four equal sides of the string. Wrap the string around the folded cloth. Toss it into the air.

Basic Concept:
Air can lift things.

Place a book over a balloon or a paper bag. Inflate the bag and raise the book.

Basic Concept:
Wind helps things to dry.

1. Make two wet spots of the same size on the chalkboard. Allow one to dry naturally. Fan the other. What happens? Why?
2. Wet two cloths. Allow one to dry in a still place. Dry the other in the wind or by waving it in the air. Record the time it took to dry each one.

Basic Concept:
Wind makes things go.

1. Fill a balloon with air. Release the air

quickly. The force will propel the balloon through the air.

2. Blow a paper boat across a pan of water.
3. Blow on a pinwheel. Why are the blades curved?
4. Blow the fluff of milkweed or dandelion seeds.

Questions: How does air help us? (windmills, airplanes, rockets, fans, parachutes, dryers, drinking straws, spray painting) How does air help your mother with her work? (clothes dryer, vacuum cleaner) How does air help our toys to work? (kites, whistles, bubble pipes, balls, popguns, bicycle tires) How does your father need air for his car? (tires) Why do we use a fan on a hot day?

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How To Teach It.* Pp. 187-228.
2. Frasier, George W. and others. Teacher Guides, *Science For You, Book 1.* Pp. 54-61; 77. *Book 2, Science All the Year.* Pp. 55-61. *Book 3, Science Adventures.* Pp. 35-38.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
4. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 1.* Teacher's Guide.
5. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teacher.* Pp. 53-91.
6. Parker, Bertha M. *Science Experiences —Elementary School.* Pp. 24-79.

Pupil References

(Reading difficult for first grade but pictures provide good learning situations.)

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 1.* Pp. 86-90.
2. Beauchamp, Wilbur L. *Science is Fun, Book 1.* Pp. 21-28.
3. Frasier, George W. and others. *Singer Science Adventure, Book 1.* Pp. 68-79. *Book 2.* Pp. 61-70. *Book 3.* Pp. 27-34.
4. Friskey, Margaret. *The True Book of Air Around Us.*
5. Leaf, Munro. *Science Can Be Fun.* Pp. 26-36.
6. Podendorf, Illa. *The True Book of More Science Experiments.* Pp. 33-45.
7. Podendorf, Illa. *The True Book of Science Experiments.* Pp. 37-39.

Films

1. *Air All Around Us* (Young America Films), 11 min.
2. *Blow Wind Blow* (Coronet Films), 11 min.
3. *How Weather Helps Us* (Coronet Films), 11 min.
4. *What Makes Rain* (Young America Films), 10 min.
5. *Unit Teaching: Science—Air*—(S.U.I. Films) 22 min.

Filmstrips

1. *The Air* (Encyclopaedia Britannica Films, Inc.)

UNIT
THREE

Seasons and Weather

I. Objectives

A. To increase the child's interest in his natural environment

B. To help satisfy his natural curiosity

C. To provide new experiences for observation and learning

D. To increase the ability to observe accurately

E. To provide experiences that will show the relationship of living things to the seasons

F. To provide an opportunity to share knowledge and observations

G. To provide experiences in classifying and collecting

II. Initiatory Activities (Motivation)

This unit will be more effective if it is taught as the seasons occur. Learning will be easier and better results will be obtained if the children have concrete experiences and the opportunity to observe nature firsthand.

The area around the school is a virtual laboratory. Use it to capture interest. A walk, very early in the year, will establish the neighborhood as it is in summer. A few weeks later take another walk. Note how it has changed. Each season will bring new experiences and new things to observe. Compare the present season to the previous one and proceed with developing the changes that take place.

III. Developmental Activities

Basic Concepts:

There are four seasons. A season is part of a year.

(Review Vocabulary: seasons, winter, year, spring, autumn (fall), summer)

1. The names of the seasons are not new to first grade children. The purpose of these activities is to organize the seasons in relation to a year.
2. If the group is interested, it could be mentioned that it takes a year for our earth to go around the sun. Use a globe or a diagram to give the pictorial approach.
3. Using a calendar, talk about the months in the different seasons.
4. Mark the children's birthdays on the calendar. List them by seasons.
5. Let the children try to recall what the weather was like on their birthdays.
6. Prepare a bulletin board or charts with pictures of the four seasons. Find out from the children what things they associate with the different seasons. List them under the pictures.

Questions: Let the children tell which season they like best. Why? In which season does each child's birthday occur?

Basic Concept:

Weather changes with the season.

(Vocabulary: change, fog, weather, cloud, rain, shadows, thermometer, snow, wind, temperature)

1. We live in a part of the world where the weather changes with the seasons. Weather means changes in the air with respect to heat or cold, wetness or dryness, calm or storm. Develop, through comparison, how the present season's weather is different from that of the last.
2. Keep a daily record of the weather on a calendar. During the early months of first grade, use pictures to describe

the weather. Later in the year use the words.

3. The seasonal changes in the position of the sun can be noted by measuring the shadow of a specific tree or fence post in the neighborhood. Observe it several times during the year. Winter shadows are long. Summer shadows are short. Notice also the amount of sunshine in the schoolroom windows during the different seasons.

Basic Concept:
(Autumn Weather) Days are becoming cooler.

Measure the outside temperature. Note the day by day changes. Record it on the calendar or a thermometer chart. This activity can be used for all seasons. Use a red line during the early months of the school year (a short line for cold weather—longer line for warm temperatures). Toward spring recording the number will provide an added number experience. There is no need to explain degree. Let the children decide which numbers mean the higher and lower temperatures.

Basic Concept:
The sky is often cloudy.

Observe the sky on a cloudy day. Make a cloud by boiling water in a teakettle. Have children observe and explain what happens. (Clouds can be seen because air is cooling water vapor.)

Basic Concept:
We often have foggy days.

Explain that fog is a cloud near the earth. (Have children explain fog-cloud relationship.)

Basic Concept:
It may often rain.

Place a pan of ice in the cloud formed by the boiling teakettle. Keep it there until the condensed moisture drops like rain. (Cooling the cloud makes the rain fall.) Have children observe and explain what happened.

Basic Concept:
The days grow shorter.

Let the children make their observations. (It is darker when they get up in the morning. They cannot play outside as long as they did in the summer.)

Basic Concept:
(Winter Weather) It is cold most of the time. It snows.

1. Observe and record daily temperature.
2. Catch snowflakes on a dark cloth. Observe them with a reading glass if possible. Note the patterns (all different and six-sided).

Basic Concept:
Snowflakes melt and become water.

Allow a quart of snow to melt. How much water does it make?

Basic Concept:
Days are shorter.

Winter has the shortest day of the year. Let the children make observations about short winter days. (We need the lights on early in the evening. Some days we have to turn them on when we get up in the morning. We cannot play outside after dinner.)

Basic Concept:
(Spring Weather) Days grow warmer.

Keep a day by day temperature record. Compare the temperature with that of winter. (A record of the weather will show an increase in the number of sunny days.)

Basic Concept:
It may rain often.

Keep a record of rainfall. Compare with other seasons.

Basic Concept:
The wind may be gusty.

Watch the clouds move in the spring sky. Make a pinwheel to show wind action. Release a balloon on a windy day. Sail a kite. Pupils should observe, record, and explain the above.

Basic Concept:
Days grow longer.

Discuss activities going on in their neighborhood or at home. (Note that we can play and work outdoors much longer than we could in the winter because it is lighter.)

Basic Concept:
(Summer Weather) The days are usually warm—sometimes hot.

1. Discuss summer activities (playing out-

side most of the time, picnics, swimming, and boating). Some days are very hot. We need fans and air conditioners to keep cool. The sidewalks are too hot to go barefoot.

2. The sun comes up early in the morning. We can play and work outside very late in the evening. (In summer we have the longest days of the year.)

Basic Concepts:
Living things change with the season. Animals change with the season. Some birds migrate in the fall.

(Vocabulary: migrate, larva, flocks, chrysalis, hibernate, butterfly, cocoon, moth)

1. Take a walk to the park or into the neighborhood. Observe the gathering flocks of birds. Note that some have already left the community.
2. Encourage the children to be on the lookout for strange birds that have stopped to eat on their trip south. Help them to identify these birds.
3. Collect seeds to put on a feeding tray for winter birds.

Basic Concept:
Some animals store food.

1. Observe squirrels gathering nuts. If possible, locate a squirrel's winter home near the school ground. Watch them throughout the year.
2. Discuss honey stored by bees. Bring a honeycomb to show children. Why doesn't the beekeeper take all of the honey out of the hive?

Basic Concept:
Some animals hibernate (prepare to sleep all winter).

Why do animals store food in their bodies? They hibernate. Explain. What animals hibernate? List them.

Basic Concept:
Some animals rest in the ground.

Place frogs, turtles, or snakes in a terrarium. Observe their actions. Explain.

Basic Concept:
Some animals grow heavy fur to keep warm.

Observe the changes in the fur of animals. (Pets, cattle, horses.)

Basic Concept:
Some animals change color.

What animals change color with the seasons?

Basic Concepts:
Butterflies adapt to the seasons. Caterpillars change in the autumn. Some butterflies migrate.

1. Encourage the children to bring caterpillars into the classroom. Keep them in jars or a covered terrarium. Feed them leaves from the plant they were found on. Watch them as they spin a cocoon or change into a chrysalis.
2. Encourage the children to use pictures to identify them as the larva of butterflies or moths. Show the characteristic differences of each.
3. If possible find the larva of a monarch butterfly. (The monarch butterfly larva is found on milkweeds.) Place it in a jar and cover top with cheesecloth. Place a stick in the jar so it can suspend itself while changing into a chrysalis. Feed it. It will develop into a butterfly in about ten days. Set it free to join other monarchs as they migrate.

Basic Concept:
People get ready for winter.

(Vocabulary: people)

1. Lead the children into a discussion about the activities at home which show that mother and father are getting ready for winter. List these activities:
   a. Getting out warm clothes.
   b. Covering plants in the garden.
   c. Storing food in the freezer.
   d. Canning.
   e. Winterizing the car.
   f. Putting on storm windows.
   g. Drying and storing feed for animals.
   h. Preparing a warm shelter for the animals.

Basic Concept:
Plants.

(Vocabulary: winter birds, seeds, fruit)

Take an autumn walk. Compare the changes that have taken place since the first-of-the-year walk.

Basic Concept:
Leaves on the trees change color and fall to the ground.

1. Select a tree that can be seen from the classroom or is near the school. Record the changes which occur throughout the entire school year.
2. Observe buds at base of leaf stems. Mark these and look for changes in spring.
3. Collect a few common leaves. Identify them. Learn names. Press them or make prints. Make a booklet.

Basic Concept:
Plants grow seeds.

Save the seeds from a Haloween jack-o-lantern. Count them—use them for a winter feeding tray or to plant in spring.

Basic Concept:
Seeds scatter in the fall so new plants will grow.

1. Collect seeds. Classify them as to how they travel.
2. Identify some of the more common seeds as fruit of plants. (The acorn is the fruit of the oak tree.)

Basic Concept:
People adapt to winter in different ways.

1. Compare winter activities with those of other seasons (indoor play, ice skating, sliding, shoveling snow, sanding icy sidewalks, keeping the house warm, and finding the animals).
2. Discuss winter safety (where to slide, how to slide, snowballing, and crossing icy streets, etc.).
3. Discuss how to keep healthy in winter (dress properly, change to dry clothes, cover a cough, and stay home when sick).

Basic Concept:
Other animals adapt to the winter in different ways.

(Vocabulary: tracks, feeding, suet)

1. Take a winter walk to look for animals. Note the scarcity of birds. Look for tracks of animals that have come out to look for food.
2. Build a feeding tray for winter birds. Use seeds collected in autumn. Have children bring old bread and suet for birds.
3. Identify birds that visit feeding tray.
4. Watch squirrels as they occasionally come out of their winter home.
5. Water cocoon collection regularly. (Explain that we must provide the water which they would get if they were outside.)

Basic Concept:
Some plants change in winter.

(Vocabulary: winter buds, needles)

1. Observe the winter buds which were marked in autumn.
2. Let children tell of trees that are still green. (Explain that needles of cone-bearing trees are the leaves.)

Basic Concept:
People do different things in spring.

(Vocabulary: planting, plowing)

A discussion of activities around home will bring forth the children's observation of changes in their lives in springtime (house cleaning, putting away winter clothes, different spring games, preparing the soil for planting, plowing, and planting seeds and little plants).

Basic Concept:
Birds which migrated in the fall return.

1. Look for birds. Record their coming on the calendar. Identify them through books and pictures. Learn the names of a few common birds. Draw pictures of them and make booklets.
2. Locate a bird building its nest. Visit often to watch it raise its family. (Stress caution in bird watching.)

Basic Concept:
Moths and butterflies appear in the spring.

(Vocabulary: moth, butterfly)

1. Keep a close watch on the cocoon and chrysalis collection. The outline of the butterfly inside shows long before it emerges.
2. Mount the butterfly or moth for a collection. (They usually come out very early in the spring, and it is too cold to release them.)
3. Identify them as a moth or butterfly.
4. Cut open and inspect a chrysalis that did not develop.

Basic Concept:
Many baby animals come in the spring.
(Vocabulary: tadpole, eggs, baby animals)

1. Watch for baby squirrels scampering about the trees.
2. Gather a few toad or frog eggs. Watch them grow into tadpoles. Return the tadpoles to a swamp where they can find food.
3. Visit a farm. Notice all the baby animals. Learn the names of the animal and the baby (as sheep—lamb; cow—calf).

Basic Concept:
Plants start to grow.
(Vocabulary: leaves, bean, bulb)

1. Early in the spring bring a branch with winter buds into the classroom (forsythia, plum, lilac, etc.). Put it in water and watch the leaves burst forth.
2. Plant a garden using fast-growing seeds (radish, bush bean, corn, etc.). Observe progressive changes in plant development. The children should take the responsibility of planning, planting, and caring for the garden.

Basic Concept:
Other animals raise their families in summer.
(Vocabulary: sounds, summer homes)

1. Observe the squirrels' summer homes of leaves high in trees.
2. Watch birds dig for worms and eating seeds and insects.
3. Listen for sounds of insects, frogs, and birds. Identify the animals by sound.

Basic Concepts:
Plants grow and produce fruit in summer.
People do different things in summer.
(Vocabulary: fruits)

1. Lead the children into a discussion of work done by mother, father, and children (tending lawn and garden).
2. Note also the difference in clothing, play activities, boating, picnics, swimming.

Basic Concept:
All places do not have the same kind of weather.
(Vocabulary: countries, jungle, map, desert, arctic)

A discussion of vacation trips to faraway places can introduce this unit. As a natural outgrowth of sharing their experiences, the topic of weather can be approached. Explaining the reasons for differences in climate around the world is not necessary at this level. However, if the question arises, it should be sufficient to show, either by diagram or with a globe, that because our earth is tilted as it moves about in space, the sun does not strike all places in the same way.

Basic Concept:
Some places are cold most of the time.

A unit on "Children of Other Lands" can help to make all of these concepts meaningful.

Basic Concept:
Some places have snow most of the time.

Have children bring dolls from other countries. The costumes of the dolls will tell much about the climate in that part of the world.

Basic Concept:
Some places it rains frequently.

Pictures, stories, and films will provide information concerning homes, food, clothing, and activities of other countries. Compare these characteristics to ours. Relate them to the weather.

Basic Concept:
Weather changes during the day.
(Vocabulary: weather, thermometer, weather report, sky, temperature)

1. Fast changes in the weather are characteristic of spring and fall. Use the following activities to show the variation throughout the day. Stress the importance of thinking ahead and dressing so one can be prepared for changes in the weather.
2. On the weather calendar, record with pictures or words, when there is a

noticeable change of weather during the day.

3. Measure the outside temperature in the morning, at noon, and at dismissal time. Let the children decide what time of day is warmest.
4. Discuss the weather reports on the radio or television. They will tell what the weather will be so that one can dress properly.
5. Looking at the sky may also tell us if the weather will change.
6. Collect pictures of clothing for various seasons. (Put them in a booklet or on a chart.)

Review Questions (to use in teaching or testing)

1. Why do we need warm clothing *and* cool clothing?
2. Do all people need warm clothes?
3. Why don't we live in a house made of grass?
4. Why do Eskimos make their clothes out of animal fur?
5. Why don't Iowa farmers grow bananas or oranges?
6. Would you like to live where the weather was different? Why?
7. At what time of day was the temperature highest?
8. How can we know what kind of clothes to put on in the morning?
9. Why should we be prepared for changes in weather?

Autumn

1. Do all trees lose their leaves?
2. How do animals get ready for winter?
3. What does hibernate mean? migrate?
4. How do seeds travel?
5. How do people get ready for winter?

Winter

1. How can we help animals in winter?
2. Where do squirrels get their food in winter?
3. What are some of the winter birds?
4. Do all animals store food?
5. How do plants live through the winter?
6. What do winter birds eat?
7. What do people do to be sure they keep warm in winter?

Spring

1. How can we find the right name for a bird?
2. What are some of the differences between a moth and a butterfly?
3. Where do the new plants come from?

Summer

1. How does the farmer care for the new plants?
2. What do you like best about summer?

IV. Instructional Materials

Teacher References

1. Beauchamp, Wilbur L. *Science Is Learning, Book 1,* Teacher's Guide. Pp. 16-52. *Book 2,* Teacher's Guide.
2. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How To Teach It.* Pp. 187-228.
3. Frasier, George W. and others. *Science for You, Book 1,* Teacher's Guide. Pp. 61-64. *Science All the Year, Book 2,* Teacher's Guide. Pp. 1; 6; 60-65; 79-83; 107.
4. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
5. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 3.* Teacher's edition. Pp. 42-147.
6. Matschat, Cecile. *American Butterflies and Moths.*
7. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teachers.* Pp. 93-137.
8. *Primary Grade Activities Instructional Aid for World Book Encyclopedia.*

Pupil References (Reading is difficult for first grade but the pictures provide good learning situations.)

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 1.* Pp. 14-19; 33.

2. Beauchamp, Wilbur L. *Science Is Fun, Book 1.* Pp. 3-34. *Science Is Learning, Book 2.* Pp. 3-24.
3. Cormack, M. B. *The First Book of Trees.*
4. Encyclopaedia Britannica Picture Stories. *Gray Squirrel, Adventures of Bunny Rabbit.*
5. Friskey, Margaret. *The True Book of Air Around Us.* Pp. 30.
6. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2.* Pp. 149-156. *Book 3,* Pp. 43-147.
7. McClung, Robert. *Tiger, The Story of A Swallowtail Butterfly.*
8. Podendorf, Illa. *The True Book of Seasons.*
9. Podendorf, Illa. *The True Book of Insects.*
10. Waller, Leslie. *A Book To Begin Weather.*
11. Webber, Irma E. *Travelers All: The Story of How Plants Go Places.*

Films

A. *Seasons*

1. *Autumn On The Farm* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Seasons Of The Year* (Coronet Films), 11 min.
3. *Spring On The Farm* (Encyclopaedia Britannica Films, Inc.), 10 min.
4. *Summer On The Farm* (Encyclopaedia Britannica Films, Inc.), 11 min.
5. *Winter On The Farm* (Encyclopaedia Britannica Films, Inc.), 11 min.

B. *Animals and Seasons*

1. *Adventures Of Bunny Rabbit* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Animals In Autumn* (Coronet Films), 11 min.
3. *Animals In Spring* (Coronet Films), 11 min.
4. *Animals In Winter* (Coronet Films), 11 min.
5. *Gray Squirrel* (Encyclopaedia Britannica Films, Inc.), 11 min.
6. *How Animals Live In Winter* (Coronet Films), 11 min.
7. *Mr. and Mrs. Robin's Family* (Coronet Films), 11 min.

C. *Plants and Seasons*

1. *Season Changes In Plants* (McGraw-Hill Book Company), 11 min.
2. *Seeds Grow Into Plants* (Coronet Films), 11 min.
3. *How Seeds Are Scattered* (McGraw-Hill Book Company), 10 min.

D. *People and Weather*

1. *Children In Autumn* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Children In Spring* (Encyclopaedia Britannica Films, Inc.), 11 min.
3. *Children In Winter* (Encyclopaedia Britannica Films, Inc.), 11 min.
4. *Children of Switzerland* (Encyclopaedia Britannica Films, Inc.), 11 min.
5. *Eskimo Children* (Encyclopaedia Britannica Films, Inc.), 11 min.
6. *Tina, A Girl Of Mexico* (Encyclopaedia Britannica Films, Inc.), 11 min.

Filmstrips

A. *Seasons* (plants, animals, weather)

1. *All My Seasons* (McGraw-Hill Book Company), 50 frames
2. *In The Autumn* (McGraw-Hill Book Company), 32 frames
3. *In The Spring* (McGraw-Hill Book Company), 31 frames
4. *In The Summer* (McGraw-Hill Book Company), 31 frames
5. *In The Winter* (McGraw-Hill Book Company), 31 frames
6. *The Seasons* (Encyclopaedia Britannica Films, Inc.), 42 frames
7. *Winter Is Here* (Society for Visual Education), 27 frames

B. *Weather*

1. *A Foggy Day—A Windy Day* (McGraw-Hill Book Company), 45 frames
2. *A Hot Day* (McGraw-Hill Book Company), 37 frames
3. *A Rainy Day* (McGraw-Hill Book Company), 34 frames
4. *A Snowy Day* (McGraw-Hill Book Company), 48 frames

C. *People and Weather*

1. *Ahmed and Adah of Desert Lands* (Eye

Gate House, Inc.), 23 frames

2. *Kofi (African Boy)* (Young America—McGraw-Hill Book Company), 40 frames
3. *Nannock and Akawa of The Cold Lands* (Eye Gate House, Inc.), 23 frames
4. *Wamba and Tawa of The Hot Lands* (Eye Gate House, Inc.), 23 frames

D. *Animals*

The World of Insects (Eye Gate House, Inc.), 23 frames

Source Materials

1. Coca-Cola Bottling Company of Chicago, Inc., 7 E. 73rd Street, Chicago, Illinois (A good assortment of many things useful in the elementary school science program—not only models of plants and animals made of oaktag, but also models of the solar system, simple machines and many other simple devices.)
2. Deere and Company, 230 S. Clark Street, Chicago 4, Illinois.
3. General Biological Supply House, 8200 S. Hoyne Avenue, Chicago, Illinois. (For cocoons.)
4. W. M. Welch Scientific Company, 1515 N. Sedgewick Street, Chicago, Illinois. (For cocoons.)

UNIT FOUR

Magnets

I. Objectives

A. To acquire a few generalizations concerning magnetism and what magnets can do

B. To appreciate the force of magnetism and what it can do

C. To increase the appreciation of the characteristics of magnets

D. To increase awareness and interest in magnetism in everyday life

II. Initiatory Activities (Motivation)

Prior to beginning this unit, place a magnet and various materials on the science table so the children may discover materials that will be attracted by a magnet. A collection of magnets of different sizes and shapes will add to the interest. A compass or several compasses should also be placed on the science table so the children may observe and discuss their behavior.

III. Developmental Activities

Basic Concepts:

Magnets attract some things. Magnets do not attract some things.

(Vocabulary: magnet, pull, attract, force, iron, strong, heavy, weak, light)

1. Gather a variety of objects—tacks, paper clips, nails, crayons, buttons, a nickel, erasers, aluminum foil, scissors, pins, and plastic. Let the children experiment with a magnet to find out which things it can pull or pick up.
2. Introduce the word "attract." Discuss pulling in toys and games. Have two children hold hands. Direct one child to pull the other. Lead the children to the understanding that the one who exerts the pulling force brings the other child toward him. A magnet attracts in the same way.
3. Let each child handle the magnet and feel its force by removing the attracted object and putting it back on again.
4. Sort the objects into boxes. Label them "will attract" and "will not attract" or "yes" and "no."
5. Make a chart, listing by words or pictures, things the magnet will and will not attract.
6. Leave the magnet and boxes of objects on the science table. Allow the children to experiment during their free time.

Basic Concept:

Magnets attract things made of iron and things that have iron in them.

1. Some children may observe that some metal objects are attracted by the magnet and some are not. Explain that if the object is iron or has iron in it, the magnet will attract it.
2. Encourage the children to bring toy magnets from home. Let them use these magnets in experiments.
3. Have class compare weak and strong magnets by comparing the number of identical objects, such as paper clips, each will pick up. Record results.
4. Cut paper fish of colored construction paper. Fasten a paper clip to the nose of some of the fish. Place the fish in a container and let the children "go fishing" with a magnet that is attached to a string and a short pole. Include a fish made of aluminum foil. Let the children explain why the aluminum fish and those without paper clips cannot be caught.

Basic Concept:
Magnetism goes through some things.
(Vocabulary: magnet, magnetism, attract, strong, thin, force, thick, weak)

1. Place objects that are made of iron, or have iron in them, on a sheet of paper. Move them about by moving the magnet on the under side of the paper. Note that the magnetism goes through the paper and attracts the iron objects.
2. Continue the experiment by showing the force of the magnet through cardboard, plastic, glass, plywood, aluminum pie pan, sheet iron pie pan, cloth, and iron fry pan.
3. Help the children to observe which materials affect the magnet's ability to attract. Does the magnet attract with greater force through the glass or wood? aluminum or iron?

Basic Concept:
Magnetic attraction decreases rapidly as the distance from the object increases.

1. Suspend a magnet from a string. Slowly bring a paper clip, also suspended on a string, close to the magnet. Note the distance through which the magnet will pull the paper clip.
2. Experiment with both weak and strong magnets on thin and thick materials such as a sheet of paper and a thick book, a thin piece of plywood, and a thick wooden desk top.
3. Let the children predict probable outcomes. Observe that the magnetism will not go through some materials. What is the result of using a weak magnet?
4. Gather considerable evidence before drawing conclusions. Summarize by recording on a chart.
5. Make a small paper dog. Attach a paper clip to it and place it in a glass jar. Use a magnet to make the dog climb out of the jar.
6. Make boats of cork. Float the boats in a pan of water. Sail them about by holding a magnet near the boats. Sink the boats by holding the magnet under the pan.
7. Tape paper clips or nails to the bottom of small plastic cars. Mark out streets on a piece of cardboard and move the cars along the streets by moving a magnet under the cardboard.
8. Secure a sensitive spring balance such as a spring postal "scale." Attach a paper clip to the hanger in case the hanger itself is not of iron. Take a relatively strong magnet and hold it below the clip at a distance where the attraction is barely observed. Read the scale. Decrease the distance to half and again read the scale. Repeat at one-fourth the distance. Do not allow the attracted article to actually touch the magnet. Have children draw conclusions.

Basic Concept:
Some magnets are stronger than others.
(Note to teacher: The strength of magnets varies with the size, the shape, the material, and the extent of magnetization.)

1. Repeat the experiment with different magnets keeping the *distance* between the attracted object and the magnet the same for each reading. Have the children draw conclusions as to the relative strength of the different magnets.

Basic Concepts:
Magnets have poles. The magnetic force is strongest at the poles. Unlike poles attract each other. Like poles repel each other.
(Vocabulary: attraction, strongest, poles, North pole, South pole, attract, bar magnet, repel)

1. Place a magnet in a pile of tacks, paper clips, pins, and other magnetic objects. Lift the magnet from the pile. More objects will have been attracted to certain points. Explain that the points of strongest attraction are called the poles.
2. Lay a magnet under a thin cardboard or a paper. Sprinkle iron filings on the paper. Tap the paper slightly and the filings will gather at the poles. (Note to teacher: This demonstration can be "frozen" for permanent display by spraying with clear lacquer from a pressurized can.)

3. Explain that the poles of a magnet have been given names. One is called the North pole, the other is called the South pole.
4. Use two bar magnets to show this concept. The poles should be marked N and S. Suspend one bar magnet with a string so it hangs freely. Let a child hold the N pole of the other magnet near the S pole of the suspended magnet. Note that they are attracted to each other. Now let them hold that same N pole near the N pole of the suspended magnet. Note that the one is pushed away. Teach the word "repel."
5. Allow the children to experiment with several marked (N and S) magnets before drawing conclusions. Let them predict probable outcomes before the experimentation.
6. Through experimentation, let the children determine which is the N and S pole of unmarked magnets.
7. Magnetize a needle by stroking it in one direction with a strong magnet. Lay the needle on a cork and float the cork in a pan of water. Hold a bar magnet, poles marked, near the needle. Let the children draw conclusions as to which end of the needle is the N and S pole.

Basic Concept:

When a magnet is broken, new poles are formed.

1. Magnetize a 4-inch length of alarm clock spring. Use experiment 7 above. Break piece in two and repeat 7 with each piece.
2. Record one or more of the experiments or demonstrations on an experience chart. Include the equipment needed, the procedure that was followed, the results, and the conclusions drawn.

Basic Concepts:

Magnets are useful. Magnetism can make a tool or machine more useful.

(Vocabulary: magnet, magnetism, useful, keeper)

1. Show pictures of machines and tools that make use of magnets.
2. Show magnets removed from old telephones, motors (permanent magnets rare in older motors), loud speakers, speedometers, refrigerator doors, electric meters, etc.
3. Discuss things around the house that are magnets or make use of magnets (scissors, hammers, screwdrivers, knife holders, can openers, hot pads, pencils, bulletin boards, catches, compasses, radio loud speakers). Let the children tell why they are magnetized.
4. Suggest that the children ask their fathers to tell them and show them where magnets are used in the home, in the garage, and in the city. Let the children tell of what they have seen.
5. Discuss the people who use magnets: sailors, aviators, hunters, explorers, doctors (to remove bits of iron from eyes), and beauty parlor operators (to remove pins from hair).
6. Spill a box of clips, pins, or thumbtacks. How can they be picked up very quickly? Use the magnet.
7. Encourage the children to bring toys and games that make use of magnets. Have them explain how they work in terms of the concepts learned.
8. Discuss reasons for and ways of taking care of magnets.
   a. Care should be taken in storing magnets. How is a keeper placed on the magnet?
   b Bar magnets should always be put away with North of one to South of the other.
   c. Magnets should not be dropped or hammered. Use a postal scale to do a simple experiment before and after hammering.
   d. Magnets must not be heated. Heat a steel magnet and test for magnetism.

IV. Instructional Materials

Teacher References

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3. *Magnets* (Encyclopaedia Britannica Films, Inc.), 45 frames
4. *Magnets and Electricity* (Society for Visual Education), 15 frames
5. *Magnets Can Attract Through Objects* (Jam Handy Organization), 35 frames
6. *Magnets Help To Find Direction* (Jam Handy Organization), 35 frames

UNIT
FIVE

Plants and Animals

I. Objectives

A. To develop understanding of the way plants and animals grow and develop

B. To develop an understanding of some factors which control growth

C. To develop an understanding of the interrelationship of plants and animals

D. To develop understanding of the differences and similarities of plants and animals

E. To develop an increased appreciation of the nature of plants and animals

II. Initiatory Activities (Motivation)

Take a nature walk to observe and record information about different plants and animals in the community.

Be sure that a variety of plants and animals are in the classroom. Representation for several of the various classifications should be included. A bulletin board which raises the question of how a plant grows would also be helpful. Make a collection of all parts of various plants such as seeds, leaves, roots, and stems.

III. Developmental Activities

Basic Concept:
Plants need light, air, water, and soil to grow.

(Vocabulary: plants, light, air, water, soil, grow, change, roots)

1. Bring a common weed into the classroom. Discuss the parts of a plant (roots, stem, leaves, flowers, and seed). Familiarize the children with the plant parts.
2. Find out what would happen if light, air, water, and soil were taken away from a plant. Have several sets of plants available for experimentation. Use them to test the concepts to be taught. Label the plants, note the dates, the conditions, and the conclusions drawn. Keep accurate data. Do not let the plant die as a result of experimentation. Allow the conditions of the experiment to remain just long enough to provide the evidence needed to teach the concept.

Basic Concept:
Some plants need light to grow.

1. Cover some grass on the school ground with a board. Leave it there several weeks. Observe what has happened. Remove the board and observe the same spot at a later date.
2. Cover a plant with a box. In a few weeks there should be a noticeable change in the color of the leaves.

Basic Concept:
Plants need water to grow.

1. Do not water a plant, such as a geranium or coleus, for several days. Notice how the leaves and stems curl. Observe the difference after watering it again.
2. Show how water travels through a plant by placing a celery stalk in a glass of water colored with ink. Note which areas of the stalk are colored. Explain.
3. Put two plants in a sunny place. Water one and not the other. Leave plants in sunny place until changes are noted. Compare. Explain results.

4. Sprinkle grass seed on two sponges. Place one in a dish of water, the other in a dish without water. Place both dishes in light. Observe the difference. The grass will grow for a while on the wet sponge. Then it will die. Use this activity to lead into discussion of the plants' need for soil.

Basic Concept:
Most plants need soil to grow.

1. Plant grass seed in two containers—one with good soil, the other with sand. Water both of them. After a time notice the difference in growth.
2. Plant seeds in gravel.
3. Plant fast-growing seeds (lima or navy beans) in a glass bowl. Place the seeds near the side of the bowl so root growth can be observed. Discuss how the roots reach into the soil for essential elements.

Basic Concepts:
Plants start growing in different ways. The new plant will grow to look like the parent plant.

(Vocabulary: plants, seeds, grow, parent, seedlings, stems, roots, bulbs, cutting)
New plants can start in many ways. Let the children tell of ways they have seen plants start (e. g., seeds that were planted, potatoes and onions that started to grow in vegetable bin at home). What did the new plant look like? What did it look like when it grew larger?

Basic Concept:
Plants grow from seeds.

1. Plan a class project of growing plants from seeds. Use pots, wooden boxes, waxed cartons, or a plot of ground. Let the children bring some of the necessary equipment, prepare the soil, and take care of the project.
Use seeds gathered on a fall field trip, take the class to a neighborhood store, purchase seeds or choose several kinds from a seed catalogue.
Label each pot or row. Keep close check on the day-to-day growth. Use a magnifying glass to observe the small plants.
2. Place a piece of blotting paper around the inside of a glass. Put a few lima bean seeds between the paper and the glass. Keep a little water in the glass. Cover the outside of the glass with black paper which can be removed for observation of the roots. The children can observe the entire growing process of roots, stems, and leaves. When the seedlings have four or more leaves, transplant them to a pot or into the garden.

Basic Concept:
Plants grow from roots.

1. Place a sweet potato in a container ot water with three-fourths of it above the water. Watch for the growth of stems, foliage, and roots.
2. Make a dish garden. Cut off the upper half of a beet, carrot, or turnip. Stand these vegetable tops in a dish of water. Each vegetable will grow foliage. Compare with plants growing in soil.

Basic Concept:
Plants grow from stems.

(Vocabulary: cuttings)

1. Cut a length of stem or a leaf with a stem from a healthy plant. Place it in water. English ivy, wandering jew, philodendron, geraniums, or begonia will grow from cuttings.
2. Rooted cuttings can be transplanted to pots to be kept in schoolroom.

Basic Concept:
Plants can grow from bulbs.

1. Show the children some different bulbs. Cut onion bulb open to see the small plant inside.
2. Bulbs can be planted in soil, pebbles, moss, and sand. Add just enough water so the root, not bulb, is covered. If the planted bulb is kept in a cool dark place until it gets a good start, the flowers will be better developed and larger.

Basic Concept:
Trees are plants.

(Vocabulary: trees, plants, leaves, change, buds, needles, pine trees)

1. The children should be led to the understanding that trees are plants. They grow slowly and stay alive year after year.
2. Walk through the neighborhood. Observe the trees, note the branches, the leaves, the flowers, the trunk, the seeds, and the root parts that are above the ground.
3. Compare the trees with other plants that they have seen.
4. How do trees differ from other plants? Trees differ mainly in size from other plants. They are *big* plants. They also contain more wood than many plants.
5. Find tree seedlings to compare with seedlings of other plants.
6. Compare tree seedlings with mature small plants. Explain how they are different and how they are alike.

Basic Concept:
Some trees change with the seasons.

1. Observe a specific tree throughout the seasons. Call attention to the colored leaves in autumn, the bare branches, and "winter buds" that have formed where the leaves fell from the branches.
2. Point out that in winter the trees are not dead but resting (dormant).
3. Watch for the growing of the "winter buds" in the springtime. Note differences in buds.
4. Identify some of the common trees in the neighborhood. Have the children make a leaf collection and identify the leaves.
5. Collect seeds from trees. Classify them in a variety of ways suggested by the class members. Save some for a winter feeding tray.
6. In early spring place a few branches of lilac, willow, or forsythia in water to force the buds to open.

Basic Concept:
Some leaves stay green in the winter time.

Discussion:

The needle-like leaves of the pine trees are hardy and can stand the cold, cold weather of winter.

Observe a neighborhood pine tree in the winter. Discuss the needles as leaves. (Place a bag of suet in the tree for the birds that come to it for protection from winter winds.)

Call attention to the needles on the ground under a pine tree. The older needles do drop off, but we do not notice them because so many others stay on the tree and it still looks green.

Collect pine cones, and try to find the seeds. Plant some of the seeds and observe.

Basic Concept:
Some plants grow seeds.

(Vocabulary: plants, fruits, scatter, store, vegetables)

1. Encourage discussion of the children's experiences with seed.
2. Secure packages of seeds. Look for similarities and differences. Give children experiences in identifying seeds.
3. Take a walk in the fall to a garden, a weed patch, or anywhere that plant life is abundant. Observe seeds that have developed. Collect a few different kinds to take back to the classroom. Plan the trip beforehand. Caution injuring plants or disturbing the environment. Stress, also, collecting just a few specimens for further study.
4. Save, sort, and identify the seeds. Use them for spring planting.

Basic Concept:
Seeds grow in different parts of the plant.

1. Look for the structures where the seeds are found in flowers. Cut open a pear or an apple to find the seeds.
2. Discuss where the seeds are in tomatoes, peas, beans, and pumpkins.

Basic Concept:
Some plants have many seeds.

1. Make a jack-o-lantern from a pumpkin. Observe the many seeds. When the seeds are dry, count them. Open a seed and note what is inside.
2. Discuss the many seeds in watermelons; on maple, elm, and oak trees; dandelions; milkweeds; and sunflowers. Observe the very small seeds through a magnifying glass.

Basic Concept:
Seeds are scattered in many ways.

1. Point out that some of the seeds from plants travel to far places and will make new plants.
2. Classify previously collected seeds according to how they are dispersed. Make charts or displays of seeds to share with another group.

Basic Concept:
Some seeds fall to the ground.

On an autumn walk, observe the seeds that have fallen to the ground near the parent plant.

Basic Concept:
Some seeds are carried by the wind.

Break open a milkweed pod. Blow on dandelion fluff. Note the "parachutes" that carry them through the air. Observe the seeds with wings, propellers, and flat thin surfaces as they float through the air (maple, elm, ash).

Basic Concept:
Some seeds are carried by animals.

1. Show and discuss the seeds that "hitch a ride" on animal fur and people's clothing. Observe the spines and hooks through a magnifying glass.
2. Observe squirrels gathering nuts. They bury seeds for winter food. Some of them will start to grow in the spring.
3. Birds drop seeds after they have eaten the fruit.

Basic Concept:
Some seeds roll.

Experiment with acorns, chestnuts, and apples. Show how they could roll to a new place.

Basic Concept:
Some seeds travel on water.

Call attention to plants growing by a river or a lake that would drop their seeds into the water and be carried away from the parent plant. Coconuts travel hundreds of miles in the ocean. Heavy rains cause streams that can help move seeds to new places. Water also pounds seeds into soil where they will grow better.

Basic Concept:
Some seeds pop open.

When some seed pods dry, they pop open and shoot the seeds far away (violet, jewelweed).

Basic Concept:
There are little plants inside of the seeds.

1. Let the children cut open a lima bean seed to observe the small plant. Note leaves, stem, and roots. Put some of the lima bean seeds in a little water. Watch the same small plant emerge.
2. Corn soaked in water will produce the small plant very quickly.

Basic Concept:
Plants store food in seeds.

1. Open a bean seed. Where is the food stored? Discuss the quantity of stored food in the seed.
2. Collect seeds of plants. Explore quantities of food available for the seed to germinate.

Basic Concept:
Plants are useful.

(Vocabulary: plants, leaves, stems, roots, seeds, grains, shelter)

Let the children tell what foods they have eaten for breakfast, dinner, and lunch. List them. Discuss which foods came from plants.

Basic Concept:
People eat parts of plants.

Classify the foods according to which part of the plant provided the food. Make a picture book of plant foods. Classify them as roots we eat; seeds we eat, skins or leaves we eat.

Basic Concept:
People eat the leaves of some plants.

Discuss plants such as lettuce, spinach, cabbage, water cress, and parsley.

Basic Concept:
People eat the leaf stalks of some plants.

Discuss plants such as celery and rhubarb.

Basic Concept:
People eat the roots of some plants.

Discuss plants such as beets, carrots, turnips, and yams.

Basic Concept:
People eat the seeds of some plants.

1. Call attention to the food stored in the seeds that people eat (beans, peas, peanuts, corn, wheat).
2. Some plants produce a supplementary food supply which may (or may not) be used by the seeds when they grow (apples, oranges, pears).
3. Provide activities that point out that some seeds are ground and people make breads, cakes, and cereals from the flour.
4. Provide activities showing how some seeds are ground to supply food.
5. Read the story of *The Little Red Hen.*
6. Visit a grocery store. Observe the foods from plants in cans and boxes. Notice the fresh fruits and vegetables. Open a coconut and cut a pineapple. Where does pepper come from and other common spices?

Basic Concept:
Other animals eat parts of plants.

Discuss the foods animals eat. Guide the discussion to the plant and plant parts that animals eat. Birds eat fruits and seeds. Squirrels eat seeds. Farm animals eat grains and hay. Caterpillars eat leaves.

Basic Concept:
Plants provide shelter for animals.

1. Observe summer houses of squirrels high in the trees. Watch squirrels bringing food to their winter home in the tree trunks.
2. Look for bird nests in trees.

Basic Concept:
Plants help to make the outdoors beautiful.

1. Notice flowers, gardens, trees, and lawns in neighborhood. Talk about things we do to make our yards look nice.
2. Plan a way to help make the schoolyard pretty.
3. Let the children suggest other ways that plants are useful (clothing, rubber, building, shade, paper).

Basic Concept:
Children can help plants grow.

1. Take a walk in the neighborhood and observe signs that say, "Please," or "Keep off the grass." Let the children tell why the signs were put there.
2. Call attention to spots where people have spoiled the beauty by making paths across the lawn.
3. Discuss helping our neighbors by obeying signs, not cutting across yards and gardens, and not picking flowers unless we have permission.
4. Make a picture and story booklet of how children can help to keep the neighborhood pretty.

Basic Concept:
(Animals) There are many kinds of animals.

(Vocabulary: animals, birds, insects, fur-bearing, kinds)

1. Explore the children's background of experiences with animals through discussion of pets, visits to the zoo, circus animals, farm animals, animals of the zoo, or animals living in the wilds.
2. Make a picture collection of various animals. Include several different kinds of mammals, birds, insects, reptiles, fish, and sea animals. The picture collection can be used to extend many of the concepts suggested.

Basic Concept:
Birds are animals.

Discuss the birds. Call attention to those birds that look very much alike; those that are different. Discuss the basic differences.

Basic Concept:
Insects are animals.

Guide the sorting of the pictures into birds, insects, fur-bearing animals, and others.

Basic Concept:
Animals have different characteristics.
(Vocabulary: pets, size, shape, coloring, kind, different, birds, move, insects, legs, feelers)

1. Encourage discussion of pets. Talk about neighborhood pets. Ask: Are they like yours? How can you tell your pet from your friend's pet?
2. Let the children describe their pets. Lead them to make comparisons in kind, size, shape, and coloring.
3. Let the children draw pictures and write stories of their pets.
4. Through discussion explore the children's background of experiences and knowledge of other animals.

Basic Concept:
Animals move in different ways.

1. Find pictures of animals in motion. Have the children tell how these animals move about (fly, walk, or swim). See if they can find pictures of animals that can move in several ways.
2. Guide them towards thinking of the advantages the animal has in his way or ways of locomotion.
3. Let some child dramatize the movements of a specific animal. Have the others guess what kind of animal it is.
4. Have live specimens of different animals so that the locomotion may be observed in class.

Basic Concept:
Animals vary in appearance.

1. Make a bulletin board display of different animal pictures and ask the children to identify the familiar animals.
2. Compare the animals as to size, shape, coloring, markings, body parts, and body covering.

Basic Concept:
Birds have feathers, two wings, and two legs.

1. Compare birds with other animals. Call attention to the many kinds of birds, as well as the physical characteristics.
2. Have the children identify or describe birds they saw on the way to school.
3. Display pictures of birds. Point out the distinguishing characteristics of specific birds. How can we tell one bird from another?
4. Learn to identify a few common birds. Draw pictures of them.
5. Take a walk to see how many different kinds of birds you can see.
6. Keep a record of birds as they come back in spring.
7. Study the differences between birds' feet, legs, and beaks. Relate to habits and habitat.

Basic Concept:
Insects have six legs and two feelers.

Have some insects in the classroom for the children to study. Study them closely with a magnifying glass. Compare them to each other. How are they alike, different? Call attention to the number of legs, feelers, body parts, and body covering.

Basic Concept:
All animals have young.
(Vocabulary: animals, young, born, hatched, care, grow, insects, life cycle)

Give the children some experiences with newborn animals. Visit a pet in the neighborhood that has a new family.

Basic Concept:
Some baby animals are born.

Take a trip to a farm. Observe the baby animals. Teach the name of the adult and the young. Call attention to those that are born and those that are hatched.

Basic Concept:
Some baby animals are hatched.

1. Hatch a few chickens in an incubator in the classroom. Record the provisions made, such as temperature, turning eggs, and others. Note the new developments that take place. Provide a suitable home for them.
2. Locate a robin's nest in the neighborhood. Watch the mother as she keeps the eggs warm.

Basic Concept:
Some young animals need care.

1. Observe how mother birds feed and protect their young.

2. A spring visit to the farm will provide the opportunity to observe how animals feed and care for their young.
3. Let the children contribute suggestions as to why animals need care.
4. Draw upon the experiences of children with young animals. Have them draw pictures and write stories of how their pet takes care of her young.
5. Call attention to how long a human needs care. Compare the length of time with that of birds.

Basic Concept:
Some young animals do not need the care of the parent.

1. Observe how baby chicks, hatched in an incubator, can find food for themselves.
2. A pair of guppies in an aquarium will provide many experiences of baby animals taking care of themselves. Provide plant life for the young to find protection from the parents, or remove the parents after the birth.
3. Collect frog or toad eggs. Watch the tadpoles. Record the changes that take place as the frog develops.

Basic Concept:
Some baby animals look like their parents.

1. Show pictures of mammals and their young. Compare them as to shape, body parts, coverings, and size. Lead them to the realization that they differ mainly in size.
2. Observe baby squirrels, birds, rabbits, and pets in the neighborhood. Compare them to the parent.

Basic Concept:
Some young animals do not look like the parent but will grow to look like them.

Tadpoles in the classroom will provide an excellent opportunity to observe young animals that do not look like the parent but grow to look like the parent.

Basic Concept:
Insects have a life cycle.

1. Encourage the children to bring caterpillars to school. Place them in jars. Feed them leaves from the plant upon which they were found. Dampen them occasionally. Watch them emerge into the adult stage of the insect.
2. Write stories about them at each stage of their life cycle. Reread the stories when the cycle is completed.

Basic Concept:
Animals live in different places.
(Vocabulary: live, different, homes, build, provide, forest, ground)

1. List the names of different animals suggested by the children. Have them tell where the animal lives (on the ground, under the ground, in the forest, in the trees, in jungles, in the water, or in houses).
2. Classify a picture collection of animals as to where the animals live. Let the children suggest reasons why they live there.

Basic Concept:
Some animals build homes.

Why do animals build homes? Guide their thinking towards the benefits of shelter, against weather, enemies, and a place to raise their young.

Basic Concept:
Some animals build homes on top of the ground, in trees, in the grass, in water, under the ground, in caves, and in the forest.

1. Take a walk in the neighborhood to find animal homes. Look for bird nests in trees, in bushes, or on the ground; squirrel homes of leaves and twigs in the tree branches or in tree trunks; spider webs, ant hills, and wasp nests.
2. Discuss some of the characteristics of the home and the animal. Point out the relationship of the home to the animal and its environment.
3. Be on the lookout for robins building a nest. Visit the site and record the progress.
4. Show pictures of animal homes (beaver, fox, and rabbits).

Basic Concept:
Some animals do not build homes.

1. Some animals that move about a great deal do not build homes. Their home

is where they are (turtles, frogs, lizards, snakes, bears, deer, and some insects). When winter comes, some animals find a good place to live but it is their home.

2. Call attention to the caterpillars in the classroom. They will make their home wherever they are placed.

Basic Concept:
People are animals.
(Vocabulary: people, human beings, think)

1. Compare human beings to mammals previously discussed. Note the similarity in number of limbs, fingers, toes, eyes, ears, teeth, ability to move, hair, physical needs, and care of young.
2. Point out that man's ability to "think" makes him a higher form of animal.

Basic Concept:
Animals are useful and give pleasures.
(Vocabulary: useful, pleasure, fun, learning, beauty, food, meat)

1. Talk about the fun of having a pet. Encourage the children to tell why they like their pets. Have them draw pictures and write stories about pets.
2. Call attention to the fun in watching wild animals (squirrels and rabbits). Mention also that learning comes from observation.
3. The birds and butterflies help to make our world beautiful.
4. The children can suggest other ways animals give pleasure (horseback riding, circus animals doing tricks, and looking at animals in the zoo).

Basic Concept:
Animals provide us with food.

1. On a visit to a grocery store, call attention to the foods that come from animals (meat, eggs, milk, butter, and fish).
2. Teach the names of the foods and the animal that provides it.
3. Make a picture booklet of foods from animals.
4. Churn butter. Put some cream in a quart jar. Cover securely and allow each child to shake it awhile. When the butter "comes" wash and salt it. Have a party of crackers and butter. Taste the buttermilk. Record the experiences. Include the objectives, equipment, ingredients, procedure, and results. Explain where the butter "came" from.

Basic Concept:
Children can help care for animals.
(Vocabulary: animals, care)

1. Discuss care of home pets.
2. Have the children recall animals they have seen on a trip, in their neighborhood, and on the way to school. Guide them into suggesting ways of helping to care for them and why. Record a few concrete suggestions.
3. Look at the baby birds. Do not touch. They might be injured. Explain how they differ from adult birds (or mother bird).
4. Do not capture baby animals. Their mother knows how to care for them better than people do.
5. Help feed winter birds and squirrels.

IV. Instructional Materials

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35. McCloskey, Robert. *Make Way for Ducklings.*
36. McClung, Robert. *Bufo, The Story of a Toad.*
37. McClung, Robert. *Stripe, The Story of a Chipmunk.*
38. Miner, Opal I. *The True Book of Plants We Know.*
39. O'Leary, Frank. *Cappy.*
40. Osswald, Edith and Mary M. Reed. *Little White Rabbit.*
41. Ozone, Lucy and John Hawkinson. *Winter Tree Birds.*
42. Podendorf, Illa. *The True Book of Animal Babies.*
43. Podendorf, Illa. *The True Book of Animal Homes.*
44. Podendorf, Illa. *The True Book of Trees.*
45. Podendorf, Illa. *The True Book of Weeds and Wild Flowers.*
46. Robinson, Irene and William W. *Picture Book of Animal Babies.*
47. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 25-26; 91-97; 167-173; 189.

48. Schneider, Herman and Nina. *Science for Work and Play, Book 1.* Pp. 102-104; 106-129.
49. Selsam, Millicent. *All Kinds of Babies.*
50. Slobodkin, Louise. *Our Friendly Friends.*
51. Steiner, Charlotte. *Bobby Follows the Butterfly.*
52. Thayer, Jane. *The Puppy Who Wanted a Boy.*
53. Tresselt, Alvin. *Hi, Mister Robin!*
54. Tresselt, Alvin. *Johnny Maple-Leaf.*
55. Lubell, Winifred and Cecil. *The Tall Grass Zoo.*
56. Udry, Janice May. *A Tree Is Nice.*
57. Webb, Addison. *Song of the Seasons.*
58. Webber, Irma. *Travelers All: The Story of How Plants Go Places.*
59. Webber, Irma. *Up Above and Down Below.*
60. Zim, Herbert. *Frogs and Toads.*
61. Zim, Herbert. *Snakes.*

Films

1. *Adventures of a Chipmunk Family* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Animals Growing Up* (Encyclopaedia Britannica Films, Inc.), 11 min.
3. *Animal Homes* (Encyclopaedia Britannica Films, Inc.), 11 min.
4. *Animals of the Zoo* (Encyclopaedia Britannica Films, Inc.), 11 min.
5. *Baby Animals* (Young America Films, Inc.), 11 min.
6. *A Balanced Aquarium* (Encyclopaedia Britannica Films, Inc.), 11 min.
7. *Bird Homes* (Encyclopaedia Britannica Films, Inc.), 11 min.
8. *Birds of Our Storybooks* (Coronet Films), 11 min.
9. *Care of Pets* (Encyclopaedia Britannica Films, Inc.), 11 min.
10. *Common Animals of the Woods* (Encyclopaedia Britannica Films, Inc.), 11 min.
11. *Farm Animals* (Encyclopaedia Britannica Films, Inc.), 11 min.
12. *Farmyard Babies* (Coronet Films), 11 min.
13. *From Seed to Plants* (Gateway Productions, Inc.), 10 min.
14. *Gray Squirrel* (Encyclopaedia Britannica Films, Inc.), 11 min.
15. *How Animals Move* (Young America Films, Inc.), 11 min.
16. *How Insects Help Us* (Coronet Films), 11 min.
17. *How Plants Help Us* (Coronet Films), 11 min.
18. *How Seeds Are Scattered* (McGraw-Hill Book Co.), 1 reel
19. *Life in an Aquarium* (Young America Films, Inc.), 11 min.
20. *Milk* (Encyclopaedia Britannica Films, Inc.), 11 min.
21. *Mother Hen's Family* (Coronet Films), 11 min.
22. *Mr. and Mrs. Robin's Family* (Coronet Films), 11 min.
23. *Our Foster Mother, The Cow* (Frith Films), 11 min.
24. *Peppy, The Puppy* (Coronet Films), 10 min.
25. *Seeds Grow Into New Plants* (Coronet Films), 20 min.
26. *Three Little Kittens* (Encyclopaedia Britannica Films, Inc.), 11 min.
27. *We Explore the Woodland* (Coronet Films), 11 min.
28. *The Zoo* (Encyclopaedia Britannica Films, Inc.), 11 min.

Filmstrips

1. *Animals and Their Young* (McGraw-Hill Book Co.), 37 frames
2. *Animals Around the World* (McGraw-Hill Book Co.), 30 frames
3. *Animal Babies* (Society for Visual Education, Inc.), 31 frames
4. *Animal Homes* (McGraw-Hill Book Co.), 30 frames
5. *Animal Life* (Curriculum Materials Corp.), set of 8
6. *Animals That Help People* (McGraw-Hill Book Co.), 30 frames
7. *Birds We Know* (Society for Visual Education, Inc.), 31 frames
8. *Butterflies Grow* (Jam Handy Organization), 34 frames

9. *Finding Out How Plants Grow* (Society for Visual Education, Inc.), 26 frames
10. *Finding Out How Animal Babies Grow* (Society for Visual Education, Inc.), 26 frames
11. *How Plants Live* (Popular Science Publishing Co.), 23 frames
12. *Insects* (Society for Visual Education, Inc.), 29 frames
13. *Insect Homes* (Jam Handy Organization), 24 frames
14. *Let's Learn About Seeds* (McGraw-Hill Book Co.), 24 frames
15. *Our Pets* (McGraw-Hill Book Co.), Series of 6, 37 frames
16. *Pet Stories* (Encyclopaedia Britannica Films, Inc.), Set of 8, 37 frames
17. *Plants Get Ready for Winter* (Jam Handy Organization), 22 frames
18. *Plants We Know* (Society for Visual Education, Inc.), 30 frames
19. *Plants Grow* (Jam Handy Organization), 25 frames
20. *Seed Travel* (Jam Handy Organization), 22 frames
21. *Trees Grow* (Jam Handy Organization), 24 frames
22. *A Trip to the Zoo* (McGraw-Hill Book Co.), 40 frames

[redacted] *Grade Two*

A complete, alphabetized list of references will be found in the bibliography. The appendix contains demonstrations and experiments for grade two.

UNIT
ONE

Temperature Affects Life

I. Objectives

A. To develop an appreciation of the effect of environment on living things

B. To develop an appreciation of the variations of the needs of living things in different parts of the world due to variations in temperatures

II. Initiatory Activities (Motivation)

Display a collection of different kinds of thermometers. Have the class determine at what temperature they are most comfortable in the room.

Make a bulletin board on temperature in relation to such recreation activities as skating, swimming, skiing, and boating.

Compare the types of clothing worn for different seasons. Observe and discuss the plants and animals of the different seasons of the year.

III. Developmental Activities

Basic Concept:
"Hot" and "Cold" are relative descriptions of heat intensity.
(Vocabulary: hot, cold, warm, cool)

1. Have the children feel an ice cube and then feel a window pane. How did the ice feel? Was the glass warmer than the ice? Can we say that glass is cool and at the same time warm compared to something else?
2. Use the same comparisons between ice and warm water, warm water and hot water.
3. Compare the descriptions of a day with an air temperature of 60° to 70° with a January day and a day in July.

Basic Concepts:
Temperature refers to a degree of heat. A thermometer measures temperatures.
(Vocabulary: temperature, degree, thermometer)

1. Make a list of ways to find out how warm or cold a day is. How do we find out how warm our body is?
2. Examine several thermometers.
   a. Outdoor thermometers.
   b. Clinical thermometers.
   c. Household thermometers.
   d. Cooking thermometers.
3. Measure the temperature of the room, the outside air, water fresh from a tap, water that has been standing in the room, a pupil's temperature, and the temperature of boiling water (make sure scale goes to 212°F.). It is valuable experience to measure the temperature of items that have changing temperatures such as the water example listed above.
   All pupils need not be expected to understand degree readings, but all should note the differences in temperature readings and the changes in those readings.

Basic Concept:
Thermometers show changes of temperatures due to the expansion of matter when it is heated and the contraction of matter when it is cooled.
(Vocabulary: expand, contract)

1. Fill a beaker or other pyrex glass container with water to a certain mark on the glass. Heat the water and observe the relationship of the level of the water to the original mark. Make a

new mark at the hot water level and allow the water to cool. What happens to water when it is heated?

2. Borrow a ring and ball apparatus from the high school physics teacher. Demonstrate the expansion of metal.

3. Screw a metal lid on a jar to the extent that the pupils cannot remove it. Heat the lid in hot water, keeping the jar cool. Let the pupils try again. What did heat do to the jar lid?

4. Fit a small flask with a one-hole rubber stopper which has a 2-foot length of glass tubing in it. Support the thermometer in a stand. Paste a strip of paper for a scale behind the tube. Place the lower end of the tube in a small bottle of colored water that is at room temperature. Heat the flask slightly to drive out some of the air. When the flask cools, the water should rise about half way in the tube.

   After standing several hours, you can mark the scale with the temperature of the room, as read on another thermometer. Next, move your thermometer to a warmer place to stand for an hour with the other thermometer near the flask. Mark the water level and the temperature. Follow the same process in a cooler place. Divide the space between the marks into equal divisions and mark off proper temperatures.

Basic Concept:

There is a pattern of temperature change during the day.

1. Keep a record for a period of at least one week of temperatures recorded in the morning, at noon, and at the end of the day. What happens to the temperatures each day?

2. Ask a teacher or other person in the community who has visited a foreign country to compare daily and seasonal temperature changes with those of our country.

Basic Concept:

There is a pattern of temperature changes during the year.

(Vocabulary: climate)

1. Collect pictures of people that show clothing differences during different seasons of the year. Why do people wear different types of clothing for different seasons? Are seasonal changes in temperature the same each year?

2. Read a story of pioneer life, or other historical setting, to the class. Are the seasonal temperatures something new?

Basic Concept:

Man wears types of clothing that are suitable to the temperature.

Compare the type of clothing offered for sale in summer and winter catalogs from a mail order firm. What differences do you find in the clothing?

Basic Concept:

Man changes his food habits as temperatures change.

1. Dry a leaf of lettuce in a warm place. Pressing between sheets of paper with an iron will hasten drying. Secure a piece of dry pie crust. Burn each of them, holding them with ice cube tongs or similar device. Which would give the most heat to the body?

2. Collect pictures of foods from a summer and a winter issue of a magazine such as *Better Homes and Gardens.* Compare the types of food we eat during these seasons.

3. Have the pupils ask their mothers how the food habits of their families change with the seasons.

Basic Concept:

Man's need of shelter changes as temperatures change.

(Vocabulary: shelter)

1. Collect pictures of homes in various parts of the world. Use these pictures as a basis for discussion of housing variations dictated by temperature variations. Why would the straw hut of Africa be unsatisfactory here? Why

would the thick-walled, mud homes of the African desert region be a desirable home for that climate?

2. Discuss the clothing needs of people in various parts of the world. Compare the clothing of the Arab with the Bushman of the jungle. How does the clothing needs of the Eskimo compare with that of the jungle dweller? with our clothing needs?

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz: and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 269-286; 397-421.
2. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 595-631.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
4. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School.* Pp. 395-438.
5. Podendorf, Illa. *One Hundred and One Science Experiments.* Pp. 73-86.
6. UNESCO. *700 Science Experiments for Everyone.* Pp. 131-142.

Pupil References

1. Beauchamp, Wilbur L. *Science Is Learning, Book 2.* Pp. 3-28.
2. Bond, Austin D. and others. *Thinking About Science.* Pp. 111-121.
3. Craig, Gerald S. and others. *Science Around You, Book 2.* Pp. 35-37; 64-78.
4. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2.* Pp. 133-156.
5. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 21-33; 100-119.
6. Thurber, Walter A. *Exploring Science, Book 2.* Pp. 33-48.

Enrichment References

1. Adelson, Leone. *All Ready for Winter.*
2. Blough, Glenn O. *Animals Round the Year.*
3. Blough, Glenn O. *The Birds in the Big Woods.*
4. Blough, Glenn O. *Plants Round the Year.*
5. Blough, Glenn O. *Soon After September: The Story of Living Things in Winter.*
6. Mason, Charles Russell. *Picture Primer of Attracting Birds.*
7. Podendorf, Illa. *The True Book of Seasons.*

Films

1. *Animals In Autumn* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Children In Autumn* (Encyclopaedia Britannica Films, Inc.), 11 min.
3. *How Animals Live In Winter* (Coronet Films), 10 min.
4. *Autumn Is An Adventure* (Coronet Films), 10 min.
5. *Winter Is An Adventure* (Coronet Films), 11 min.

Filmstrips

1. *Animals Get Ready for Winter, Birds Get Ready for Winter, Insects Get Ready for Winter, People Get Ready for Winter, Plants Get Ready for Winter* (Jim Handy Organization)
2. *Autumn and Winter* (Eye Gate House, Inc.), 40 frames
3. *How Hot and How Cold* (McGraw-Hill Book Co.)
4. *Winter Is Here* (Society for Visual Education, Inc.), 27 frames

Charts

1. *Elementary Science Charts* (A. J. Nystrom and Co.)
2. *Science Is Wondering* (Scott, Foresman and Co.)

UNIT TWO

Sound

I. Objectives

A. To develop an appreciation of the place of sound in his life

B. To develop an appreciation of the ability of man to produce a variety of sounds in many ways

II. Initiatory Activities (Motivation)

Make a tape recording of all the sounds in class over a period of time, play it back, and discuss. Note the different sounds made by objects when struck lightly. Observe how some objects vibrate more than others when struck.

Discuss how sounds are made by a piano, a drum, and other musical instruments. Play a game in which someone makes different sounds, and the rest of the class guesses what makes the sound.

During a walk outside, listen for sounds and record the different ones.

III. Developmental Activities

Basic Concept:
Many vibrating objects make sounds we can hear.
(Vocabulary: vibrate, stretch, tuning fork)

1. Stretch a rubber band across an open box and pick it with thumb or finger. Does the rubber band move? How does it move?
2. Place a drum in a horizontal position. Strike the drum. Quickly drop a few peas on the drum head. Is the drum head moving? What does it do to the peas?
3. Strike a tuning fork on the palm of the hand and touch it to the surface of a pan of water. Why does the water move? Do all objects that make sound move? Check several objects making sound, for movement.

Basic Concept:
Some sounds come from vibrations we can feel.
(Vocabulary: instrument)

1. Conduct a sound feeling excursion. Have the pupils feel a piano being played, an auto with its horn honking, the case of a record player playing, the milk cooler running, and the telephone ringing.
   Can you feel the vibrations of many objects making sound?
2. Have each pupil place his fingertips on his throat as the class sings a song. Do the vibrations change or feel different with different parts of the song?

Basic Concept:
Some sounds are louder than other sounds.

1. Let each pupil listen to the sound of the tuning fork or a note on a piano. What happens to the sound with the passage of time? Does the pitch of the sound change?
2. Take the class to the school grounds. Have the pupils listen for as many sounds as they can recognize. Are all sounds alike? Are they all of the same pitch? Are they all of the same loudness?

Basic Concepts:
Sound takes time to travel. Sound is slower than light.

1. Take the pupils to the school ground or on a sidewalk in such a position

that they can see a pupil with a drum a block or more away. A tub or other object may be substituted for the drum. Have the pupil strike the drum with a broad gesture.
Where was the pupil's arm when you heard the sound of the drum?

2. Make a list of situations in which sounds do not fit the actions that are seen, due to the slowness of sound compared to light. Lightning and thunder, a man hammering on a roof, and the position of a plane in the air and its sound are all good examples.

Basic Concept:
Sounds are called noise when they are too loud or are irregular.
(Vocabulary: noise, tension)

1. Have the class sing a song. Then ask the members of the class to repeat their names and telephone numbers in unison. How does the sound in the room differ in each of these cases? Which would you call noise?
2. Make a list of sounds which are pleasing and a list of those sounds that we call noise. How do the sounds differ?

Basic Concept:
Sounds tell us what is happening around us.

1. Have each pupil cover his eyes with his hands. The one pupil who is "it" is to make a sound. The other pupils are to guess what he was doing. The first to guess correctly is "it." Examples of sounds to make are:
opening a book
writing
putting foot on desk and
tying shoe
2. Make a list of all sounds that give us warnings.
3. Make a list of sounds that tell us something pleasant is happening.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 500-519.
2. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 801-813.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
4. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teacher.* Pp. 379-380.
5. Podendorf, Illa. *One Hundred and One Science Experiments.* Pp. 87-93.
6. UNESCO. *700 Science Experiments for Everyone.* Pp. 122-130.

Pupil References

1. Craig, Gerald S. and others. *Science Around You, Book 2.* Pp. 78-89.
2. *Schneider, Herman and Nina. *Science Far and Near, Book 3.* Pp. 244-265.
3. *Thurber, Walter A. *Exploring Science, Book 3.* Pp. 33-46.

Enrichment References

1. Borten, Helen. *Do You Hear What I Hear?*
2. Branley, Franklyn M. and Eleanor K. Vaughan. *Timmy and the Tin-Can Telephone.*
3. Kettelkamp, Larry. *The Magic of Sound.*
4. Pine, Tillie S. and Joseph Levine. *Sounds All Around.*
5. Podendorf, Illa. *The True Book of Sounds We Hear.*

Films

Sounds For Beginners (Coronet Films), 11 min.

Filmstrips

Sounds Around Us (Eye Gate House, Inc.), 38 frames

Charts

1. *Elementary Science Charts* (A. J. Nystrom and Co.)
2. *Science Is Wondering* (Scott, Foresman and Co.)

Records

Sounds Around Us (Scott, Foresman and Co.)

*These books are listed as books for grade three. The content is not beyond the level of grade two.

UNIT
THREE

Basic Animal Needs

I. Objectives

A. To develop an appreciation of the basic needs of life

B. To develop an appreciation of man's role in supplying the needs of life to some animals

C. To develop an appreciation of the changing needs of life

II. Initiatory Activities (Motivation)

Set up a terrarium in the room so that the children can observe and discuss how this terrarium provides for animal needs.

Make a collection of different kinds of animals and group them as to similarities and differences.

III. Developmental Activities

Basic Concept:

We need food, water, air, and shelter to live.

(Vocabulary: need, life, food, water)

1. Hold a class discussion about the essential things of life. Call attention to the need of food, water, air, and shelter, as compared to the need of such things as cars, telephones, watches. What do we need to live?
2. The children are fully aware of the need of food and water. Air is also needed. This is an appropriate time to discuss the danger of the old icebox. What can we do to it to make them safe? Why?
3. A study of pictures of people and their dwellings in foreign lands will provide evidence that the climate dictates the shelter need.

Basic Concepts:

Animals need food, water, air, and sometimes shelter to live. All animals are not alike in the types of food, the sources of water, the form of air, and the type of shelter that they need to live.

(Vocabulary: terrarium, shelter)

1. Observation and care of pets in the classroom is an invaluable experience in establishing this concept.
   a. Feeding needs can be planned.
   b. Provision must be made for water.
   c. Observe features of the cage that insure adequate air supply.
   d. Comparisons can be made between the needs of mammals, fish, and other types of pets.
2. Do all animals need the same things? Make a study of the contents of pet foods for different kinds of animal pets. Suggested foods to study are:
   a. Cat food.
   b. Dog food.
   c. Turtle food.
   d. Goldfish food
   e. Tropical fish food.
   f. Bird food.
3. Pupils have observed worms on sidewalks after rains. Place a worm in a jar of water. Can the worm live under these conditions? What is missing that the worm must have?
4. Place a frog or toad in a terrarium that is moist but has no water other than soil moisture and humidity. Where does this animal get its water?
5. Make a collection of pictures of animal homes. Do all animals need the same kind of shelter? Do all animals

need shelter?

6. If the unit is used in the winter or very early spring, the class might enjoy and profit from making birdhouses. The pupils should be informed that not all birds will use a house. What would be the natural home of a bird that will not use a house? The specification for birdhouses vary with the bird for which they are intended.

Basic Concept:
When an animal is taken from its natural surroundings, the things it needs for life must be provided.

(Vocabulary: moisture, aquarium)

1. Establish an aquarium for tropical fish. A booklet on tropical fish will provide the information about the needs of various types of fish. There may be pupils in the class who can report on special equipment used in tropical aquariums.
   Explain how the needs of tropical fish differ from those of native fish?
2. Keep a baby turtle in the classroom. Why must you provide a log or rock for the turtle in his pan?
3. Most children will have experienced the finding of a baby bird fallen from its nest. Hold a class discussion on the reasons for the near impossibility of raising such a bird.
4. Make a list of birds that man raises from babies. How do these birds differ from baby songbirds?
5. Some children may be able to report on a visit to a zoo. Books, films, or filmstrips about zoos will provide information for a class discussion of the different types of cages and housing conditions needed for the different types of animals. Why does the polar bear have a pond to swim in? Why are lions and tigers kept in a building that can be heated?
6. The local conservation officer may be asked to speak to your class on the difficulties of keeping wild animal pets.

Basic Concept:
Animals have different types of needs at different times in their lives.

1. Baby brothers or sisters in the homes of your pupils provide excellent material for class discussion of the differences of needs of babies, children the age of your class, and adults. These discussions can be summarized in a listing on the blackboard or poster for comparative purposes. Pictures may be collected of babies, children, and adults that show them eating different foods and wearing different types of clothing.
2. A child with farm experience may be able to tell of the change in the needs and care of baby chickens as they grow older.
3. If the unit is studied in the spring, the class will profit by and enjoy the experience of observing the hatching and growth of frogs or toads. The changing tadpole clearly illustrates the change in the needs of an animal as it matures.
4. Make a study of the life cycle of a butterfly or moth in respect to the needs of each stage.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 231-249.
2. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 461-486.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
4. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teacher.* Pp. 395-438.
5. Palmer, E. Lawrence. *Fieldbook of Natural History.*
6. UNESCO. *700 Science Experiments for Everyone.* Pp. 52-57.

Pupil References

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 2.* Pp. 67-82; 90-95

2. Dowling, Thomas I. and others. *The New Seeing Why, Book 2.* Pp. 67-82; 90-95.
3. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 168-177.

Enrichment References

1. Ballard, Lois. *The True Book of Reptiles.*
2. Bendick, Jeanne. *All Around You.*
3. Blough, Glenn O. *The Pet Show.*
4. Darby, Gene. *What Is a Turtle.*
5. Friskey, Margaret. *The True Book of Birds We Know.*
6. Foster, Polly and Larry. *Your Parakeet.*
7. Jordan, E. L. *Hammond's Guide to Nature Hobbies.*
8. Neurath, Marie. *Wonder World of Animals.*
9. Podendorf, Illa. *The True Book of Insects.*
10. Podendorf, Illa. *The True Book of Animal Babies.*
11. Podendorf, Illa. *The True Book of Pets.*
12. Sootin, Laura. *Let's Go to a Zoo.*

Films

1. *Animals and Their Foods* (Coronet Films), 11 min.
2. *Living and Nonliving Things* (Coronet Films), 11 min.
3. *Mr. and Mrs. Robin's Family* (Coronet Films), 11 min.
4. *Animals Growing Up* (Encyclopaedia Britannica Fiims, Inc.), 11 min.
5. *Care of Pets* (Encyclopaedia Britannica Films, Inc.), 11 min.

Filmstrips

1. *Animals and Their Young* (McGraw-Hill Book Co.), 40 frames
2. *Animal Homes* (McGraw-Hill Book Co.), 40 frames
3. *The Parakeet* (McGraw-Hill Book Co.), 37 frames
4. *The Puppy* (McGraw-Hill Book Co.), 37 frames
5. *The Turtle* (McGraw-Hill Book Co.), 37 frames
6. *How to Make An Aquarium* (McGraw-Hill Book Co.), 37 frames
7. *Finding Out How Animals Live* (Society for Visual Education, Inc.), 24 frames
8. *Animals Grow and Change* (Eye Gate House, Inc.), 30 frames
9. *Finding Out How Animal Babies Grow* (Society for Visual Education, Inc.), 24 frames
10. *How Animals Live* (Eye Gate House, Inc.), 39 frames

Charts

1. *Elementary Science Charts* (A. J. Nystrom and Co.)
2. *Science Is Wondering* (Scott, Foresman and Co.)

UNIT FOUR

Parts of Plants and Plant Needs

I. **Objectives**

A. To develop an appreciation of the place of plants in the world of living things

B. To develop an appreciation of the similarities between plants and animals

C. To develop an understanding of the basic functions of the parts of a plant

II. **Initiatory Activities (Motivation)**

III. **Developmental Activities**

Basic Concept:
Plants are living things in that they grow, reproduce themselves, and are sensitive to their environment.

(Vocabulary: plants, living things, reproduce)

1. Make a list of the things that children know to be alive and those that are not alive.
   a. Living Things
      (1) Grow
      (2) Reproduce
      (3) React to surroundings
      (4) Must have food and water
   b. Nonliving Things
      (1) Do not grow
      (2) Do not reproduce
      (3) Do not move of own accord
      (4) Do not need other food or water
2. Plant a bean or corn seed in a pot and record its growth (length of time before seedling can be seen, how much it grows each week, and other such information).
3. Observe the motion, over a period of time, of a plant turning toward the light (sensitive to environment).
4. Make a list of the ways we get new plants from older plants. You may need to provide the experience of seeing a cutting rooted in water, the stem that grows roots when touching the soil, and other asexual forms of reproduction.
5. Observe plants that fold their leaves or close their flowers at night, such as clover, day lilies, and "sensitive plants." Grow a *Mimosa pudica* plant (sensitive plant) from seed. This plant demonstrates very clearly motion in plants. The plant responds to touch by folding its leaflets and leaves.

Basic Concept:
Plants are like animals in their need of food, water, air, and proper temperatures for growth.

(Vocabulary: temperature, air, food, water)

1. Wrap several bean or corn seeds in moist cloth or paper towel. Place these in a small jar with a lid and put them in a cold spot in the refrigerator.
2. Repeat with second lot of seeds but place in warm dark place. Compare. Do the seeds sprout without warmth? What are the requirements for seed germination?
3. Place a few seeds on cotton in a jar. Pour water over the seeds and place a layer of cooking oil over the water. The cooking oil will exclude air. Repeat with second lot of seeds but do not add cooking oil. What does the oil do to the air? Do seeds sprout without air? What happened?
4. Place a few seeds on cotton in the bottom of a jar. Do not moisten the cotton. Repeat with seeds on moisten-

ed cotton. Do the seeds sprout without water?

Basic Concept:
Most higher plants need an attachment to the soil to grow properly.
(Vocabulary: soil)

1. Place several bean seeds on moist blotter cut to fit the bottom of a jar. Keep the jar covered until the seeds show signs of sprouting. When they start to sprout, carefully plant one or more seeds in a pot of soil or sand. Leave the remaining seeds in the jar. Do plants need support to grow upright?
2. Place a coleus (foliage plant) cutting on its side in a pan of water. The tip will grow upward. When the plant has assumed an upright position, blow on it. How do roots in soil protect plants from winds?

Basic Concept:
The three basic parts of a plant are leaves, stems, and roots.
(Vocabulary: leaf, stem, root)

1. Have members of the class examine different types of plants. Ask each pupil to make a drawing of his plant and label the leaves, stems, and roots. Plants growing in the room from seeds make fine material for observation.
2. Make a collection of leaves and twigs of common trees. Are all stems and leaves alike?

Basic Concepts:
The green leaf makes food for the plant. The food is usually stored in the form of starch. Sunlight is needed by plants to manufacture food.
(Vocabulary: starch, iodine, alcohol)

1. Treat starchy food items with iodine. Establish the fact for the class that foods containing starch such as bread, crackers, and potatoes will turn dark blue when treated with iodine solution. The iodine solution can be diluted to strong tea color.
2. Select a leaf. In selecting a leaf to be tested for starch, choose one that has been growing in sunlight several hours. Geranium or coleus leaves are excellent.

Place the leaves for one minute in boiling water or until limp. Then place the leaf in hot 95 per cent ethyl alcohol.

Heat the alcohol in a double boiler or in a small beaker placed in a larger beaker of boiling water. (*Warning! Do not heat alcohol over an open flame or directly on a hot plate.*) Let the leaves remain in the hot alcohol until all the chlorophyll has been dissolved and the leaves are light colored. Gently wash leaves in water.

Treat the leaves with the iodine solution. Do leaves contain starch? Where does the leaf gets its starch?

3. Repeat the above demonstration using a leaf that has been in darkness at least 24 hours. Do leaves that have not been in sunlight contain starch? Where did the starch go?
4. Place a bean seedling, that has been growing normally, in a dark place. How long can the plant live without light?

Basic Concept:
The stem of a plant supports the leaves in light.
(Vocabulary: support)

1. Tilt several different house plants on their sides to enable the class to view them from the top. Call the attention of the class to the fact that almost all of the leaves can be seen. This means that sunlight can fall upon all leaves.
2. Use a clothes sprinkler to sprinkle water on a plant from a position directly overhead. If water were sunshine, how many leaves could be touched by sunlight?

Basic Concept:
The stem of a plant carries food and water to the leaves.
(Vocabulary: tubes)

Place a celery stalk, with leaves attached, in a glass containing water and food coloring. Observe the celery for several days. Is the food coloring carried to the leaves through the stem? If so, describe. Does this indicate that food or water is moving through the celery leaf stem?

Basic Concept:
The stems of plants contain tubes to transport food and water.

Examine the stems of the plants used in above activity to find the tubes that carry food and water. Celery and corn stems provide excellent material for examination at this level.

Basic Concept:
Roots anchor plants to the soil.

1. Plant a number of bean seeds in a large pot. After the plants appear above the ground, choose one pupil to pull a plant from the soil each day. Do the plants become more difficult to pull each day? Why? Why does the same pupil do the pulling each day? Does soil cling to the roots of the pulled plant? (If seeds are planted in moist sand or sawdust, the amount of the substratum held by the roots is more obvious.)
2. Take an excursion in the schoolyard to an unexposed location on the lawn. Let the pupils discover how firmly the grass is held to the soil by its roots.

Basic Concept:
Roots of plants take water and dissolved substances from the soil.

Allow a growing plant to become dry to the point of wilting. Drench the soil with water containing food coloring (red or blue). Examine the leaves and stem of the plant within several days for traces of the food coloring. (Oat seedlings and stalks of celery are desirable plants to use because of their natural light color.) What part of the plant is colored? Which way (direction) was water moving? Note localization of color. How does the food move in the plant? Food manufactured in green plant parts moves downward if it is in soluble form. Some of this food will be used by living cells and surplus will be stored in roots. The food is usually stored in form of starch which is insoluble. Some of this stored food may move upward in plant if it is needed.

Basic Concepts:
Some plants have one main root. Some plants have many branched roots.

Compare the root growths of oats, corn, beans, radishes, and carrots. Are all of the roots alike after several weeks of growth? Examine the root of a dandelion. Are all roots the same?

Basic Concept:
Roots have root hairs.

(Vocabulary: root hairs)

1. Germinate several seeds on top of a blotter or folded cloth in bottom of a closed jar. Examine the roots daily for changes as the roots grow.
2. Fill a jar with moist sand. Plant several seeds between the jar and the sand in such a way as to observe the roots of the germinating seed. Allow the seeds to grow until the root hairs are observed. Pull the seed from the sand. Are the hairs still visible? Why do we not see root hairs on plants that have been pulled or dug from the soil?

IV. Instructional Materials

Teacher References

1. Atkin, J. Myron and R. Will Burnett. *Working with Plants.*
2. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 231-268.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
4. Navarra, John G. and Joseph Zaffroni. *Science Today for the Elementary-School Teacher.* Pp. 395-436.
5. Podendorf, Illa. *One Hundred and One Science Experiments.* Pp. 128-146.
6. UNESCO. *700 Science Experiments for Everyone.* Pp. 39-49.

Pupil References

1. Beauchamp, Wilbur L. *Science Is Learning.* Pp. 102-118.
2. Craig, Gerald S. and others. *Science Around You, Book 2.*
3. Dowling, Thomas I. and others. *The New Seeing Why.* Pp. 31-66.

4. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2.* Pp. 65-106.
5. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 179-191.

Enrichment References

1. Bulla, Clyde Robert. *A Tree Is a Plant.*
2. Darby, Gene. *What Is a Tree?*
3. Darby, Gene. *What Is a Plant?*
4. Downer, Mary L. *The Flower.*
5. Miner, Opal I. *The True Book of Plants We Know.*
6. Podendorf, Illa. *The True Book of Plant Experiments.*
7. Podendorf, Illa. *The True Book of Weeds and Wild Flowers.*
8. Zim, Herbert. *What's Inside of Plants?*

Films

1. *Learning About Flowers* (Encyclopaedia Britannica Films, Inc.), 10 min.
2. *Living and Nonliving Things* (Coronet Films), 11 min.

Filmstrips

1. *Finding Out About Seeds, Bulbs, and Slips* (Society for Visual Education, Inc.) 28 frames
2. *How Plants Live and Grow* (McGraw-Hill Book Co.), 37 frames
3. *Plants Change and Grow* (Eye Gate House, Inc.), 34 frames
4. *Plants We Know* (Children's Press), 32 frames
5. *Trees Grow* (Jam Handy Organization), 24 frames

Charts

1. *Elementary Science Charts* (A. J. Nystrom and Co.)
2. *Science Is Wondering* (Scott, Foresman and Co.)

UNIT
FIVE

Our Body is Like a Machine

I. Objectives

A. To develop an appreciation of habits as aids to daily living

B. To develop a desire for good health

C. To develop an appreciation of preventative health care

D. To develop a desire to know why we suggest certain health habits

II. Initiatory Activities (Motivation)

III. Developmental Activities

Basic Concept:
Health habits are the things we do each day to stay healthy.
(Vocabulary: habit, health)

1. Make a list of those things we do to keep an automobile running.
   Make a list of those things that we do each day to maintain good health. Keep these lists as reference points for discussion as the unit progresses. What is a health habit?
2. Have each pupil write a story of his activities from the time he wakens in the morning to the time he arrives at school. Do many people have similar health habits?
3. Make a collection of pictures showing people engaged in activities that keep them healthy. The teacher should make sure that pictures of doctors or nurses are included in the collection. An important phase of health education is teaching the value of the professional medical person in maintaining good health as opposed to only treating illness.

Basic Concept:
We must supply our bodies with energy and raw materials for growth and repair.
(Vocabulary: food, fuel, burning, clinical thermometer)

1. Ask the class to discuss the purpose of the stop at an automobile service station. Establish the meaning of fuel. Discuss the use of fuel for purposes other than running automobiles. Call attention to the presence of heat in fuel consuming operations.
2. Establish the presence of heat in the human body by comparing the temperature of the room to that of a pupil. This would be an opportune time to introduce the clinical thermometer. Where do we get the fuel to keep us warm?
3. Do we need warm foods to keep warm? Ask several pupils to experiment to check the answers to this question. Ask several pupils to eat nothing but cool foods for one day. You might suggest such foods as cold toast, cold boiled eggs, milk, and sandwiches. Compare temperatures of child with "cold" diet with those of children on normal diet. Note: It is important to seek advance permission and cooperation from the parent for this activity.
4. Establish the heat content of foods by burning dry bread, cooked bacon, and dried lettuce leaves.

Basic Concept:
Our bodies need air to combine with our food to keep us warm and give us energy.
(Vocabulary: chemical, energy)

1. Explain that our bodies do not have

an internal flame to produce heat, but that our bodies get heat and energy from foods in much the same chemical manner.

2. Make a small lamp from a ketchup bottle lid or similar container, cooking fat, and a bit of string. Fill the cap with the fat and insert the string. Light the wick of the lamp and place in a large-mouth, one-gallon jar. A glass container, large enough to introduce the burning lamp, may be substituted for a jar.

   Place a cover over the jar. What happens to the flame? Does the flame continue to burn if you do not cover the jar?

Basic Concept:
Like a machine, our bodies need periods of rest and repair.

(Vocabulary: machine)

1. Have each class member ask his father if the family car has been taken to a garage for repairs. If it has, was some part worn out? Why do machine parts wear out? Why do we turn machines off when we are not using them?
2. Have each pupil hold one hand extended, flexing the index finger as rapidly and as long as possible. Why do you stop? Allow several minutes to elapse and try again. Did the rest change the feeling in your finger?
3. Discuss the value of sleep. Why do we sleep? How do you feel at night as compared to morning? How do you know how much sleep you need? How much sleep should you have?
   Note: It is far better to overestimate the sleep needed than to undermine the bedtime established by the parents.

Basic Concepts:
Water is needed to help our bodies use food. Our bodies contain a lot of water.

(Vocabulary: perspiration, temperature)

1. Demonstrate the need of water for many chemical reactions by putting water with baking powder; dry yeast with sugar, then adding water; mixing baking soda with aluminum sulfate, and then adding water.
2. Place some dry sugar in a small, clean paper sack. How does our food get from our stomach into our blood stream?
   Place a bit of water in the sack with the sugar. Have the pupil taste the outside of the sack again.
3. What is meat? Where do we get our meat? Meat is the muscle of animals. Place a bit of meat in a warm dry place. Place a small piece of moist clay next to the meat. What happens to the clay? What happens to the meat? What did both the meat and clay contain?
4. Following a period of physical education, ask the children how they feel. What is on the surface of their skin? Where did this moisture come from? Why do we need to drink plenty of water?

Basic Concept:
Dirt may cause illness which prevents our bodies from working properly.

(Vocabulary: illness)

1. Have the pupils ask their fathers why they have the oil changed in their automobiles. What is dirt? (In common usage, dirt is used to indicate the presence of something which does not belong. Egg is *dirt* on the face, *food* on the table.)
2. Place some very moist soil in a sealed container in a very warm dark place, 90° to 100°. An incubator is a very fine place for this experiment. After three days, allow the class to smell the soil. The odor is caused by small plants living on the soil and using part of the soil as food. Why do we need to remove soil from our skin at frequent intervals?
3. Repeat the above experiment using food in the jar. Why should we wash both before and after meals?
4. Have a pupil wash his face and hands with a piece of cloth as a washcloth. Wring the water from the cloth but do not rinse it. Repeat experiment with this cloth. Do we need clean clothing daily?

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 308-333.
2. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*

Pupil References

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 2.* Pp. 26-45.
2. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2,* Pp. 157-187.
3. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 192-206.

Enrichment References

1. Dentler, Marie. *Time to Eat.*
2. Haynes, Olive V. *The True Book of Health.*
3. Jubelier, Ruth. *Jill's Checkup.*
4. Lerner, Marguerite Rush. *Doctor's Tools.*
5. Zim, Herbert. *What's Inside of Me?*

Films

1. *Growing Up Day by Day* (Encyclopaedia Britannica Films, Inc.), 11 min.
2. *Tommy's Healthy Teeth* (Coronet Films), 11 min.

Filmstrips

1. *Health Habits* (Encyclopaedia Britannica Films, Inc.), 45 frames
2. *Proper Food* (Encyclopaedia Britannica Films, Inc.), 45 frames
3. *Health Helpers* (Encyclopaedia Britannica Films, Inc.), 45 frames
4. *Keeping Clean* (McGraw-Hill Book Co.), 37 frames
5. *Rest and Sleep* (McGraw-Hill Book Co.), 37 frames
6. *Food for Health* (McGraw-Hill Book Co.), 37 frames
7. *Keeping Well* (McGraw-Hill Book Co.), 37 frames
8. *Let's Get Ready for School* (Society for Visual Education, Inc.), 30 frames

UNIT
SIX

Physical and Chemical Changes

I. Objectives

Concepts

1. Matter has weight and occupies space.
2. Matter can be changed.
3. Some changes are physical.
4. Some changes are chemical.

Attitudes

1. To develop an appreciation of changes in nature
2. To develop an appreciation of ability of man to control these changes
3. To develop an understanding of value of observations as "building blocks" of thought
4. To develop an understanding of value of past observations to formulation of new concepts

II. Initiatory Activities (Motivation)

The classroom can provide interest needed to launch study of changes.

1. The pencil is changed when it is placed in sharpener. In what form is pencil remaining in the sharpener?
2. Chalk and crayons grow shorter when we use them. How does use of chalk or crayon change them?
3. Observe decreasing water level in the aquarium. Where did water go?
4. The blackboard dries quickly when it is washed. What happens to water?

A walk outside the school will allow the class to observe many changes.

1. Leaves can be observed on the ground. Where are leaves that fell a year ago? Are leaves changing now?
2. Snow may be melting. Why?
3. Clothes may be seen hanging outside. Why are they placed there?
4. Smoke may be seen coming from chimneys. What does it come from?

III. Developmental Activities

Basic Concept:
Matter has weight and occupies space.

(Vocabulary: matter, weight, balance, scale, space)

1. Weigh a large number of objects found in room to illustrate the weight concept of matter. Spring balances or postage scales will weigh most of the smaller objects found in the room.
2. The construction of a simple balance will enable the teacher to demonstrate the weight of paper or a feather. When possible, borrow a beam balance from the high school. A cork with two wires bent and inserted into it will serve as a balance when placed on a paper spindle.

   Questions: Do all objects have weight? Does light, a shadow, or heat have weight?

3. Demonstrate space requirement of matter by trying to place two objects in the same space at the same time; two pupils in the same chair; or a rock into water. Call attention to displacement of some of the matter when other matter occupies original space. This activity calls for critical observations.

   Questions: Where does water go when it is pushed out of the way by a rock? Is air matter? Is air empty space?

Basic Concept:
Matter can be changed in size and shape without changing its characteristics.

(Vocabulary: characteristic, dissolve, iodine, starch)

1. Examine a sheet of paper and make a notation of its characteristics. It burns, you can write on it, and it absorbs water. Tear paper into smaller odd-shaped parts. Re-examine characteristics of parts.
2. Have the pupils taste rock salt. Crush rock salt in a mortar and test the taste again. Dissolve the salt in water and again test the taste. Repeat above experiment using powdered sugar, cane sugar, and beet sugar.
3. Cut an oat seed in half. Place some iodine solution on cut end. The blue color is a result of the reaction between iodine and starch. Test with iodine, oatmeal, a Cheerio, or any other changed oat. Note color change of starch indicating presence.

   Questions: Is paper still paper after it is torn in small pieces? Does crushing or dissolving change taste of salt? Can you find starch in oats in all forms? Does changing shape or size of something really change?

Basic Concept:
Matter can be found in any one of three states, solid, liquid, or gas, and can be changed from one to another.

(Vocabulary: freeze, solid, liquid, gas, steam, evaporate)

1. Examine the characteristics of water; it makes paper wet, it is colorless, and it is odorless. Freeze water and examine the characteristics of the ice (clear ice is the most satisfactory). Place some water in a teakettle and produce steam.
2. Steam is not visible. True steam is found only at the end of spout. The steam soon forms water droplets which can be seen.
3. Make a listing of other materials, common in children's lives, that are found in more than one form. Butter, paraffin, solder, and moth crystals are good examples.
4. Some solids change directly from solid to gaseous state. Dry ice evaporating, frozen clothes drying on line, and disappearing moth crystals illustrate this type of change. Solid iodine is excellent because the gas is purple and readily sublimes on cool part of test tube (consult high school chemistry teacher).

   It will take special effort to develop the concept of the gaseous state of matter.

   Warning: Do not heat paraffin or moth crystals near open flame.

   Questions: What do we do to change ice to water? to steam? How is water that has evaporated like steam? Do we change water in our use of it in our homes? Why do we heat paraffin over hot water instead of a flame?

Basic Concept:
Physical changes in matter can be reversed.

(Vocabulary: reverse)

1. Fill a teakettle with ice and bring water to a boil. Collect steam at end of teakettle spout on a cool object. (Water droplets will form from gas.) Place these droplets in the refrigerator and freeze them. (The state of the water has been changed several times, ending with original state and set of characteristics.)
2. Cut paraffin into small parts. Melt it over hot water. Allow the paraffin to cool a bit. Observe what happens.

Basic Concept:
Burning is a chemical change that changes the characteristics of materials.

(Vocabulary: burn, heat, ash, smoke, soot)

1. Place a bit of burning paper in a bottle, note results. The paper has changed. Note the characteristics of residue. Call attention to smoke. Hold a cool mirror over burning paper. (Water should form on the mirror.)
2. Discuss the characteristics of ash,

smoke, and water as compared to characteristics of original paper. Demonstrate that smoke is composed of solids by collecting soot from a burning candle on a piece of glass.

Questions: Where does the smoke from a fire come from? the water? Can we reverse the changes made in the burned paper?

Basic Concepts:

Heat is important in changing state of matter. Heat is important in making chemical changes in matter.

1. Discuss various activities conducted in earlier parts of unit.
2. Use words *torn, cut, heated, melted,* and *dissolved* in discussion. Ask class which word is used often in discussing the activities.

   Questions: How many physical or chemical changes can you think of that are caused by heat? When we cool something, we take heat away. What happens to the heat removed from food placed in refrigerator?
3. Look for the external coil of the refrigerator. It should feel warm to the touch.

IV. Instructional Materials

Teacher References

1. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
2. UNESCO. *700 Science Experiments for Everyone.* Pp. 92-94.

Pupil References

1. Hagaman, Adaline P. *What Is Water?*
2. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2.* Pp. 107-144.
3. Pine, Tillie S. and Joseph Levine. *Water All Around.* Pp. 20-31.
4. Podendorf, Illa. *The True Book of More Science Experiments.*

Films

Things Dissolve (McGraw-Hill Book Co.), 20 min.

Filmstrips

1. *All Matter Has Three Forms* (McGraw-Hill Book Co.), 45 frames
2. *Changes All Around Us* (McGraw-Hill Book Co.), 45 frames
3. *Some Things Dissolve* (McGraw-Hill Book Co.), 40 frames
4. *Things in the World Change* (L. W Singer Co.), 42 frames

UNIT
SEVEN

Wheels, Levers and Pulleys

I. Objectives

To develop an understanding of the use of simple machines to construct the complex machine

II. Initiatory Activities (Motivation)

In this unit several terms are introduced which have very precise scientific meanings quite different from those of common usage. While you, as a teacher, may never want to discuss the definition of these terms with your pupils, it will be helpful for you to have familiarity with the scientific meanings.

Force is the push or pull on an object. The object does not need to move as a result of the force applied. If, however, the object does move in the direction the force is being applied, *work* has been done. Note that in doing work, two things are necessary. The force applied to the object *moves* the object, and the force moves it in the *direction* that the force is applied. One might push on a heavy table very strenuously, but, if the table does *not* move, no work has been done as defined by science. A person picks up a suitcase. Work has been done by moving the suitcase against the pull of gravity. The person may hold the suitcase indefinitely, but he is *not* doing work. Neither is he doing work if he carries the suitcase across the room. The suitcase is being moved, but the force applied is vertical, against gravity, not horizontal in direction of motion.

Previous classroom experiences have made the children aware of simple machines and of their value to man. Further discussion of these kinds of machines are a logical and natural preface to this unit. The discussion should stimulate questions such as those under the first basic concept of this unit.

III. Developmental Activities

Basic Concept:

Wheels, levers, and pulleys help us to move objects more easily.

(Vocabulary: wheel, pulley, lever, axle)

1. Have the pupils collect a number of pictures showing men using machines to make their work easier. The majority of these machines will be complex machines, those having a large number of parts. Bring such simple machines as hammers, forks, brooms, and small block and tackle to class. Discuss these using the following questions as a guide.
   a. Why do we use machines?
   b. What examples of simple machines are levers? wheels? pulleys?
   c. Can you find simple machines as parts of complicated machines?
   d. What makes each of the machines move and do work?
2. Tie a number of books together with a piece of string. Try to pull the books across the table. Is it easy to slide the books?
3. Place several round pencils or pieces of chalk under the books. Try to pull the books again. Is this easier?
4. Take the children to the playground. Have the children try to pull each other in a wooden box. Now put broomhandle rollers under the box. Is it easier to pull the box on rollers than it was to pull them by sliding the box?
5. Place two boxes on a board, one with wheels, the other without. Lift the

end of the board. Which box moved first? Which moved fastest?

6. Point out that the wheels of the wagon are fixed to "axles" so they do not have to be picked up and moved. The wagon is a machine that helps to make work easier because of the wheels. Collect and display pictures of machines that have the wheels visible. Let the children tell how these wheels help the machines to do the work.

Basic Concept:
A large wheel moves farther in one turn than a small wheel.
(Vocabulary: circle, distance)

1. Measure the distance around two large circles, one an inch or more larger than the other in diameter. Use string to convert the circumference to linear distance.

   Would you run farther on the outside of a circle or inside of a circle?
2. Secure two wheels of different size. Measure the distance each moves in one turn.

Basic Concept:
A pulley is a "kind" of wheel.

1. We usually see the wheel travel on the road. What would it be like to have the wheel stand still and have the road move upon it?
2. Cut a piece of paper as wide as a spool and about two feet long. This will serve as the road. A spool with a nail through the hole will serve as the wheel. The wheel can be rolled on the road. Now hold the wheel between the thumb and finger by the axle. Pull the paper (road) over the wheel. We now have a pulley.

Basic Concept:
A pulley can be used to change the direction of a force.
(Vocabulary: force)

1. How can we lift a heavy load into the air without climbing a ladder with it, or standing above it and pulling it up?
2. Demonstrate that a single pulley will allow an object to be lifted while the person is standing on the ground.
3. Hang a weight of one pound on one end of a cord over a single fixed pulley. Show the class that you must pull with a force of one pound or more to lift the weight.

   A single fixed pulley (1) changes direction of pull making it easier to lift an object, (2) makes it possible to lift objects very high, (3) will use a little more force than the weight of the object because of function.

   A single fixed pulley can be made by driving a long finishing nail into the wall and putting a bobbin over the nail.

   Paper cups of sand can be substituted for the spring balances. Put same amount (by volume) of sand in each cup, or use several metal washers as weights.
4. Make a list of activities which use the pulley to lift an object while standing on the ground, raising the flag, or lifting hay to the hayloft.

Basic Concept:
Several pulleys in combination make it possible to lift heavy loads.
(Vocabulary: weight)

1. Use the rotary bobbins (sewing machine) instead of spools. Try this experiment with the same cups of sand as in first experiment. What happens? Put more sand into cup A or remove some from cup B until they balance. How do the amounts of sand compare? Try lifting the cup A by pulling down at B (without cup B). Then lift cup A without the pulley. How does this compare?
2. First use one pulley to lift a one-pound weight. Then use a combination of pulleys to lift the same weight. Which set of pulleys made it easiest to lift the weight? Why?

Basic Concepts:
There are many kinds of levers in our lives. A hammer is one type of lever. A see-saw is another type of lever. Levers are sometimes used in pairs.

1. Try to pull a nail from a board with your fingers. Now use a hammer to

pull the nail. Which is easier? Can you think of another type of lever that lifts things the way that a hammer lifts nails?

2. Try to lift a heavy box of books. Place one end of a broomstick under the box. Place a brick under the broomstick near the box. Lift the box by pushing down on the end of the broom. Does the broom (used as a lever) help lift the box?
3. Discuss different types of playground apparatus. Which piece of equipment is used to lift a weight on one end by pushing down on the other end? How can two children of different weights adjust themselves to balance on the see-saw?

   If this equipment is available on the playground, it is a wonderful opportunity for children to experiment.
4. Examine a pair of pliers, scissors, and tin snips. Can you find a lever in each? Can you find two levers in each? What other tools or machines have pairs of levers? What about a nut cracker?

Basic Concept:
Some machines are made up of a number of simple machines working together.
(Vocabulary: machine, simple)

1. Possibly one of the youngsters will have a working model of a power shovel or crane. The class can examine it for the simple machines they have studied.
2. Study pictures of steam locomotives, power shovels, tractors, or other large, open machines. Look for the simple machines that have been studied.
3. Sketch or bring to class the following common simple machines and ask the children to identify the lever and the wheel axle.
   a. Wheelbarrow
   b. Wall can opener
   c. Movie projector

IV. Instructional Material

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 444-464.
2. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 688-715.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
4. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teacher.* Pp. 331-348.
5. Podendorf, Illa. *One Hundred and One Science Experiments.* Pp. 107-114.
6. UNESCO. *700 Science Experiments for Everyone.* Pp. 108-114.

Pupil References

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 2.* Pp. 80-91.
2. Beauchamp, Wilbur L. *Science Is Learning.* Pp. 47-66.
3. Bond, Austin D. and others. *Thinking About Science.* Pp. 7-25.
4. Craig, Gerald S. and others. *Science Around You, Book 2.* Pp. 110-130.
5. Dowling, Thomas I. and others. *The New Seeing Why, Book 2.* Pp. 147-163.
6. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2.* Pp. 1-30.
7. Schneider, Herman and Nina. *Science for Here and Now, Book 2.* Pp. 10-20.
8. Thurber, Walter A. *Exploring Science, Book 2.* Pp. 129-144.

Enrichment References

1. Barr, Jene. *Big Wheels! Little Wheels!*
2. Elting, Mary. *Machines at Work.*
3. Lewellen, John B. *The True Book of Toys at Work.*
4. Mitchell, Lucy S.; Margaret Wise Brown; and Blanche K. Verbeck. *Animals, Plants, and Machines.*
5. Zaffo, George J. *The Big Book of Real Building and Wrecking Machines.*

Films

Big, Wide Highway (Coronet Films), 10 min.

Filmstrips

1. *Simple Machines Help Us Work* (Jam Handy Organization), 6 filmstrips
2. *Tools and Simple Machines* (McGraw-Hill Book Co.), 40 frames
3. *Machines and Tools Help Us Work* (Society for Visual Education, Inc.) 40 frames

Charts

1. *Elementary Science Charts* (A. J. Nystrom and Co.)
2. *Science Is Wondering* (Scott, Foresman and Co.)

Grade Three

A complete, alphabetized list of references will be found in the bibliography. The appendix contains demonstrations and experiments for grade three.

UNIT ONE

Movement of Earth and Moon

I. Objectives

A. To help children gain some understanding and develop some skills essential to becoming well-informed individuals

B. To learn to appreciate the study that men have made concerning the sun, earth, and moon

C. To help the children learn cooperation, group planning, and consideration for others

D. To arouse an interest and curiosity in the sun, moon, and earth

E. To develop an appreciation of benefits received from the sun and moon

F. To appreciate the fact that the earth's movements around the sun and on its axis are responsible for plant and animal life adaptation

G. To develop an appreciation of the vastness of space

H. To develop wholesome interests for their leisure time

II. Initiatory Activities (Motivation)

Set up a bulletin board showing phases of the moon, eclipses of the sun and moon, as well as one showing the relative location of the planets, and the path of the earth and moon around the sun.

There may be a possibility of taking a field trip in the evening to study the moon through a telescope or field glasses, or to visit the planetarium.

Pictures showing rocket ships and conception of life on the moon would be valuable for a bulletin board display.

III. Developmental Activities

Basic Concept:

The earth is the shape of a huge ball.

1. Discuss what we know of the earth and its movements.
2. Examine a globe. Discuss pictures on bulletin board—views showing curve on the earth.
3. Read or tell stories believed by early people concerning the shape of the earth.
4. Attach a paper ship or small figure of a person on the globe or large ball. Turn the "earth" so that more and more of the marker shows as it comes over the curve of the earth.

Basic Concepts:
The earth turns around on an invisible axis—never stopping. It has a north pole. It has a south pole.
(Vocabulary: axis)

1. Use a spinning top to show how the earth turns on an axis, though the top will stop because it is rubbing against something.
2. Start a file or booklet in which to keep the questions, answers, understandings, reports, stories, and drawings connected with this study.

Basic Concepts:
The earth rotates, which causes day and night. One complete turn every twenty-four hours. The earth turns counter-clockwise or from west to east.
(Vocabulary: rotate, corona)

Darken the room. Use a flashlight or lamp for the sun, an apple or ball for the earth. Attach a marker where we live. Turn the marker to the light for day. Turn it to show morning, noon, evening, and midnight.

Basic Concepts:
The earth revolves around the sun while it rotates on its axis. The earth always tilts in the same direction, toward the North Star. One revolution takes 365 days or one year.
(Vocabulary: revolve, Pole Star, North Star)

1. A child representing the sun moves slowly in a given direction. Another child, carrying and rotating the globe, walks around the sun, being careful to notice that the North Pole always points in the direction of the North Star, or Pole Star.
2. To show how the Pole Star does not change its position, paste silver stars in the positions of the big dipper and the Pole Star on black or dark blue paper. Thumbtack the paper to bulletin board at the Pole Star. Turn the paper so that the dipper seems to circle the Pole Star. Be sure the children know it is the earth that turns rather than the dipper.

Basic Concepts:
The earth has four seasons due to the tilt of the earth while it travels in its orbit around the sun. Slanting rays produce less heat and light; shorter days, longer nights, or the winter season. Direct rays produce more heat and light; longer days, shorter nights, or the summer season. The equator has constant direct rays, giving nearly an equal number of hours of day and night all year long.
(Vocabulary: seasons, equator, orbit)

1. Shine a flashlight straight at a paper or chalkboard. Draw a ring around the round spot of light. Next shine the light at the paper or chalkboard at a slant. Draw a ring around the larger spot. The same amount of light covers a larger area at a slant, reducing the concentrated light.
2. Hold a magnifying glass so that the sun shines on the smallest spot on a piece of paper. In time the spot should smoke and burn. The glass held so that a large spot is made will not cause the paper to burn readily.
3. Rotate the globe and travel around the lamp used as the sun. Notice how the equator always receives direct rays of light.
4. Diagram the relationship of the earth and the sun at each season of the year.

Basic Concepts:
The earth is surrounded by a sea of air. It is many miles deep. The air is thinner higher up.
(Vocabulary: atmosphere)

1. Pupils read for information to answer questions concerning the atmosphere. Such as: How far up does air reach? Why is it colder up on the high mountains closer to the sun than it is down in the lowland?
2. Use opaque projector on the pictures from *Giant Golden Book of Science*, p. 62 and Blough, Glenn O., *Elementary-School Science and How to Teach It*, p. 188.

Basic Concepts:
Earth has a force called gravity. The weight of an object represents the gravitational pull of the earth on that object. Up is away from the center of the earth. Down is toward the center of the earth.

Gravity keeps things from falling off the earth. The earth's gravity keeps the moon in orbit.

(Vocabulary: gravity, gravity pull-weight)

1. Lift a pencil, then a chair. The weight of each tells us how much gravitational pull the earth has on each.
2. Throw anything up into the air or climb upstairs. It will be easier coming down.
3. Pour water from one container to another.
4. Discuss the meaning of gravity. What would life be like without gravity. Write a make-believe story.
5. Cut a hole down through the core of an apple. Put a string through and tie. Swing the apple around in a circle. The apple represents the moon and the string the gravitational pull to the earth.
6. Draw pictures to illustrate each concept.
7. Find information about men who discovered these concepts such as Newton and Galileo.

Basic Concept:

The moon is the shape of a ball.

(Vocabulary: lunar)

Explain how the moon is like our earth. Arrange pictures of the moon on the bulletin board.

Basic Concept:

The surface of the moon has mountains, valleys and plains, and craters.

(Vocabulary: crater, shadows)

Discuss the pictures on the bulletin board. What do you think causes the shadows and craters? Make a model of the surface of the moon of clay.

Basic Concept:

The moon reflects light from the sun.

(Vocabulary: reflect)

Darken the room. Mention how dim the globe looks. Shine a light on it so that it will reflect light. Use a mirror to show how something with no light of its own can reflect sunlight.

Basic Concept:

The moon revolves around the earth once about every 28 days (one month).

A child may walk around the globe keeping his face toward the globe. Back at the starting point he will have rotated once because he has faced all four sides of the room.

Basic Concepts:

The moon rotates once during a revolution around the earth; therefore, it keeps the same side toward the earth. The moon is made of rock. The moon is a natural satellite.

(Vocabulary: satellite)

Select books for a bibliography. Write reports by answering questions raised such as:

1. Why do we always see the same side of the moon?
2. Why is one side of the moon very hot and the other side very cold?
3. Why does the moon look bigger than the sun?
4. What is the surface of the moon like?
5. Why do people refer to the "man in the moon"?
6. How do we know how the moon looks?
7. What is the size of the moon?
8. How far away is the moon from the earth?
9. Why does the moon seem to change shape?
10. Could people live on the moon? Why?
11. Can we ever see the moon during the day? Why?

Basic Concept:

The moon is smaller than the earth.

1. Discuss how the moon differs from the earth.
2. To show the relative size of earth and moon, place fifty marbles in a cloth or plastic bag to represent the size of earth. Compare with one marble representing the moon.
3. Make fifty-one balls of clay the same size. Label one ball "moon." Squeeze the other fifty together and label it earth to show the comparative size of moon and earth.

Basic Concept:

It is believed the moon has little or no air, water, clouds, plants, or animal life.

Read for information. Find why there is little or no life on the moon.

Basic Concept:
The moon has very little gravity, as we know it.

1. Discuss the effects of gravity and the lack of it.
2. Write a story of a trip to the moon. Illustrate.

Basic Concepts:
We see only the part of the lighted side of the moon which is facing the earth. The sunny half of the moon is very, very hot; the other half is very, very cold.
(Vocabulary: phases, crescent, quarter)

1. Discuss why the moon seems to change shape.
2. Place a ball (moon) on the end of a stick or a wire. Mark the side which is to be kept facing the child (earth). Close the window blinds. Hold the moon up to reflect the light of a stationary lamp or projection lantern. The fully lighted side is called a full moon. Hold the ball up and turn it slowly to the left. As the child and the ball continue to turn left, less and less of the lighted side will be seen. The shape of the lighted part we see gets smaller until it starts to get larger and larger.
3. Draw pictures of the different phases of the moon. Label—full, quarter, new moon, crescent.
4. Make a calendar for the month to illustrate the phases of the moon.

Basic Concepts:
The sun is a star because it shines by its own light. Sunspots may be recognized as dark areas on the sun. Prominences extend from the surface of the sun.
(Vocabulary: scientists, astronomer, stars, sunspots, prominences, millions)

1. What have scientists learned about the sun?
2. Show pictures along with a discussion of the sun, sunspots, and prominences.

Basic Concept:
The sun's heat and light comes from hot glowing gases.

Show how a light bulb or heater glows and does not burn up, but gives heat and light.

Basic Concepts:
The sun is very, very hot. Metals are in the form of gas. The same metals on earth are solid.

Boil water to observe the steam or gas. Compare the hot steam with the billowing gas from the sun. Compare ice cube with earth's rocks.

Basic Concept:
The sun's light is too bright to look at directly.

Look through an overexposed film, blue glass, or smoked glass at the sun.

Note to Teacher:

There is danger of eye damage even using above mentioned objects—allow children to look at sun only a few seconds even when using smoked glass.

Basic Concept:
The sun moves along through space.

Show diagrams of how the sun moves.

Basic Concept:
The sun looks small because it is so very far away.

Show pictures which show that large things look small when they are far away—as a large building in the background or a big tree in the distance.

Basic Concept:
The sun is many times larger than the earth.
(Vocabulary: legends, mural)

1. Cut out of cardboard a circle 27 inches in diameter to represent the sun. Cut out a circle ¼ inch in diameter to represent the earth. Paste the small circle on the large one. Compare sizes.
2. Fasten one end of a three-foot string to the floor or paper with a thumbtack. On other end of string attach chalk or pencil. Draw a circle. Place a dime in the circle to show relative size of sun and earth.
3. Report on legends of the sun.
4. Paint a mural showing earth and moon's orbits.
5. Make a planetarium.

Basic Concept:
Sunlight has colors.
(Vocabulary: prism)

1. Hold a prism or a glass of water in the sunshine to see a rainbow.
2. Paint or color a rainbow.

Basic Concept:
The sun makes shadows and can be used to tell directions and time.
(Vocabulary: gnomon)

1. Make and observe shadows. Discuss why there is a shadow. When is it longest and shortest during the day and seasons?
2. To show how shadows change during the day, outline the shadow of a child on a piece of wrapping paper at 9, 2, and 3 o'clock. Use the same child in the same position.
3. To show how shadows change during the seasons, outline the shadow of a child each month at noon. The same child and the same day of the month should be used.
4. Make a shadow stick. Cut a 6 x 6-inch square of wood. Drill a hole in the center. Insert a 6-inch dowel. Have children look at stick in morning, noon, and afternoon to notice how the length of shadows change.
5. Make a sundial. Cut a circle out of cardboard. Make a slit in the center. Cut the gnomon pointer out of another piece of cardboard. Insert this in the slit. It will stand up and cast a shadow when the sun shines on it. Number with Roman numerals.
6. Make silhouettes of the children.

Basic Concept:
The sun gives heat and light.

1. Explain importance of sun to us.
2. Touch the window sill or a book in the sunshine. Compare with a window sill or book in the shade.
3. Discuss and write a paragraph, poem, or story about what the earth would be like if there were no sun. Duplicate stories to put in booklet.

Basic Concept:
The sun helps with the growth of plants and animals.

1. Use two plants with the same quality of soil; see that each has water, fresh air, and warmth. Place one in the sunshine and the other in a dark place. Without the sun, one of the plants will turn yellow and drop its leaves while the one in the sunshine will remain green and healthy.
2. Discuss the reasons animals need sunshine.
   a. Animals depend on plants for life.
   b. Plants depend on sun for life.

Basic Concept:
The sun supplies heat to evaporate water.
Read, discuss, and draw pictures showing the water cycle.

Basic Concept:
The sun is the source of all life.
Summarize by listing the different things that the sun is responsible for doing.

Basic Concepts:
The earth is the third planet from the sun in the universe. Telescopes are used to discover new knowledge.
(Vocabulary: universe, galaxy, telescope, solar system, planet)

1. Explain our relationship to the sun and moon in the universe.
2. Choose an object in the room and trace its origin to its need of sunshine.
3. Write the child's address:
   Name:
   Grade:
   Name of School:
   Street and Number:
   Town:
   County:
   State:
   This may be used to show cooperative relationships:
   United States
   North America
   Earth
   Solar System
   Milky Way Galaxy
   Universe

IV. Instructional Materials

Teacher References

1. Arey, Charles K. *Science Experiences for Elementary Schools.* Pp. 39-49.

2. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.*
3. Craig, Gerald S. *Science for the Elementary School.*
4. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*
5. Teacher's editions and manuals of each of the pupil's textbooks.

Pupil References

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 3.* Pp. 162-192.
2. Blough, Glenn O. and Ida DePencier. *How the Sun Helps Us.*
3. Bond, Austin D. and others. *Knowing About Science.* Pp. 78-109.
4. Craig, Gerald S. and others. *Science Everywhere.* Pp. 87; 117-133.
5. Dowling, Thomas I. and others. *The New Learning Why.* Pp. 140.
6. Frasier, George W. and others. *Finding Answers.* Pp. 101-108; 201-209.
7. Freeman, Mae and Ira. *The Sun, Moon, and the Stars.*
8. Gallant, Roy A. *Exploring the Moon.*
9. Gallant, Roy A. *Exploring the Sun.*
10. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 3.* Pp. 16; 101-184.
11. Knox, Warren and others. *The Wonderworld of Science, Book 3.* Pp. 111-132.
12. Lewellen, John. *The True Book of Moon, Sun, and Stars.*
13. Parker, Bertha M. *The Golden Book of Science.* Pp. 62-68; 87.
14. Smith, Victor C. and Katherine Clarke. *Science Around the Clock.* Pp. 77-98.
15. Thurber, Walter. *Exploring Science, Book 3.* Pp. 5-18.
16. Ware, Kay L. and Gertrude B. Hoffsten. *You Find Out Worktest.* Pp. 42-64.
17. Zim, Herbert. *The Sun.*

Films

1. *The Sun's Family* (Classroom Film Distributors, Inc.), 842.
2. *This Is the Moon* (Classroom Film Distributors, Inc.), 845
3. *What Makes Day and Night* (Classroom Film Distributors, Inc.), 830

Filmstrips

1. *The Earth and its Wonders, The Story of Air* (Encyclopaedia Britannica Films, Inc.
2. *The Earth and Its Neighbors in Space* (Encyclopaedia Britannica Films, Inc.)
   a. Our Earth
   b. The Moon
   c. The Sun
   d. The Solar System
   e. The Stars

Source Materials

1. Encyclopaedia Britannica
2. World Book
3. Compton's Pictured Encyclopedia.

Charts

1. Comparing the size of the sun and earth.
2. Comparing the size of the earth with the moon.
3. Showing different phases of the moon around the sun.
4. Showing the path of the earth and moon around the sun.
5. Showing the tilted earth, receiving direct rays from the sun during summer.
6. Showing the earth during winter when the northern hemisphere receives indirect rays from the sun.
7. Showing the diagram of the four seasons.
8. Calendar to record the phases of moon.

UNIT
TWO

Changes in the Earth's Surface

I. Objectives

A. To develop a fundamental understanding of: (1) forces which build up earth, (2) forces which wear down earth, (3) how mountains are formed, and (4) how we can conserve our soil

B. To become aware of differences in the earth's surface

C. To realize that changes in the earth's surface have been going on for millions of years and will continue to change

D. To appreciate seeing the beauty of nature around them

E. To understand the forces which change the surface of the earth

F. To understand the importance of conserving the earth's natural resources

II. Initiatory Activities (Motivation)

To capture and hold interest of class, several attractive ideas should be offered with enthusiasm on the part of teacher. One way to initiate this unit would be in connection with the study of the pioneers. The teacher may read or give a description of what Iowa was like before white man came, particularly the immediate locality. Then discuss changes —trees cut down, fences around grain fields and pastures, rivers dammed up, cities, bridges, and highways cut through a hill showing rock layers. This unit could also be developed during language period by listing on the chalkboard questions the children raise.

During language period, letters of request, invitations, or thank-you notes could be written following a visit to a museum or a visit from a resource person. A diary of each day's activities could be kept.

Interest could be aroused by sharing oral reports on vacation experiences, using bulletin board or opaque projector to display scenic photographs, or post cards with special attention paid to water and land forms. After a wind or rain storm, a field trip could be taken around school vicinity to see firsthand effects of wind and/or water on planted and unplanted soil, and soil and stones washed into street.

A child may bring in a fossil of a clam or some other sea animal which was brought to the surface from a recent digging of a ditch, road cut, or from gravel on a street or road. The unit could develop from the explanation that the sea covered this part of our state at one time.

Prepare a bulletin board of pictures showing different parts of the earth's surface: rivers, lakes, ocean shore lined by rocks, beaches, waterfalls, mountains, valleys, deserts, volcanoes, and glaciers.

The use of films, filmstrips, and slides could also be an aid to capturing interest of the children.

To start a discussion, the children are asked what they know about the earth's surface and how or why it is being changed. Next, ask them what they would like to know about the surface of the earth and its changes. The children will show their interest by asking questions. The questions should be written down on the chalkboard as problems to be answered. The questions which seem to belong together are classified under main headings, such as: forces which build up earth, forces which wear down earth, how mountains are made, and how we can conserve our soil.

III. Developmental Activities

Basic Concepts:

The natural surface of the earth differs in various parts of the world. There is a wide variety of earth structures.

(Vocabulary: surface)

1. Pupils will listen, watch, and ask questions while the teacher reads, tells, and shows pictures.
2. Pupils will find, mount pictures, identify, and label each different structure. Discuss the characteristics which make them different. Tell how they think they have changed and will change.

Basic Concept:

The structure of the earth's surface affects the way people live, food they eat, houses they live in, and how they earn their living.

(Vocabulary: mountains, lake, hills, ocean, pond, valley, stream, gully, river, plains, waterfall, desert, island, sand dune, swamp)

1. Make a mural. (Individual or small groups would be responsible for depicting various surface formations.)
2. Draw pictures of those formations which are of the most interest to each child. (Plan to keep for a booklet.)
3. Keep a diary of each day's experiences of activities in connection with this unit. (This integrates handwriting, spelling, and language skills.)
4. Organize small groups or committees to find information about the people, food, clothing, and the ways of earning a living in different parts of the world; such as, Iowa, Alaska, Hawaii, on a desert, and in a jungle. Share the findings in a general discussion.

Basic Concept:

Under the entire earth's surface there is a layer of bedrock.

(Vocabulary: bedrock)

1. Take a field trip to a nearby quarry or a road which has been cut through a hill of rock to see the layers. Samples of rocks seen should be brought back to school.
2. Discuss the way the layers looked, draw a picture, and write a brief description.

Basic Concept:

Under the exposed crust of rock are layers of rock with different characteristics.

(Vocabulary: crust)

Fill a fruit jar three-fourths full of water, put in enough stones to cover the bottom, add two handfuls of smaller pebbles, also enough soil to make definite layers. Shake. Let it settle. Heavier rocks will settle first; lighter ones will form the next layer with soil on top.

Basic Concept:

There are zones of structure in the earth where the temperature increases as one goes deeper toward the center of the earth.

(Vocabulary: molten, zones, structure)

Draw a diagram on the chalkboard of a cut-out section of the earth showing the zones. Use the opaque projector with diagram. [1]

Basic Concepts:

Inner structure of the earth may bring about changes in its surface. Hot liquid rock in the earth is forced up to the surface and forms volcanoes.

(Vocabulary: lava, erupt, magma, crater)

1. For a miniature volcano, a model can be shaped of clay or plaster of Paris over chicken wire. Burn ammonium dichromate in the crater. The ash shoots up and settles down to form a cone at the top and slopes down the sides.
2. Use a globe or map to locate Hawaii, Aleutian Islands, and other volcanic islands.
3. Collect and display pictures of different kinds of volcanic mountains. Explain how they differ.

Basic Concept:

Pressure from within the earth causes the earth's rocky crust to fold and form great mountain ranges, such as the Alps, Rocky Mountains, and Appalachians.

(Vocabulary: mountain range)

Use a dozen or more sheets of different colored, heavy construction paper

[1] Glenn O. Blough; Julius Schwartz; and Albert J. Huggett, *Elementary-School Science and How to Teach It* (New York: The Dryden Press, 1951), 119; or, Gerald S. Craig, *Science for the Elementary-School Teacher* (Boston: Ginn and Company, 1958), 28.

with sheets of cardboard between each. Wet each one and place on top of another. Push two sides toward the middle to form humps. Let this dry.

Basic Concepts:

Pressures may be so great that the rocky crust may break. This may push one side higher than the other to form a block mountain.

(Vocabulary: fault)

To show how a block mountain is formed, the above activity may be used. Cut with scissors across the humps and let one side slip up higher than the other.

Basic Concept:

Some of the present mountainous areas were once ocean bottoms.

Show fossils of clams or other sea animals which were brought to the surface from recent diggings of a ditch, road cut, or from gravel on a street or road.

Basic Concepts:

Rocks are formed by different methods. Igneous rock is formed from the cooling and hardening of molten rock brought to the surface by volcanoes. Sedimentary rock is formed by sediments, like sand, pebbles, and mud, cemented together. Metamorphic rock is formed by heat and pressure on igneous and sedimentary rock which changes them into a new rock.

(Vocabulary: igneous, sandstone, sedimentary, quartz, metamorphic, gypsum, limestone, plaster of Paris)

1. Start a collection of rocks gathered from the community. (A rock collection purchased from a supply house or loaned by a friend may be used as a key to help in identifying them.)
2. Take a field trip to a nearby source of rocks—a stream bed, a gravel pit, newly dug basement, or a quarry—to gather specimens.
3. Develop a scheme for classifying rocks collected. Possible classifications may be "soft and crumbly rocks," "hard," "rocks that scratch glass or wood," "rocks made up of small pebbles," "rocks in layers."
4. Develop a hardness scale or chart. Possible groups: "scratched by fingernail," "scratched by gypsum," "scratched by limestone," "scratched by glass."
5. Examine rocks through a magnifying glass.
6. Divide a shallow cardboard box into compartments. Group like specimens together and label.
7. To test limestone—place a piece of the rock in warm vinegar, if it is limestone bubbles will appear. An eyedropper of *hot* vinegar on limestone will make bubbles. Muriatic acid (diluted hydrochloric acid 10%) purchased from a drugstore may be used in place of vinegar.
8. Refer to the reference books for information about specific rocks. A written account could be kept of various activities.

Basic Concepts:

Soil contains rock which has weathered and has been broken up by many forces. A temperature change will expand and contract the rock and break it.

(Vocabulary: weathered, contract, expand)

1. To show there is rock in soil, put some soil in a jar of water. Stir it. Let it stand until it settles. Pour off the water and some of the soil. Feel the tiny rocks in the soil which is left on bottom of jar.
2. Fill a glass jar to the top with water. Seal tightly. Place in a paper sack or lay in a pan. Keep it in a freezer until it is frozen solid. Discuss what happens to jar.
3. Heat a small piece of quartzite or limestone over a flame or on a hot plate for at least a half hour. Drop it quickly into a pan of ice water. The rock should break. Caution children not to stand close to pan of water.
4. Weigh a piece of porous rock. Soak the piece of rock in water overnight. Weigh it again. Place it in a freezer until frozen. Thaw it and notice any change as the rock thaws.

Basic Concepts:
Running water carries sand and bits of rock. These will scrape and cut away edges of rock.

1. Exhibit smooth pebbles which were taken from a river or a stream.
2. Rub sandpaper over soft rock many times or rub two pieces of sandstone or limestone together. Examine rubbed-off particles with magnifying glass.

Basic Concept:
Wind-carried sand wears away rock.
(Vocabulary: erosion)

1. Display pictures of the desert with cliffs showing action of wind erosion.
2. If a stone building is being cleaned in the community, discuss how sand is used to clean the building.

Basic Concept:
Plants and tree roots widen cracks in rocks and break them.
(Vocabulary: lichen, sprout)

1. Find a rock on which little plants are growing. Pull off a bit and observe condition of rock. Notice pieces of rock clinging to plant.
2. Locate a tree growing out of the side of a rocky hill. Note how the tree is anchored and how rocks are affected.
3. Place a bean seed in plaster of Paris before it solidifies. The moisture will cause the seed to sprout and crack plaster of Paris after it is hard.

Basic Concept:
Some soils contain decayed plant and animal material.
(Vocabulary: decayed, humus)

Collect samples of soil in glass jars from several different places (a garden, the schoolyard, woods, river bank, etc.). Cover with water. Some of the samples will have plant material floating on top. Examine with a magnifying glass.

Basic Concepts:
Forces of nature build up earth in some places, and wears it down in others. Wind carries sand and loose soil from one place to another.
(Vocabulary: sand dune, dust storm)

1. Fill a box half full of dry soil. Turn on an electric fan and hold it over box. Sprinkle water over the surface. Turn on the fan again and compare results. Repeat the activity using dry sand in another box.
2. Notice and discuss how wind blows clouds of dust across the schoolyard.

Basic Concept:
Wind causes lake and ocean waves to erode shore line.

Place a continuous mound of sand or fine soil around the edge of a large pan. Pour enough water in center of pan to cover edge of soil or sand. Turn an electric fan on the water. Waves will wear away the shore line.

Basic Concept:
Swiftly running water carries rocks and soil from high lands and deposits the load in other places as the water slows down.
(Vocabulary: soil, erosion)

1. Take a walk to study a small stream. Notice what the current has done to the bank around a bend. Look for rocks, pebbles, and any islands built up from materials deposited in the stream. Note clearness of the water and explain.
2. Place stones, soil, and water in a quart jar. Stir. Notice how soil and rocks are held up when water is moving swiftly. Stop stirring. What happens?
3. Make a hill in a large pan by placing a large rock in the center. Cover with several different types of soil (clay, sand, loam, and small rocks). Make holes in the bottom of a can. Fill the can with water and sprinkle the hill. Explain how the running water carries soil and rock to level ground.

Basic Concept:
Ice glaciers move soil and rock to change the surface of earth.

1. A letter may be written to the State Geological Survey, Des Moines, Iowa, to find whether a glacier has ever covered your part of the state.
2. Use opaque projector to show class illustration in Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett, *Elementary-School Science and How to Teach It*. Pp. 130.

3. Look for evidence of a glacier having deposited soil and rock or formed lakes in community. (May not be observed in every community.)
4. Collect and display pictures showing effects glaciers had on the earth.

Basic Concepts:

How can we conserve our soil? There are natural forces that cause soil erosion.

1. Review and discuss different ways in which wind and water move soil from one place to another. Use again the activity of turning the electric fan on a large pan of dry loose soil. Observe running water on the hill of unprotected soil and rock. Notice the muddy water and where the soil is deposited.
2. Keep a record of the activities and understandings.
3. Walk to a nearby place where water or wind has caused soil erosion.

Basic Concept:

Ground cover will slow soil erosion.

Use the large pan of dry loose soil shaped into a hill. Cover soil with a piece of sod or with leaves, twigs, and other plant materials. Turn the electric fan toward pan of soil. Observe results. Sprinkle hill with water. Discuss the results.

Basic Concept:

Roots of growing plants help to keep soil in place.

1. Try to wash the soil from the roots of a piece of sod. (This shows how tightly roots will hold the soil.)
2. Find information on how tree planting helps soil conservation. Demonstrate and report on contour plowing, strip planting, tree planting, windbreaks of trees and shrubs, and grass planting.

Basic Concept:

Farmers use various soil conservation practices.

Build a model farm in a sand table, large lined box, or pan showing some ways to practice soil conservation. Demonstrate and report on contour plowing, strip planting, tree planting, windbreaks of trees and shrubs and grass planting.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 118-140.
2. Craig, Gerald S. *Science for the Elementary-School Teacher.* Pp. 158-183; 234-310.
3. Editorial Staff of Life. *The World We Live In.* Pp. 20-39; 42-61; 176-195.
4. Navarra, John G. and Joseph Zafforoni. *Science Today for the Elementary-School Teacher.* Pp. 169-199.
5. Parker, Bertha. *The Earth's Changing Surface.*
6. Parker, Bertha. *Soil.* Pp. 4-10.
7. Teacher's editions for each of the pupil science textbooks.

Pupil References

1. Barnard, J. Darrell and others. *A Unified Program in Science, Health, and Safety, Book 3.* Pp. 159-160; 193-194.
2. Beauchamp, Wilbur L. and Helen J. Challand. *Science Is Exploring.* Pp. 85-104.
3. Craig, Gerald S. and Marguerite W. Lembach. *Science Everywhere.* Pp. 55; 98-115; 134-157.
4. Frasier, George W. and others. *Finding Answers.* Pp. 7-31.
5. Jacobson, Willard J. and Cecilia J. Lauby. *ABC Science Series, Book 2.* Pp. 33-64. *Book 3.* Pp. 122-148.
6. Schneider, Herman and Nina. *Science Far and Near.* Pp. 4-20.
7. Thurber, Walter. *Exploring Science, Book 3.* Pp. 145-158.

Enrichment References

1. Craig, Gerald S. and Beatrice Davis Hurley. *Discovering With Science, Book 4.* Pp. 78-85; 198-199; 220-235.
2. Schneider, Herman and Nina. *Rocks and Rivers and the Changing Earth.*
3. White, Anne T. *Rocks All Around Us.*

Free and Inexpensive Material

1. *The Soil That Went to Town* by C. W.

Gee; Bulletin 95, 1952, State Conservationist, Iowa Building, 505 Sixth Avenue, Des Moines, Iowa.

2. *Who Lives On The Forest Farm?* (Comic Book and Suggestions for Teachers) International Paper Co., New York, 1954, Free.
3. *The Story Book Of Land: Its Use and Misuse.* (Comic Book) The Soil Conservation Society of America, 1016 Paramount Building, Des Moines 9, Iowa. Single Copy 20 cents; 10-100, 10 cents each.
4. U. S. Department of Agriculture and The Soil Conservation Service, Washington, D. C.

or

State Soil Conservationist, Soil Conservation Service, Iowa Building, 505 Sixth Avenue, Des Moines, Iowa.

A 1B 174 *Sediment Is Your Problem,* March, 1958.

P. A. 391 *Soil And Water Conservation Activities,* April, 1959.

No. 175 *More Wildlife Through Soil and Water Conservation,* March, 1958.

P. A. 400 *Soil Conservation Tips For Sportsmen,* October, 1959.

Films

1. *Birth Of The Soil* (Encyclopaedia Britannica Films, Inc.), 11 min., color
2. *Erosion* (U. S. Department of Agriculture), 6 min.
3. *Rocks and Minerals* (Film Associates of California), 11 min., color
4. *Soil And Water Conservation* (U. S. Department of Agriculture), 10 min.
5. *Topsoil* (U. S. Department of Agriculture), 10 min.

Filmstrips

1. *Great American Desert* (Encyclopaedia Britannica Films, Inc.)
2. *Gully Erosion Problems* (Society for Visual Education)
3. *How The Earth Came To Be* (The Jam Handy Organization)
4. *How Rocks Are Formed* (The Jam Handy Organization)
5. *Our Earth* (Encyclopaedia Britannica Films, Inc.)
6. *Our Earth Is Changing* (The Jam Handy Organization)
7. *The Soil* (The Jam Handy Organization)
8. *The Story Of The Earth We Find In Rocks* (The Jam Handy Organization)
9. *The Story Of Ice And Glaciers* (Encyclopaedia Britannica Films, Inc.)
10. *The Story Of Mountains* (Encyclopaedia Britannica Films, Inc.)
11. *The Story Of Rivers* (Encyclopaedia Britannica Films, Inc.)
12. *The Story Of Underground Water* (Encyclopaedia Britannica Films, Inc.)
13. *The Story Of Volcanoes* (Encylopaedia Britannica Films, Inc.)

UNIT
THREE

Magnets and Electricity

I. Objectives

A. To show the relationship between electricity and magnetism

B. To develop manual dexterity and skills

C. To develop certain concepts about electricity

D. To show how man has made practical use of his knowledge

E. To become familiar with the basic equipment necessary to make magnets and electricity

F. To replace fear of electricity with an understanding and respect for it

II. Initiatory Activities (Motivation)

Review unit on magnets for grade one in this guide for ideas that would be of value for motivation.

Visit a power plant to see one means of generating electricity.

Display various household appliances on the science table. Have children list the number of different things in their home that makes use of electricity in their operation. Provide children with materials that will make a bell ring.

III. Developmental Activities

Basic Concept:
A magnet is any piece of iron or steel with north and south poles which is able to attract iron and steel.
(Vocabulary: lodestone, attract)

For bulletin board, cut out large magnets of colored construction paper. Include a lodestone, U, bar, and horseshoe magnets. Label each. Also place pictures showing magnets and their use.

Basic Concepts:
The horseshoe, bar, and U magnets are artificial, permanent magnets. Each has a north-seeking pole and a south-seeking pole. Each was made into a magnet.
(Vocabulary: artificial, permanent)

1. Identify the horseshoe, bar, and U magnets. Discuss and experiment with the meaning of the north and south poles. Tie a string or a strong thread around the middle of a bar magnet, balance the sides and let it hang free from your hand or a stand to take a north-south position. Label the north-seeking pole end with a N, and color with nail polish for identification.
2. Use reference material to help draw conclusions. List the names of available books and page numbers on the chalkboard.

Basic Concepts:
The lodestone is the original natural magnet found in the ground. It is usually an irregular, cinder-like shape. A lodestone may have more than one set of north and south poles.
(Vocabulary: natural)

1. Tell or read the legends of how and where the first magnets were discovered, how they may have received their name, how they were first used, and how they helped man explore the world.
2. Display a sample of lodestone.
3. Lay lodestone in container of tacks or iron filings. Things will cling in clusters at the poles.

Basic Concept:
Objects containing iron and steel are attracted to a magnet.
(Vocabulary: attraction)

On the science table, place objects for testing attraction to magnets—paper clips, thumbtacks, spools, pencils, erasers, pins, needles, cloth, paper, nails, brass tacks, feather, glass, aluminum, penny, nickel, a piece of lead, and objects of plastic and rubber. Let the children experiment with the objects to organize and classify. Head two columns with "Things a magnet will pick up," and "Things a magnet will *not* pick up." List the material and the objects under the correct heading.

Basic Concept:
Magnets are strongest at their poles.

The children will experiment at the science table to find *where* a magnet holds the most tacks or any other attracted object.

Basic Concept:
Like poles of magnets repel, unlike poles attract each other.
(Vocabulary: repel, repulsion)

1. Suspend a bar magnet by a string from your hand or a wooden support. When the magnet stops moving, it will point north and south. If the north pole of another magnet is held close to the north pole of the suspended magnet the suspended magnet will move away. If the north pole is held close to the south pole of the hanging magnet, they will pull to each other.
2. Each child should have the experience of holding a bar magnet in each hand to feel the attraction of the north and south poles. Also to feel the repulsion of the two north poles and the two south poles.
3. All children should be encouraged to experiment to discover for themselves how the poles react to each other, how one end of a magnet can chase another, or be made to follow or flip over another magnet.

Basic Concept:
Magnetic strength or force will travel through many different materials.
(Vocabulary: magnetic force, magnetized)

1. List different materials for testing strength of magnetism through water, wood, plastic, glass, rubber, aluminum, a child's hand, cardboard, and iron pan. After experimenting, some of the children could form groups of two, each team to demonstrate its findings with a different material. Will a magnet held under the material move a piece of iron or steel resting on the top of the material? These demonstrations should be included if a program for parents or other classes is planned.
2. Catch fish with a magnet through water.
3. Paper clip animals climb a wooden fence.
4. A "bug" crawls on the back of a hand and up the arm.
5. A little car travels along a highway drawn on cardboard.
6. A tack slides up the side of a glass and over the top.
7. The children will think of more ideas.

Basic Concepts:
Some magnets are stronger than others. U and horseshoe magnets have a greater concentrated strength or force. Size, shape, or color does not always determine the strength of a magnet.

1. Test the strength of different magnets. Place a thumbtack an equal distance between two magnets to be tested. Move magnets together slowly. The tack will jump to the stronger magnet. Also the stronger magnet will hold more objects than a weaker magnet.
2. By experimenting with the collection of magnets on hand, a smaller magnet most likely can be found to be stronger than a certain larger one. Many different sizes and shapes should be tried before coming to the conclusion.

Basic Concepts:
The force around a magnet is called its magnetic field. The pattern of the lines of force can be seen under certain conditions.

1. Place a bar magnet on the table. Cover with a sheet of glass or stiff plain paper. Sprinkle iron filings over it. Tap gently. The picture that is formed will show how far magnetism extends as well as the lines of force. Repeat with two like poles as close as possible, two unlike poles, a horseshoe and U magnets.
2. For a permanent picture use blueprint paper in place of the stiff plain paper over a magnet. Sprinkle with iron filings, tap gently, shine a bright light or sunshine on the pattern for three or four minutes. Develop the picture by washing in water for several minutes. Hang it up to dry.

Basic Concept:
A magnet may lose its strength in several ways: (1) by striking hard or dropping a magnet, (2) by the absence of keepers, and (3) by heating.

1. Discuss the responsibility we have in caring for the magnets.
2. Guard against dropping a magnet. Always see that a keeper is placed across the ends of the magnets as they are put away—unlike poles near each other.
3. Discuss how objects such as watches are demagnetized.
4. Have children bring from home toys and other useful articles which use magnets; can opener, pot holders, writing pad, pencil; also tools, magnetized hammers, and screw drivers.

Basic Concept:
A steel needle can be made to be a temporary magnet.
(Vocabulary: temporary)

Rub a steel needle in one direction (not back and forth) against one end of a magnet, using 15 to 20 strokes. Does the needle now attract thumbtacks and paper clips?

Basic Concept:
When a magnet is broken, each piece becomes a magnet with a north and south pole.

Break a small toy magnet bought at a dime store. Test the poles before and after breaking it. Break again. Test again.

Basic Concept:
A magnet is used to make a compass.

1. Lay a magnetized needle across a piece of waxed cardboard or a cork. Hold fast by tape. Float this on water. The needle will point north and south. It will lose its strength and have to be magnetized again.
2. Several magnetic compasses should be made available for examination.
3. Prepare reports on the first compasses; how they changed man's life. In what way is a compass used today (surveyor, hikes, and trip)? Compare compass Columbus used to present-day compass.
4. To show that a compass needle is a magnet, hold a bar magnet with its south pole near the end of the compass needle which points north. They attract. Next, hold the south pole of the bar magnet close to the south end of the compass. It will move away.
5. Show film, *Magnets*—a review.

Basic Concepts:
An electromagnet is a temporary magnet which is magnetized by an electric current. It is a magnet only as long as current is going through it. An electromagnet has a north and south pole. A switch is used to open or close a circuit.

Basic Concepts:
A conductor is needed to complete the circuit. An electromagnet is useful and powerful for (1) lifting heavy loads of scrap iron and (2) for electric bells, bells, motors, telegraph, and telephone.
(Vocabulary: electromagnet, open circuit, switch, closed circuit, conductor, insulator)

1. Read for information to demonstrate making an electromagnet. Wind an insulated wire around an iron bolt or nail ten to fifteen times. Pull the

cover from the wire an inch or more from the ends. Fasten the ends of the wire to the two posts of the dry cell. Touch the end of the bolt to paper clips or thumbtacks. Disconnect one of the wires to stop the current of electricity.

2. Compare the electromagnet to a bar magnet. Hold an end of the electromagnet close by the north pole of a bar magnet. If poles are alike they repel, if unlike they attract.
3. Cut one of the wires leading to the electromagnet while the current is flowing. Discuss how to get the electric current flowing again. Pupils could refer to the bibliography to find ways to make a switch. List the switches used at home and school. Discuss the meaning and importance of an open or closed circuit.
4. Press two thumbtacks into a piece of wood a few inches apart. Take the two ends of the wire that were cut through and connect each one to one of the thumbtacks. Is electricity flowing? Try several materials to find the right conductor for the switch: rubber, glass, various metals, copper wire, and lid of a tin can. Make a list of good conductors and a list of good insulating materials.
5. Take the cover off a bell or buzzer and find the electromagnets. Wire a bell. Trace the circuit through the bell.

Basic Concept:

Static electricity is more in evidence during cold, dry weather.

(Vocabulary: static electricity)

1. Share shocking experiences with static electricity.
2. Scuff across a wool rug and touch a person or metal object.
3. Brush or comb hair, listen to it crackle and fly around. Touch comb to bits of paper.
4. Rub inflated balloon on wool, fur, or hair. Place against the wall.
5. Follow directions for experiments with pith balls—Craig, Gerald S., *Science for Elementary-School Teachers.* Pp. 745-746.
6. Place bits of paper in a glass jar—lay on its side—rub a silk cloth on the glass jar. Why does the paper move?
7. Try these experiments on damp days as well as cold, dry days. Compare results. Explain.

Basic Concept:

Flashes of lightning show static electricity.

Discuss Benjamin Franklin's discovery of electricity. Draw pictures of lightning on black paper with white or yellow crayon.

Basic Concepts:

Electricity gives us light. A thin wire connected between the two screws of a dry cell will give light. An electric light bulb contains thin wire. The path on which electricity moves is called a circuit.

(Vocabulary: dry cell, filament)

1. Name different ways where electricity gives light.
2. Draw pictures of the objects. Collect and show pictures of lights from electricity.
3. Fasten a thin strand of picture wire around one screw at the top of a dry cell; bring the wire across to the other screw. When it glows, compare it to the thin wire in an electric light bulb. Examine an old bulb to find how the circuit would be completed.
4. Connect a light and socket to a dry cell by two insulated wires. Complete the circuit to light the bulb.
5. Draw pictures to show where the wires should go from the dry cell to the switch, to socket, and back to dry cell.

Basic Concepts:

Electricity gives us heat. A thick wire connected between the two screws of a dry cell will give more heat than light.

1. Fasten a piece of *thick* picture wire around one screw at the top of a dry cell. Bring wire across to the other screw. It will be hot enough to smoke paper and ignite.
2. Secure an old iron or toaster to take apart and examine the thick wire to give heat.
3. Draw or collect pictures of things that use electricity for heat.

Basic Concept:

A safe source of current electricity is a dry cell.

1. Cut an old dry cell open.
2. Write a story about a few days at home when all electricity was cut off.

Basic Concept:

Explain ways to protect ourselves in the use of electricity.

1. Always dry hands before touching any electrical appliance.
2. Keep a bulb in a light socket even when it is burned out.
3. Never handle or use a frayed cord.
4. Disconnect a cord by pulling on the *plug.*
5. Never use electrical outlets for experimenting.
6. Keep fingers and other objects out of electrical outlets.
7. Stay away from broken wires that hang down from poles and buildings.
8. Make a list of safety rules.

Basic Concept:

Electricity is made in power plants.

(Vocabulary: generator)

1. Take a trip to a power plant to see the generators. Follow the wires on poles. How do we get electricity when we see no wires going into a building?
2. Examine the two wires in an electrical cord.
3. Visit a house under construction. Trace some of the electrical circuits in the house.

IV. Instructional Materials

Teacher References

1. Blough, Glenn O.; Julius Schwartz; and Albert J. Huggett. *Elementary-School Science and How to Teach It.* Pp. 466-499.
2. Craig, Gerald S. *Science for the Elementary-School Teachers.* Pp. 716-782.
3. Hone, Joseph, and Victor. *Teaching Elementary Science: A Sourcebook for Elementary Science.*

Pupil References

Magnets

Thurber, Walter. *Exploring Science.* Pp. 130-144.

Magnets and Electricity

1. Barnard, J. Darrell and others. *A Unified Program In Science, Health, and Safety, Book 3.* Pp. 205-217; 230-233.
2. Bond, Austin D. and others. *Knowing About Science.* Pp. 122-147.
3. Craig, Gerald S. and others. *Science Everywhere.* Pp. 84-85.
4. Frasier, George W. and others. *Finding Answers.* Pp. 120-124; 167-171.

Electricity

1. Beauchamp, Wilbur L. and Helen J. Challand. *Science Is Exploring, Book 3.* Pp. 46-62.
2. Schneider, Herman and Nina. *Science Far and Near, Book 3.* Pp. 264-278.

Films

1. *Flow of Electricity* (Young America Films, Inc.), 16 mm
2. *Magnets* (Young America Films, Inc.)

UNIT
FOUR

Plant and Animal Adaptations and Communities

I. Objectives

A. To have children become aware of the outdoor world, to look, listen, and be alert to the small things around them

B. To encourage children to see things by themselves; to help them know what to look for, how, and where to look

C. To gain some understanding of the interdependence of plants and animals

D. To develop an appreciation of the living things in their environment

II. Initiatory Activities (Motivation)

This unit may be used in any order which seems to fit a situation best. Parts of the unit can be used as soon as school starts in the fall, while other activities would be more desirable for spring.

Pictures on the bulletin boards can be arranged to show some interdependence between plants and animals.

During the first few days of school, someone is sure to bring some living plant or animal into the schoolroom with a, "Look what I found!" This should be received with enthusiasm and preparations made for its comfort. After identification, a discussion should follow as to its needs for survival.

III. Developmental Activities

Basic Concept:

Most living things need: (a) air, (b) water, (c) food, (d) sunshine.

(Vocabulary: oxygen, exhale, carbon dioxide, energy, root hairs)

1. Discuss the needs of most living things. What is in the air that most animals need to live? What happens when oxygen is absent? What is the purpose of oxygen tanks for deep sea diving, high altitude flying, and oxygen tents? What do plants take from the air?
2. Have class decide upon an experiment to show that living things need water; such as, watering one plant and not watering a similar plant, or sprouting radish seeds on moist blotting paper and dry paper. Look at root hairs through which water enters plant with magnifying glass.
3. Discuss how foods give plants and animals energy to move and grow. Add fertilizer to one plant and not another. Is fertilizer a plant food? (Fertilizer is not a food, but it promotes good plant growth so green plant can produce more food by photosynthesis.)
4. Discuss the need of heat and light from the sun. Find or place a board over grass. How will the grass under the board look after a few days? Why does it turn yellow?

Basic Concepts:

All living things bring offspring into the the world. These develop into likenesses of the parents. Plants are reproduced by: (a) seeds, (b) roots, (c) runners, (d) bulbs.

(Vocabulary: offspring, plankton, reproduce)

1. Collect, label, and display seeds of different plants. Compare. Show different ways in which seeds are adapted for travel—by means of clinging to animal fur or clothes, wind, water, or by rolling and popping open.
2. Soak some lima beans in water overnight. Take off the covering of one

seed. Find the two big fleshy leaves (cotyledons) with food in them. Find the stem. Find the tiny leaves between the big leaves.

3. Break off a pussy willow or geranium branch. Place it in water or wet soil to root.
4. Illustrate how the strawberry plant sends out runners.
5. Dig up a tulip bulb. There will be many small bulbs attached. Plant them. Cut a bulb in half. See the tiny plant inside.

Basic Concept:

Some tiny animals are reproduced by splitting in two.

Plan to examine pond water through microscope to see the tiny plant and animal life. Find definition of plankton. Use drawings to show children what to look for in seeing animals divide.

Basic Concept:

Some animal offsprings are carried in the mother's body until they are born.

Look for pictures of animals with babies that are born. Notice likenesses and differences of parent and offspring. How does the parent care for baby?

Basic Concept:

Some animal offsprings are hatched from eggs.

1. Find pictures of animals hatched from eggs; such as, turtles, snakes, hens, birds, insects, and others, and their offspring. How are the young provided for?
2. Put several flies in a cage with some raw meat. Put it where the meat will not smell badly when it spoils. See if you can watch the flies grow from eggs.

Basic Concepts:

Interdependence exists between all living things and their environment. Plants need animals. Animals need plants.

(Vocabulary: pollinate, link, distribute, till, terrarium)

1. Read, observe, discuss, and draw pictures to describe how plants need animals.
   a. For the carbon dioxide they exhale
   b. To pollinate the flowers
   c. To help distribute seeds
   d. To help keep the soil loose and let in air and water.

   Measure off one-half square foot on the lawn. Dig down four inches and carefully lift this into a pan or pail. Take this indoors. Let everyone take a small handful and pull it apart over a sheet of white paper. Watch for and collect anything that shows evidence of life. Place in a jar. Have a magnifying glass handy. A secretary keeps a record of all things found—grass, weeds, ants, grubs, worms.
2. Make a terrarium. Fill a half-gallon jar with good soil. Add a dozen earthworms. Keep sides covered so they will tunnel next to the glass. Raise cover to observe.
3. Make a chain to show that animals feed on other animals that feed on plants. Each animal and plant is one link in a chain. Record on chalkboard: **fox** eats **rabbit** eats **clover;** or **kingfisher** eats **fish** eats mosquito wiggler eats **plankton**
4. Play food-chain tag. Print the name of an animal or plant on a piece of paper, **hawk**—each person holds a link and is hungry. At a signal they hunt for food and grab the first food they can find. When the time is up, see how the chains are linked correctly.

Basic Concept:

The food made by plants is stored in their leaves, stems, roots, flowers, fruits, and seeds.

Bring examples to class which show the different places plants store food.

Basic Concept:

Adaptations help living things to stay alive.

(Vocabulary: adapt, migrate, hibernate)

1. Collect pictures of animals. Group them on bulletin board according to:
   a. Types of food they eat—meat, grass, insects, fish, nectar, seeds
   b. How they are adapted to gather

food—feet, mouth, tongue
c. The way they travel or move about
d. The way they are adapted to protect themselves
e. The way they resemble the place where found
f. How they adapt themselves to change in season or scarcity of food
(1) Some migrate—birds
(2) Some hibernate—snakes, frogs, bats, bears
(3) Some stay and adapt themselves for winter—squirrels, rabbits, plants, people

2. Make a terrarium. Place gravel or sand and soil in the bottom of a glass aquarium. (A gallon jar on its side may be substituted.) Pieces of charcoal will absorb any offensive odors, but are not absolutely essential. Plant small plants and a few acorns. In a lower corner put moss around a small dish for water. Water the plants. Leave some loose, bare soil in another corner. Add turtles, frogs, or small snakes. Cover the terrarium with a piece of glass. As cold weather comes, keep in a cool place. Later bring it back into a warm room. How does the animal behave?

Basic Concept:
As plants and animals adapt to their environment, they form a community.
(Vocabulary: interdependence, community, aquarium)

1. Make an aquarium. Put 1½ inches of sandy soil on the bottom of one-gallon, wide-mouthed glass jar. Plant a few water plants found at the marshy edge of the pond. Fill the jar with pond water to an inch below where the jar narrows. Let water settle a few days. Watch for tiny plant and animal life. Add a couple of tiny minnows and snail from the pond. Screw on cap, turn tightly and seal with paraffin. Keep jar where there is good light, but not direct sunlight. Discuss reasons why plant and animal interdependence exists between these living things.
2. Other aquariums can be made by different groups of children. Include frog or toad eggs, tadpoles, snails, or dragonfly nymphs, and plants found in their own community.
3. Make a mural of a pond and marsh community.

Basic Concept:
A backyard is a plant and animal community.
(Vocabulary: prey, pollen, silk, nectar)

1. Walk to a backyard, schoolyard, vacant lot, or park to become aware of small things to see, hear, feel, taste, or smell. Let each child sit or lie down on his choice of spots to find something that he never saw or knew about before.
2. Look at things through a magnifying glass—a grasshopper moving his mouth parts, a spider spinning its web or wrapping its prey in silk, a bee gathering pollen and nectar, the parts of a flower, a leaf, insect eggs, a caterpillar chewing a leaf. Watch and feel an ant walk across your hand. Follow another ant carrying something until it gets its load home.

Basic Concept:
Some animals go through several stages of development called life cycle.
(Vocabulary: chrysalis, cocoon)

1. Be alert in the fall to collect all sizes and colors of caterpillars. Provide them with leaves and twigs in a lamp chimney set down over soil in a flower pot. Cover top with wire or cheesecloth. After the cocoon or chrysalis is spun, occasionally drip water over it for moisture. Reference books will help identify caterpillars.
2. Read for information and draw pictures of the life cycle of moths and butterflies. Call attention to likenesses and differences of each stage of development.
3. Speculate as to what moth or butterfly will emerge in spring. Keep records. Examine walls of silk (cocoon).
4. Find the meaning of larva, pupa, chrysalis, cocoon.

Basic Concepts:
Bees depend upon flowers for food.
Flowers depend upon bees for pollination.
(Vocabulary: pollinate, worker bees, queen bee, pollen baskets, nursemaids, soldiers)

1. Walk to nearby flowers. Watch for bees to light on flowers. Follow from one flower to another.
2. Catch a bee and place in an insect cage made from a lamp chimney. Set the lamp chimney over a flowering plant growing in a flower pot. Tie a piece of cheesecloth over the top. Keep moist by watering the plant. Use magnifying glass to look at the bee. Release the bee after a few days.
3. Discuss from where the bee may have come. Why is it on the flower? How does the bee get nectar? What does the bee do with the nectar? What kind of bee is this? What is the yellow fuzz clinging to the bee? Where will the bee go and what will it do when it leaves the flowers?
4. Pull petals from a sweet clover flower and taste the nectar.

Basic Concept:
Bees and ants are insects that live in social communities.
(Vocabulary: social, aphids, colony, cylinder)

1. Make an observation nest for ants. Place a block of wood in the center of a quart jar. This will force the ants to build tunnels closer to the outside of the jar. Fill jar about two-thirds full of soil taken from an ant hill with ants in it. Dig deep to get plenty of ants, a queen, and some eggs. Cover top with cheesecloth. Make a black paper cylinder which will slide down around the jar. Remove when you want to see the ants. Feed them small amounts of bread or cookie crumbs and sugar. Keep a pencil or stick pushed into the soil near the edge of the jar. Remove occasionally and pour a little water in the hole.
2. Make nests of several different kinds of ants using different soils.
3. What are the duties of different members of the ant community?
4. Write and illustrate a story which might include a queen, workers, soldiers, ant cows, nursemaids, larvae, or pupae. This may lead to a play or puppet show.

Basic Concepts:
Green plants make their own food in their leaves from sunlight, air, and water containing minerals.
(Vocabulary: pores, chlorophyll, tubes)

1. Bring out in discussion why green plants need sunlight, air, and water. Do plants breathe? Have class work out experiments to show that sunlight, air, and water are needed.
2. Read for information. How does a plant use roots, stems, leaves, and flowers?

Basic Concept:
Trees are the biggest plants in a community.
(Vocabulary: adopt, lichen, fungus, wounds)

1. Adopt a tree. Each person chooses a tree. It must be one he can see every day on his way to school or at home. He must watch it and discover:
   a. When the leaves change color, when the leaves open, when the flowers open, and when the fruit forms.
   b. What animals use this tree: birds nesting or roosting; squirrels; insect eggs on leaves, twigs, or bark; cocoons; caterpillars; carpenter ants; or beetles.
   c. See whether the tree has lichen growing on the bark, green moss, or algae. Look for fungus growing on dead limbs. Does the tree have wounds? How are they healing?
   d. How big around is the trunk? Get out a tape line and measure. How far out do the branches reach? Measure the ground.
   e. Draw your tree. Take snapshots of it at different seasons. Make leaf prints.
   f. Read about your tree. Find out

what use is made of its wood and where in North America you might expect to find trees of the same kind.

g. See what lives under the tree (plants, animals—on the ground, in the ground). Go out some night and see what stars are over it.

h. Make a big map showing the school and all territory in which adopted trees are located. Make a small paper leaf like those on the tree, write your name and the name of tree on it. Paste it on the map so that the stem of the leaf points to the dot showing the tree's position. When something exciting is going on in someone's tree, everyone can tell just where to go to see it.

i. Have a tree visiting day and make a tour of the adopted trees.

j. The above activities and many more ideas can be found in the *Nature Program Guide*, National Audubon Society, 1130 Fifth Avenue, New York 28, New York.

k. Each person should keep a chart, record, or diary of the activities which take place around the tree.

Basic Concepts:

A pond or marsh may be a balanced community. There is air in water. There is food in water. Water plants and animals are equipped for living in water.

(Vocabulary: protect, larvae, life cycle, pupae)

Discuss the bulletin board pictures of ponds and marshes active with plant and animal life.

a. Let a glass of cold tap water stand in the sun. Air bubbles will form on the side of the glass. How do fish get air?

b. Take a trip to a pond or marsh. (If impossible, then take an imaginary trip.)

c. List the plants and animals that might be found. Keep a record of those actually seen; such as, cattails, waterlilies, pondweeds, redwing blackbirds, ducks, crayfish, snails, dragonflies, fish, frogs, tadpoles, turtles, whirligig beetles, pond skaters, evidence of muskrat, beaver, or mink. Have books available to identify those not known.

d. Have several magnifying glasses or hand lenses to examine specimen clearly.

e. Draw a picture map of the pond. Show the shape of the pond. Show where birds and animals live and where plants grow.

f. From reference books, find information about the plants and animals seen at the pond. Be sure to tell:
   (1) Where and how food is obtained
   (2) What they eat
   (3) What eats them
   (4) How they protect themselves
   (5) How they are reproduced
   (6) How they breathe
   (7) What their homes are like
   (8) How they adapt themselves to a change in seasons and the scarcity of food

g. Select an animal group which goes through several stages in its life cycle. Read, outline in class, write, and illustrate its life history; such as, from egg, growth as a tadpole to frog; or mosquito eggs to larvae (called wigglers) to pupa to mosquito; also the dragonfly from eggs to nymph to adult dragonfly. If possible collect specimens for each stage of life cycle.

Basic Concept:

Desert plants and animals are adapted to their community.

1. Make a habitat group; that is, a model scene showing a group of plants and animals as they are naturally found. Use mounted specimens or make models. A sand table or box is a good foundation.
2. A desert habitat may include a barrel cactus and "hen and chickens" plants planted in sand. Add models of jackrabbits, road runner, lizard, rattlesnake, fox, coyote, and mice.
3. Compare a desert to our winter season, also to a large paved area.

4. Is there a relationship between cactus and evergreen needles?
5. Find pictures of desert communities. *Arizona Highways Magazine* is a good source. Pictures in color.

Basic Concept:

There are many other types of plant and animal communities: (a) forest, (b) meadow, (c) seashore, (d) mountain, (e) swamp, and (f) woodland.

1. Each of these following communities and others can be studied in a manner similar to the preceding part of the unit.
2. Write a description of a forest, meadow, seashore, mountain, swamp, or woodland. Tell about the different kinds of animals that live in each place. Can you find reasons as to why each animal finds its home a good place in which to live? *Britannica Junior Science Study Guide.*

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(Reading is difficult for first grade, but the pictures provide good learning situations.)

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1. *Adaptations of Plants and Animals* (Coronet Films), 13½ min.
2. *Animals in Autumn* (Encyclopaedia Britannica Films, Inc.), 11 min., color

3. *Animals in Spring* (Encyclopaedia Britannica Films, Inc.), 11 min., color
4. *Animals—Ways They Eat* (Encyclopaedia Britannica Films, Inc.), 11 min.
5. *Animals—Ways They Move* (Encyclopaedia Britannica Films, Inc.), 11 min.
6. *Animals in Winter* (Encyclopaedia Britannica Films, Inc.), 11 min.
7. *Ants* (Encyclopaedia Britannica Films, Inc.), 11 min.
8. *A Frog's Life* (Coronet Films), 11 min.
9. *Honey Bee* (Encyclopaedia Britannica Films, Inc.), 11 min.
10. *How Animals Defend Themselves* (Young America Films, Inc.), 11 min.
11. *How Insects Help Us* (Coronet Films), 11 min.
12. *Life in a Pond* (Coronet Films), 11 min.
13. *Life in an Aquarium* (Young America Films, Inc.), 11 min.
14. *Life in the Desert—North America* (Encyclopaedia Britannica Films, Inc.), 11 min., color
15. *Life in the Grasslands—North America* (Encyclopaedia Britannica Films, Inc.), 11 min., color
16. *Pond Life* (Encyclopaedia Britannica Films, Inc.), 10 min.
17. *Roots of Plants* (Encyclopaedia Britannica Films, Inc., 11 min.

UNIT FIVE

Causes of Disease

I. Objectives

A. To develop an intelligent and cooperative attitude toward his responsibility to himself and others to keep in good health

B. To become aware of the contribution of science to our good health

C. To develop an appreciation for the part our community plays in guarding our health

II. Initiatory Activities (Motivation)

Bring specimens of diseased plants to class for display purposes. Take a nature walk to locate plants that are diseased. If in rural areas, have children from farms tell what precautions their fathers take to prevent diseases among his livestock and crops.

Discuss vaccinations, trips to doctors, and so on. Display agar plates which have been inoculated with microorganisms.

III. Developmental Activities

Basic Concept:
Disease is any malfunction of the body.
(Vocabulary: disease)

Find the definition of disease. Discuss what causes disease.

Basic Concept:
Nutritional deficiencies may cause disease.

1. Display pictures of people with scurvy or rickets. How do people get these diseases?
2. Assign reports—discuss.

Basic Concept:
Many things may cause disease.
(Vocabulary: bacteria)

1. List diseases pupils have had.
2. Make a graph or table showing number of boys and girls having had these diseases. (Diagram on chalkboard.)
3. Discussions: What causes you to have these diseases?

Basic Concept:
Bacteria are very small living organisms.

1. Examine drop of pond water, also a drop of tap water through a microscope. Compare and discuss.
2. Report on microscope, Pasteur, Lister, Leeuwenhoek.
3. Discussion: Why do you think the discovery of bacteria was important?
4. Grow colonies of microorganisms on specially prepared nutrient materials.

Basic Concept:
Many diseases are contagious and can be contracted from persons who have them.
(Vocabulary: contagious, contracted)

1. Study kinds of sicknesses which caused absences from school.
2. Discuss ways sicknesses could have been contracted—especially common colds.

Basic Concept:
Moisture from sick person's nose and mouth can spread contagious diseases.
(Vocabulary: garbage, quarantine)

Make posters, captions, and illustrate how to keep germs from spreading, such as:

a. Cover nose and mouth when one coughs or sneezes.
b. Put only clean food or liquid in your mouth.
c. Keep pencils and toys out of mouth.
d. Use own drinking glass.
e. Stay away from a sick person.
f. Quarantine persons with a contagious disease.

g. Clean away rubbish and garbage.
h. Wash raw food before eating.

Basic Concept:
Impure milk, water, or food can spread disease.
(Vocabulary: pasteurized)

1. Visit a dairy to see milk pasteurized.
2. Purify river water.

Basic Concept:
Bacteria may enter the body through open places.

Read for information. Write reports on care of:
a. eyes
b. ears
c. teeth
d. cuts and scratches

Basic Concept:
Bite of infected animal may spread certain diseases.
(Vocabulary: infection)

Discuss first aid for bites of animals.
a. tetanus
b. rabies
c. snake serum

Basic Concept:
Insects and rodents carry disease.

Discuss how to keep insects, rats, and mice away from food. Why is it important?

Basic Concept:
Dishes and clothes used by a sick person should be sterilized and disinfected.

Discuss proper care taken of things used by a sick person. How does the sun help to kill germs?

Basic Concept:
The air we breathe carries organisms which cause disease.

1. Grow microorganisms by exposing nutrient material to air.
2. Why do we keep food covered?

Basic Concept:
The body has barriers which help prevent bacteria and other organisms from causing infection: (a) hair and liquid inside of nose, (b) layers of skin, and (c) antibodies in blood.

1. Discuss the purpose of hair and liquid in nose. Why should we use a clean handkerchief each day?
2. With magnifying glass, examine the pores, oil, and folds in one's skin. Why should we use warm water and soap when bathing?
3. Discuss the blood as a line of defense.

Basic Concept:
A healthy body can help fight harmful microorganisms.
(Vocabulary: antiseptic, straight, exercise, microorganisms, posture)

1. Invite the school nurse into the room to speak about health habits.
2. Make a chart with pictures of healthful food; such as, milk, eggs, meat, fruit, vegetables, juices and cereals.
3. Make a set of health rules; such as:
   a. Keep clean.
   b. Wash a cut or scratch and apply antiseptic.
   c. Eat nutritious foods.
   d. Get plenty of rest and sleep.
   e. Exercise every day.
   f. Have fresh air every day.
   g. Sit, stand, and walk as straight as possible.
   h. Do not borrow other people's clothes or shoes.
   i. Visit the dentist regularly.

Basic Concept:
Much scientific research is devoted to the control of diseases and the improvement of health.
(Vocabulary: communicable, immune, vaccination, immunization)

1. Study a communicable disease chart. Discussion: Which of these diseases have we not had? Why didn't any of us have these diseases?
2. Make a chart, table, or graph of the different diseases for which the pupils have had vaccinations.

Basic Concept:
Vaccines and antibiotics are chemicals prepared by scientists to help the body fight disease causing organisms.
(Vocabulary: antibiotics)

1. Become acquainted with the words vaccine, antibiotic, drug.
2. Prepare a bulletin board for newspaper clippings dealing with vaccines for control of smallpox, rabies, diphtheria, and polio. Antibiotics such as, penicillin for pneumonia, measles, and influenza.

Basic Concept:
There are national food laws to protect the public, city, county, and state health departments.

1. Invite the manager of the school lunch program to tell the pupils of governmental rules and regulations dealing with food and their protection; such as, dress and age of food handlers, garbage disposal, and inspections.
2. Examine the paper coverings on cans of food, and labels from other foods. Discuss.
3. Talk to a County Board of Health member on duties of the Board.

Basic Concept:
Our community serves us in prevention of disease by (1) testing public water, (2) disposing of sewage properly, and (3) keeping streets and parks free of litter.

1. Invite the water plant manager to give an illustrated talk or take a field trip to the water plant.
2. Write a creative story. Pretend you are a germ.
3. Compose health jingles.
4. Write thank you letters to all resource people and places visited.

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3. "Disease," *World Book Encyclopaedia,* Vol. 4.
4. "Germs and Disease," *Britannica Junior,* Vol. 6.
5. "Pasteur and His Fight Against Germs," *Compton's Pictured Encyclopaedia,* Vol. 11.
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1. *The Common Cold,* Iowa State Department of Health
2. *How Our Bodies Fight Disease,* Iowa State Department of Health
3. *Insects As Carriers of Disease,* Iowa State Department of Health
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Appendix

The science experiments presented in the appendix have been selected as appropriate for teaching some of the science concepts contained in the primary science guide. The suggested unit, or units, for which these demonstrations may be most helpful, is indicated under the title of each experiment.

In many cases, there are severel levels of understanding involved in the presentation of the experiment. For this reason, the teacher should exercise care in the selection of any of these demonstrations. The level of ability of the individual class, the organization of the science program of the school, and the particular concept to be taught should be carefully considered.

Acknowledgment is made to Dr. C. Alan Riedesel, now of the Pennsylvania State University, for the preparation of these activities and to Dr. Marvin W. Ingle, of the Iowa State Department of Public Instruction, for the illustrations.

SCIENCE EXPERIMENTS OR DEMONSTRATIONS

DEMONSTRATING NIGHT AND DAY

(Grade 1 — Unit 1)

(Grade 3 — Unit 1)

Materials:

movable globe
light source — flashlight or electric lamp
chalk or washable crayon

Procedure:

Mark location of your city on globe with chalk or crayon. Darken room and shine light on globe. Turn globe slowly from west to east. Experiment with rotation asking pupils to discuss results.

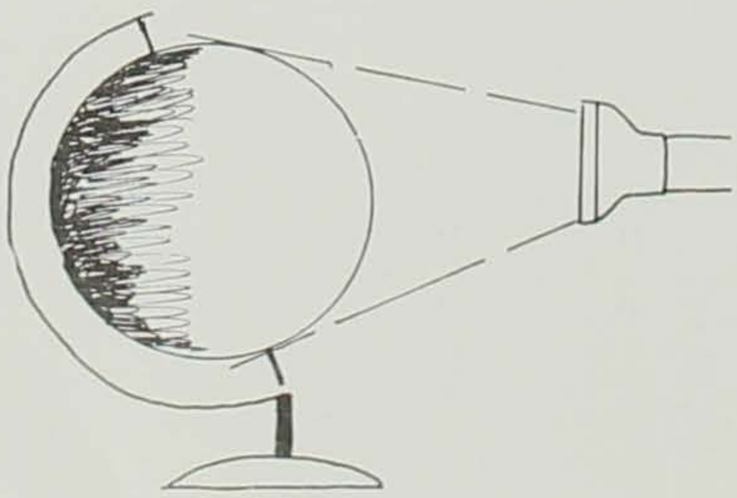
Expected Outcome:

Demonstration shows causes of day and night.

Scientific Explanation:

Earth rotates on its axis once every twenty-four hours. Since earth is ball shaped and revolves around the sun, only one-half of earth facing sun can be lighted. Periods of darkness and daylight differ with the seasons because of the tilt of the earth's axis.

Note: Take care to be certain that the globe rotated from west to east.



SHOWING THE CONSTELLATIONS

(Grade 1 — Unit 1)

Materials:

shoe box
electric lamp or flashlight
pieces of cardboard — (black or dark blue)

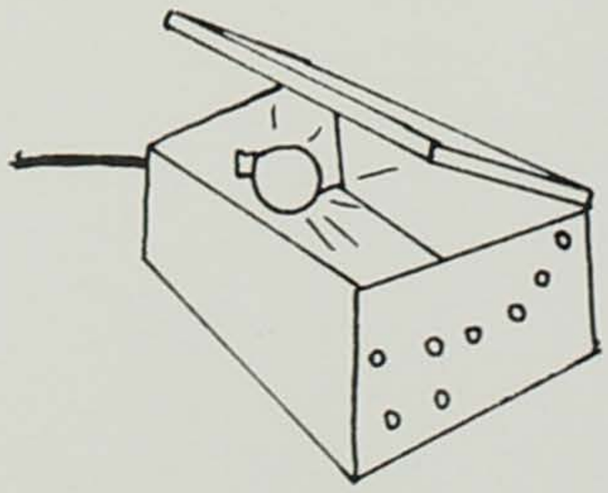
Procedure:

Remove one end of box. Cut cardboard size of end of box and punch holes in it to represent a constellation. Cut hole in other end of box and place electric light or flashlight through hole. Darken room and hold constellation cards over open end of box.

Expected Outcome:

Most pupils find this an interesting and enjoyable device to use in becoming familiar with shape of constellations.

Note: Discuss the relative size of the constellations with class. Be sure that they do not get a distorted sense of size.



DEMONSTRATING THE FORCE OF AIR PRESSURE

(Grade 1 — Unit 2)

Materials:

drinking straw
water

Procedure:

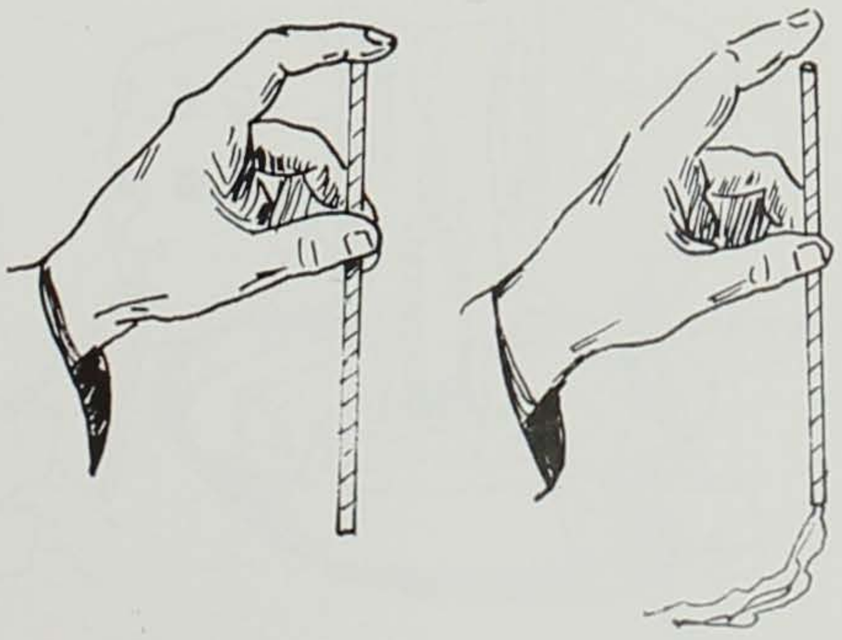
Fill straw with water. Place tip of index finger over straw. Remove straw from water source. Remove finger from straw.

Expected Outcome:

While finger is over tip of straw, water should remain in straw. When finger is removed, water will drain from straw.

Scientific Explanation:

With straw filled and finger over opening, air pressure is not being exerted on top of water column. Air pressure on water holds it in straw. When finger is removed, pressure is balanced and water drains from straw.



AIR CAN BE "POURED"

(Grade 1 — Unit 2)

Materials:

aquarium or large transparent bowl
2 glasses

Procedure:

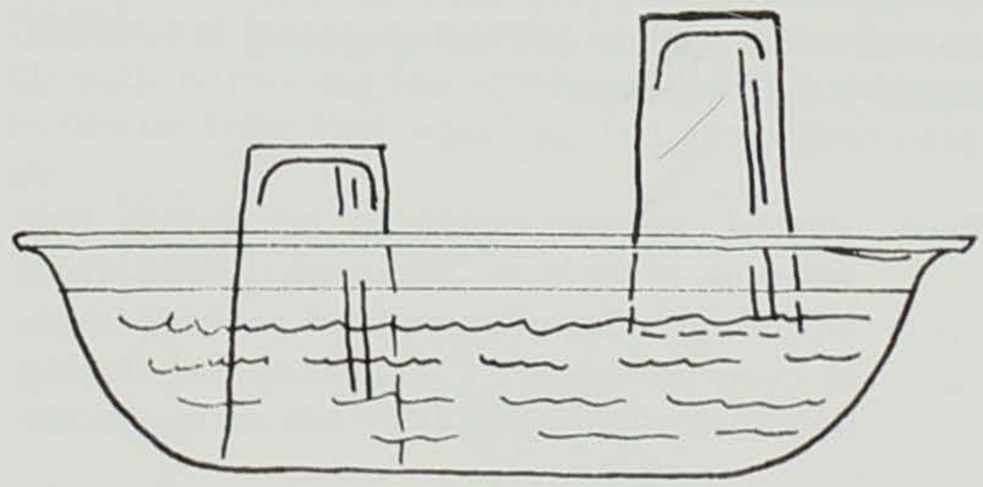
Fill aquarium with water. Lower one glass into water and fill it with water. Lower other glass, mouth down, into water so that air connot escape from it. Lower second glass so that it is directly under first glass which is full of water. Tilt second glass slightly.

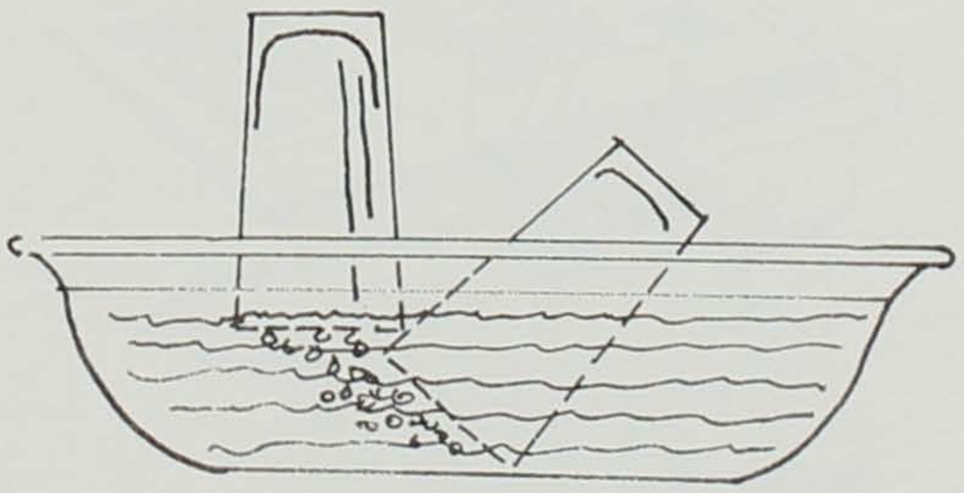
Expected Outcome:

Air escapes from glass two and replaces or pushes water out of glass one. Air can be "poured" back and forth under water.

Scientific Explanation:

Air takes up space and is lighter than water. Thus, it replaces some water in glass one.





STRENGTH OF AIR PRESSURE

(Grade 1 — Unit 2)

Materials:

newspaper
very thin piece of wood, 3' by 4 ''
table

Procedure:

Lay slat on table so that one end sticks out about four inches beyond table edge. Put two double sheets of newspaper over wood on table. Smooth papers down with hand, removing air spaces.
Strike end of slat a hard downward blow with fist or hammer.

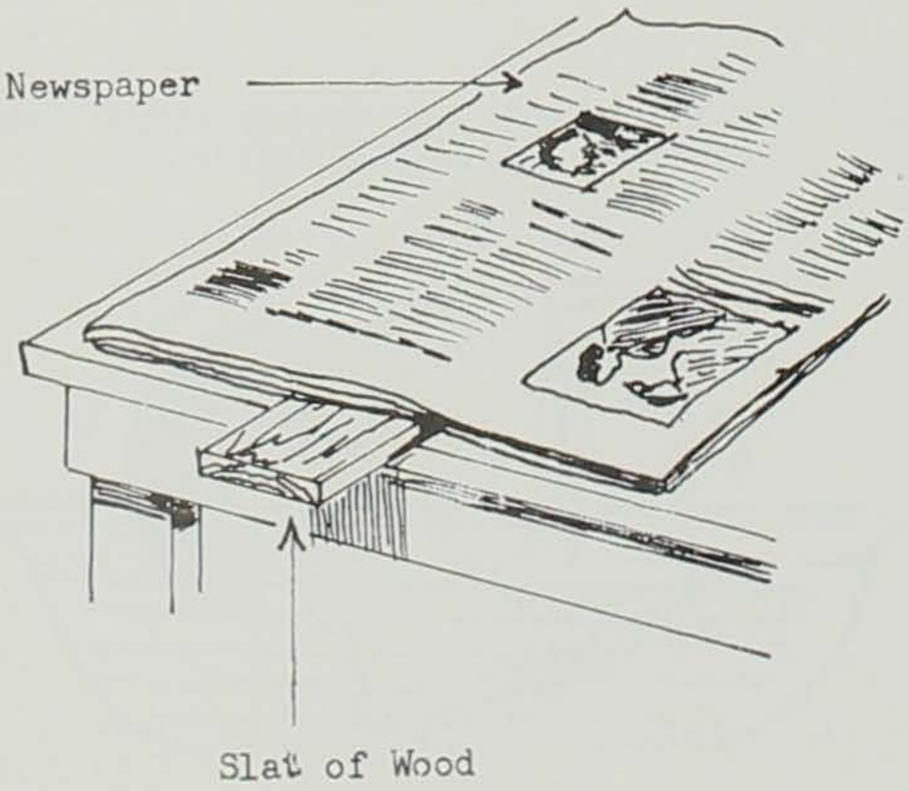
Expected Outcome:

Slat breaks beneath blow of hand or hammer.

Scientific Explanation:

Air pressure on paper is unequal, 14.7 lb. per square inch on top, very little beneath because of table. Pressure holds down slat causing it to break when hit with hammer.

Note: Pretest demonstration to be certain that wood is of proper thickness. (Wood from bottom or sides of some fruit packing boxes is good thickness.) Create suspense during demonstration by skillful use of questions.



PRINCIPLE OF THE DRINKING STRAW

(Grade 1 — Unit 2)

Materials:

drinking straws
glass
water
pin

Procedure:

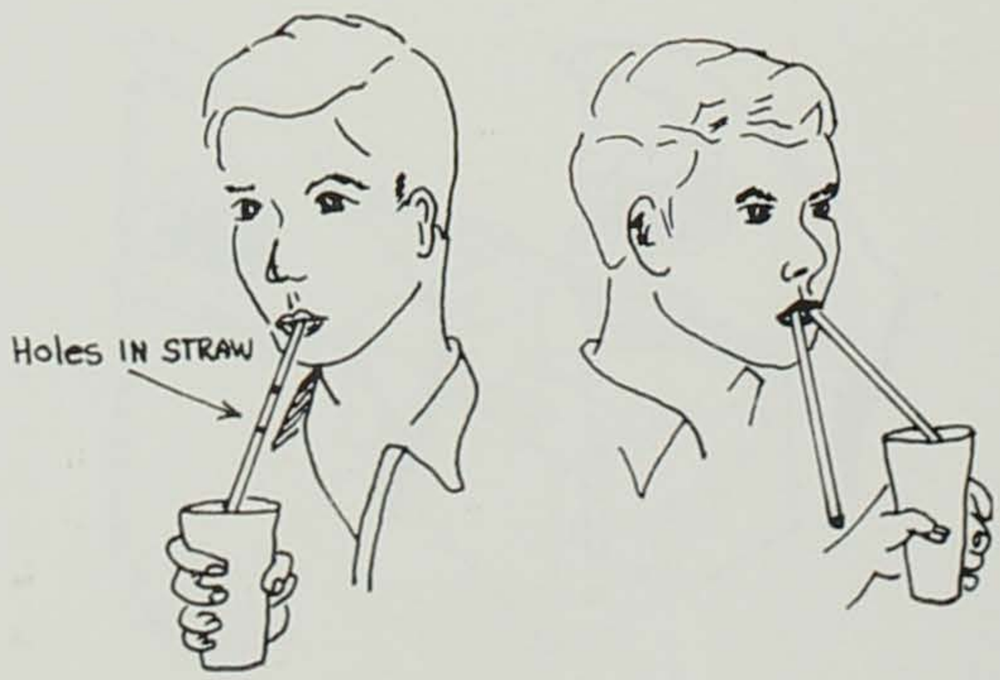
Have class member drink through a straw. Discuss what happens. Make several holes in a straw with pin and try to use it. Discuss. Try to drink with two straws with only one in liquid.

Expected Outcome:

Little liquid will come up through straw with holes. With one straw in liquid and other in air, liquid will not come up either straw.

Scientific Explanation:

Sucking on a straw reduces air pressure within straw. Air pressure on liquid forces it up straw. With holes in straw pressure cannot be reduced greatly. When two straws are used, air coming through one keeps pressure in mouth equal to that one in liquid. Without difference in pressure no liquid will travel up straw.



TO DEMONSTRATE THAT AIR IS COMPOSED OF SEVERAL DIFFERENT GASES

(Grade 1 — Unit 2)

(Grade 2 — Unit 6)

Materials:

candle about 3" high
shallow dish
milk bottle
water
matches

Procedure:

Fasten candle to bottom of dish by melting its base with a match. Fill dish with water. Light candle and then invert bottle over lighted candle with top of bottle under water.

Expected Outcome:

Water will rise in neck of bottle.

Scientific Explanation:

As candle burns, air inside bottle expands and some escapes in bubbles. Oxygen is also used, and materials that are produced by burning take up less space than oxygen. Water rises and replaces oxygen because air pressure is greater on surface of water. After candle is extinguished, air remaining in bottle cools, contracts, and pressure is reduced. The greater pressure of air on water in dish forces more water up into bottle.

WARM AIR IS LIGHTER THAN COLD AIR

(Grade 1 — Unit 3)

Materials:

large diameter glass tube or glass lamp chimney
two blocks of wood 1" x 3" x 5"
candle paper matches

Procedure:

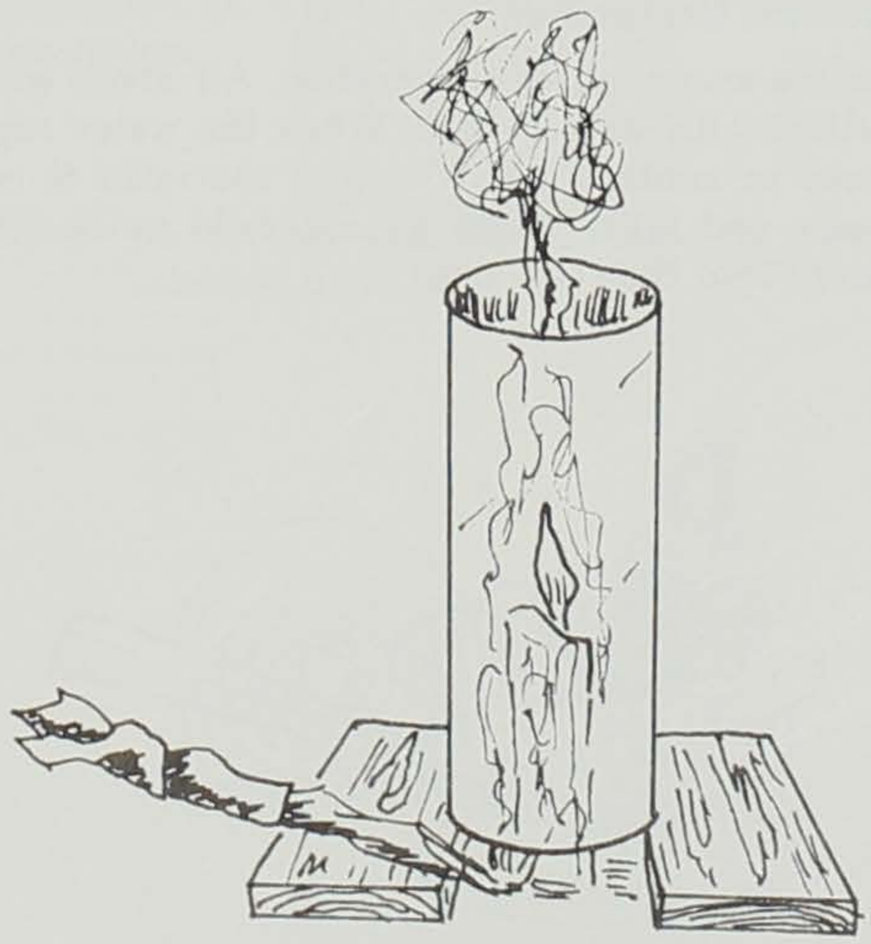
Place lighted candle on table between two pieces of wood. Put tube over candle. Light a rolled up paper napkin or towel, quickly extinguish allowing paper to smoke. Hold smoking end of paper beneath bottom of tube.

Expected Outcome:

Smoke will rise and come out top of tube.

Scientific Explanation:

The warm air in the tube (caused by the lighted candle) is rising. Cooler air rushes into tube to replace air which is rising. It draws the smoke up with it causing the smoke to rise. This helps to demonstrate that warm air is lighter than cold air.



PRINCIPLE OF A RAINSTORM

(Grade 1 — Unit 3)

Materials:

pyrex saucepan
saucer
water
ice
heat source

Procedure:

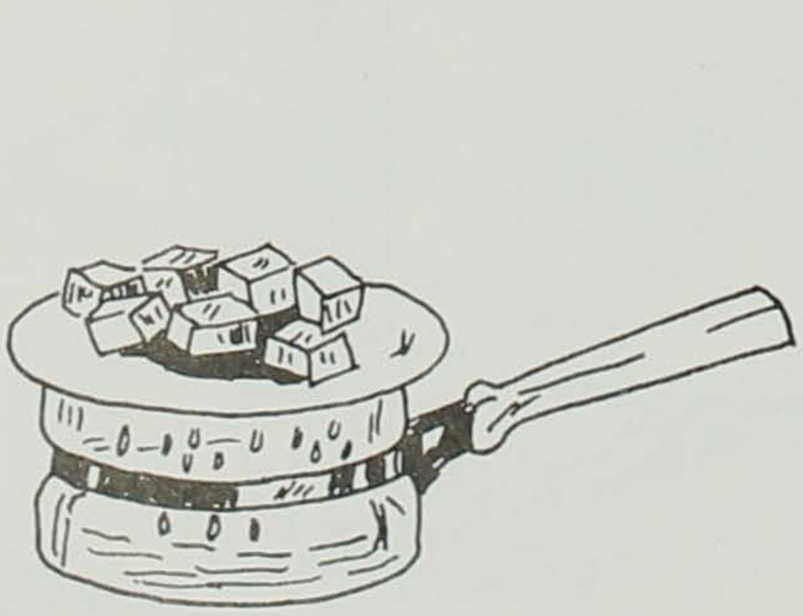
Put a cup of water in saucepan and put on heat source at low heat. When water is hot, put saucer on top of pan and fill with ice cubes.

Expected Outcome:

Small drops of water will form on bottom of saucer. Soon they will combine to form "raindrops" and will fall into pan like rain.

Scientific Explanation:

Heating water causes evaporation. Air above water is filled with water vapor. When the water vapor comes in contact with the cool saucepan it condenses and falls. Warm air can hold much more water vapor than cool air.



ANOTHER WAY TO MAKE RAIN

(Grade 1 — Unit 3)

Materials:

teakettle
glass jar
heat source

Procedure:

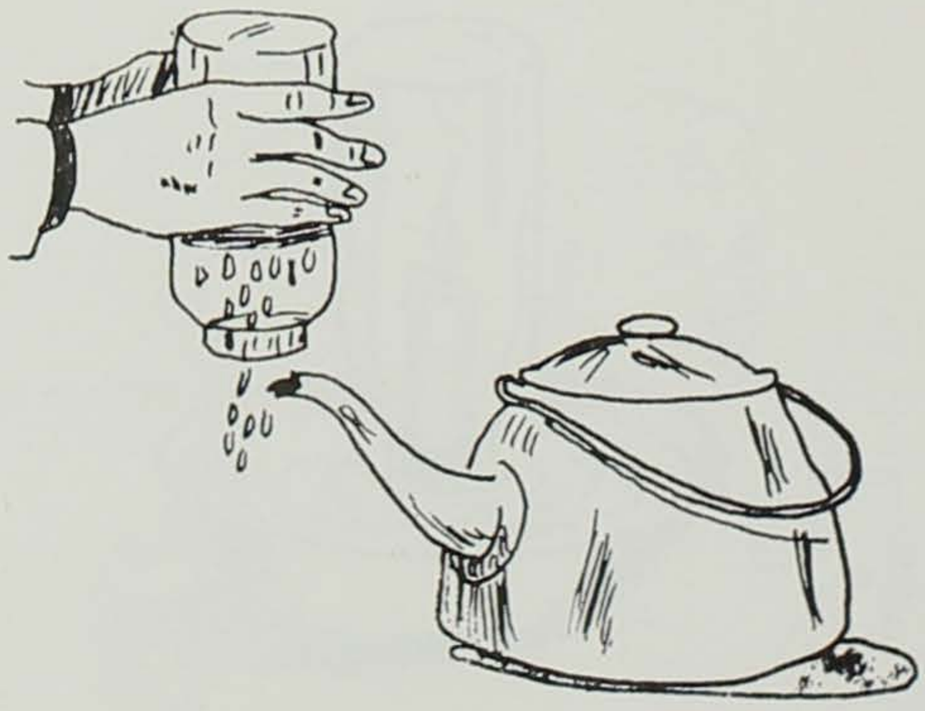
Fill kettle half full of water and heat. When vapor begins to leave spout of kettle hold jar mouth downward over spout of kettle, allowing water vapor to fill it. Observe.

Expected Outcome:

When jar is full of vapor droplets, water will start to form inside jar. They will join together to form larger drops and soon "rain" will begin to fall.

Scientific Explanation:

Since jar is cooler than warm air close to kettle, water vapor condenses in jar. Principle that warm air can hold more water vapor than cold air is demonstrated.



WIND CURRENTS
(Grade 1 — Unit 3)

Materials:

matches
shoe box
cellophane 8" by 16 "
candle
cellophane tape
paper towel

Procedure:

Remove cover of box and cover top with cellophane. Make door on one end of box with knife (see illustration). Hinge door in place with tape. Cut hole size of quarter near bottom of door and in cellophane top two inches from other end. Light short piece of candle and place inside box directly beneath hole in roof. Close door and seal with tape. Burn a moistened paper towel to obtain smoke. Hold paper close to hole in bottom of door. Observe.

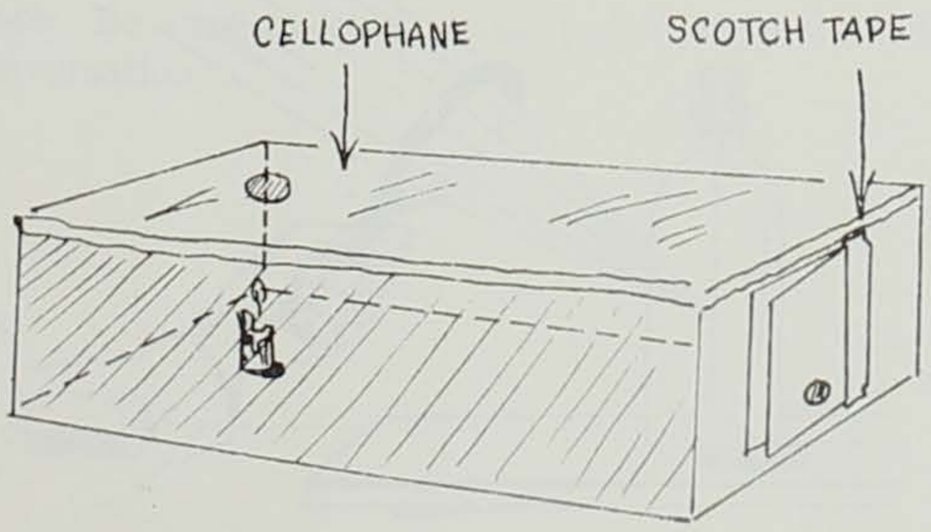
Expected Outcome:

Smoke will rush toward candle and go out through hole in roof.

Scientific Explanation:

Candle in box creates an area of warm air. Cold air is heavier than warm air and gravity pulls it down toward earth while warm air rises. Cool air with smoke replaces warm air near candle. When air is heated it is replaced by cooler air and escapes through hole in roof.

Note: Warning, if candle is too long it will melt the cellophane directly above it.



DETECTING WARM AIR CURRENT
(Grade 1—Unit 3)

Materials:

circle of construction paper 5" in diameter
thimble
pencil
pin
spool
scissors

Procedure:

Draw spiral line on paper and cut along line with scissors. Place thimble on center of circle and draw around with pencil. Using sharp knife cut circle out of center. Push pencil into spool and put pin into pencil eraser. Place thimble on top of pin. Place spiral of paper around pencil as shown in diagram. Place over radiator or electric light bulb.

Expected Outcome:

Spiral of paper should revolve.

Scientific Explanation:

Warm air currents rising from heat source cause movement of paper. Spiral in paper causes the revolution.

Note: Be certain that the thimble is carefully balanced upon the pin.

MAGNETIC ATTRACTION

(Grade 1 — Unit 4)

Materials:

two bar magnets*
small piece of cloth
string
support for magnet

Procedure:

Experiment with two magnets to determine attraction of poles. Make a sling out of cloth for one magnet and suspend it from a support. Experiment with poles to see which combinations attract and which repel.

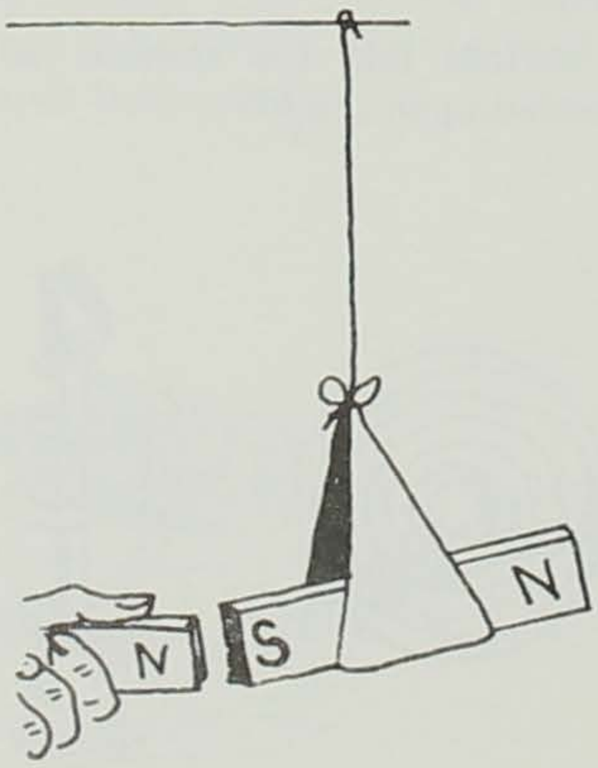
Expected Outcome:

North pole will attract south pole and repel north pole of other magnet.

Scientific Explanation:

Magnetism is concentrated in ends of magnets. One end is north-seeking pole and other is south-seeking pole. A basic principle of magnetism is that like poles repel and unlike poles attract.

***Note:** Poles should be marked on the magnets.



USING LIGHT ENERGY TO CAUSE BURNING

(Grade 2 — Unit 1)

Materials:

magnifying glass
small mouthed bottle
stopper
string

Procedure:

Tie a short piece of string around a thumbtack. Push thumbtack into bottom of cork and put cork in bottle. Focus rays of sun onto string using magnifying glass.

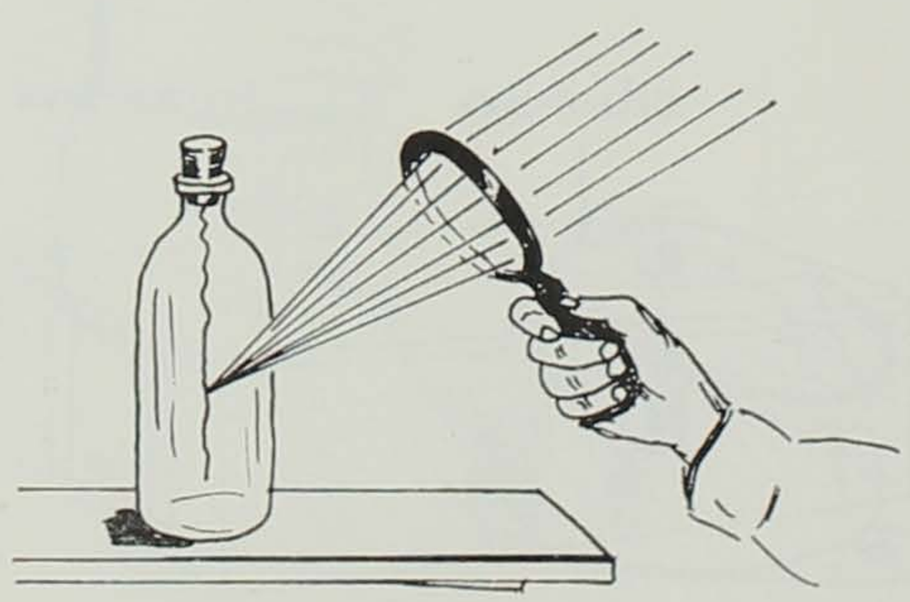
Expected Outcome:

Heat will burn string in two.

Scientific Explanation:

Magnifying glass concentrates the rays of the sun increasing the temperature. This is somewhat similar to earth's summer temperatures from direct rays, and winter temperatures because of slanting rays.

Note: In discussion before experiment, question concerning ways that string could be "cut" without opening bottle. Try this with string hanging in air instead of in bottle.



TIN CAN TELEPHONE

(Grade 2 — Unit 2)

Materials:

two tin cans
twenty-five feet of string or thin wire
wax or paraffin if string is used

Procedure:

Coat string with paraffin. Punch a small hole in bottom of each can. Run string or wire through holes in each can and tie knots in end of string or wire. Move cans apart until string is taunt. Use as telephone speaker and earpiece.

Expected Outcome:

Voice of one student will be heard easily by the other.

Scientific Explanation:

Talking into can caused bottom of can to vibrate. String carries these vibrations to other can so that bottom of that can vibrates in the same way. Sounds can be heard more clearly when traveling through string than through air.

Note: Be sure to keep string pulled tight during conversation.

PRODUCTION OF SOUND

(Grade 2 — Unit 2)

Materials:

tuning fork
glass
water
cork
string
small wooden box (such as chalk box)

Procedure:

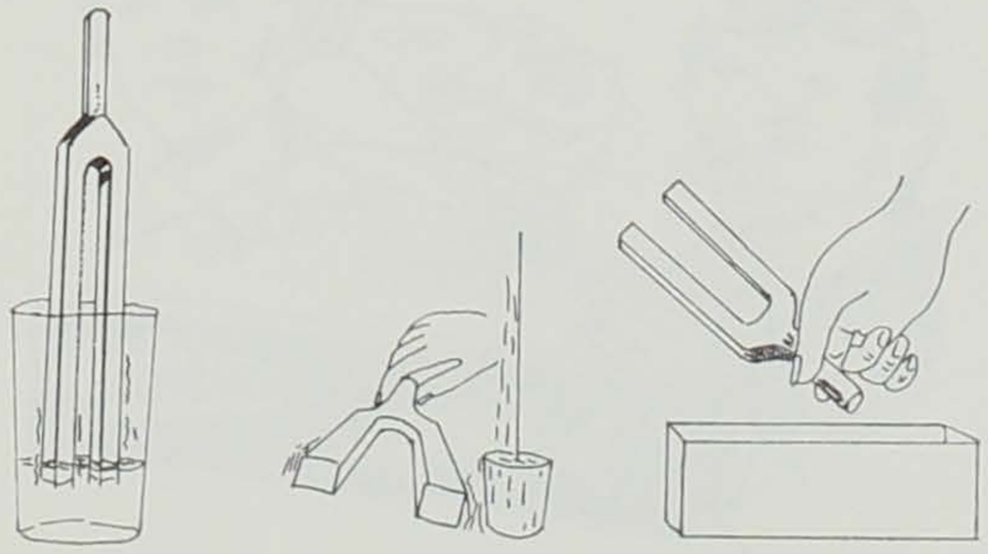
Strike tuning fork against hard rubber objects such as heel of shoe. Place fork in water and observe results. Strike fork again and hold cork on string against one prong. Strike fork again, listen for loudness—then place fork on wooden box.

Expected Outcome:

Water will splash up when fork is placed in it. Cork will bounce away from fork. Sound will get louder when fork is placed on box.

Scientific Explanation:

Sound is caused by vibrations. Their presence can be shown by the splashing water and bouncing cork. Sound is louder when fork is placed near box because box is caused to vibrate also.



VIBRATIONS TRAVEL THROUGH AIR

(Grade 2 — Unit 2)

Materials:

two empty milk bottles

Procedure:

Have a student hold a milk bottle close to his right ear (about one-half inch away). Another student should sit at his right and blow across mouth of bottle. Observe what happens. Try experiment with several students.

Expected Outcome:

Blowing across bottle will make a whistling sound. The other bottle will produce the same sound only not quite as loud.

Scientific Explanation:

Sound in bottle near student's ear is caused by the movement of air by the top of bottle. This is the same way that "sound of the sea" is produced in a shell.

THE STRAW "CLARINET"

(Grade 2 — Unit 2)

Materials:

several drinking straws

Procedure:

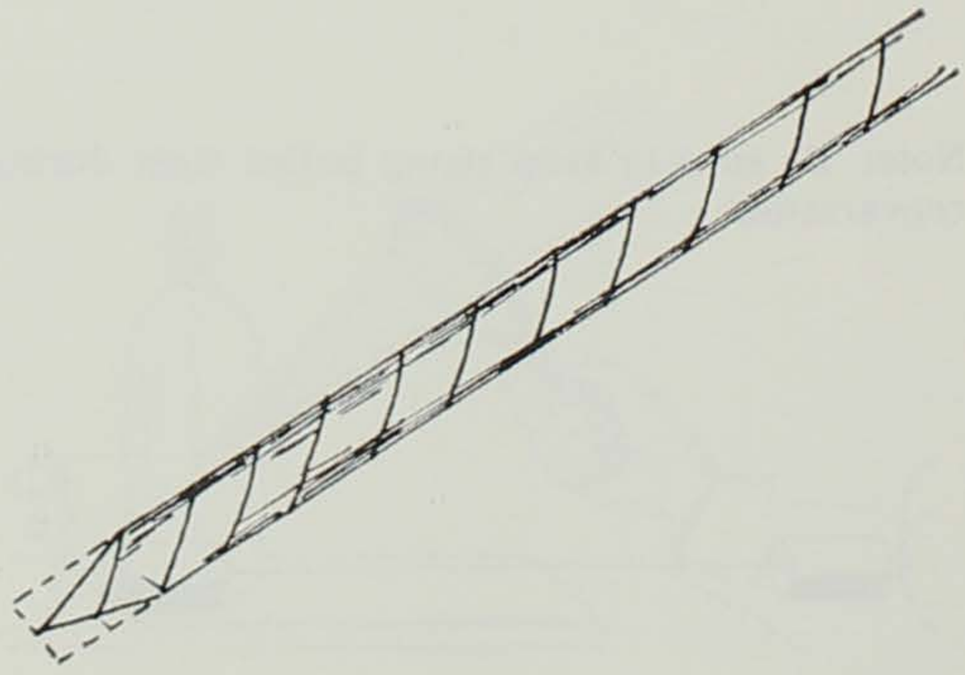
Flatten one end of straw for a distance of one-half inch. Cut a small slanting piece from both corners as shown in drawing. Put the other end of straw in mouth and blow into it hard. Try experimenting with straws of different lengths.

Expected Outcome:

Straw should produce a sound somewhat like that of a play tin horn.

Scientific Explanation:

Breath causes flattened part of straw to move rapidly. This makes air inside straw vibrate and produce a musical note. Note the differences when short straws are used. The shorter the straw (the shorter the column of air) the higher the pitch.



MAGNIFYING SOUND WAVES

(Grade 2 — Unit 2)

Materials:

pencil
string about six feet long

Procedure:

Make a loop two feet long at one end of string. At other end make a loop just large enough to hold a pencil tightly. Ask someone to place his hands over his ears. Place large loop around the head and hands of the subject. Put pencil in small loop and draw string tight. Holding pencil at top and bottom, turn slowly around. Discuss sound produced.

Expected Outcome:

Sound of pencil's movements should be magnified so that it sounds like gunfire to listener.

Scientific Explanation:

Sound waves are concentrated in string and magnified by the hands cupped over the ears.

SOUND WAVES IN ACTION

(Grade 2 — Unit 2)

Materials:

cigar box
table fork
face powder

Procedure:

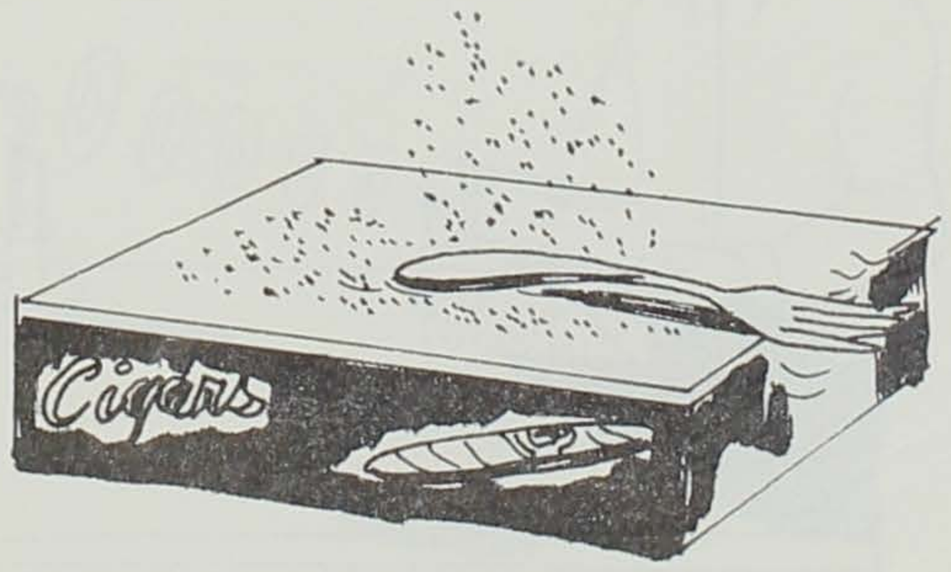
Cover top of box with thin layer of face powder. Pluck prongs of fork. Rest fork handle on box (see illustration).

Expected Outcome:

The powder will jump up and down in response to the vibrations.

Scientific Explanation:

The fork prongs vibrate when they are plucked. This vibration is transmitted to the wood causing the powder to move.



SOUND RINGS IN ACTION

(Grade 2 — Unit 2)

Materials:

oatmeal box
cellophane tape
candle
wet paper towel

Procedure:

Cut hole exactly size of penny in center of box cover. Fasten cover tightly to box with tape. Place box on table and put a lighted candle three feet from it. Point hole in box at flame and tap bottom of box sharply. Move candle farther away and repeat experiment. To see sound rings — light damp paper towel. When it is smoldering, put it in box and fill box with smoke. Repeat experiment.

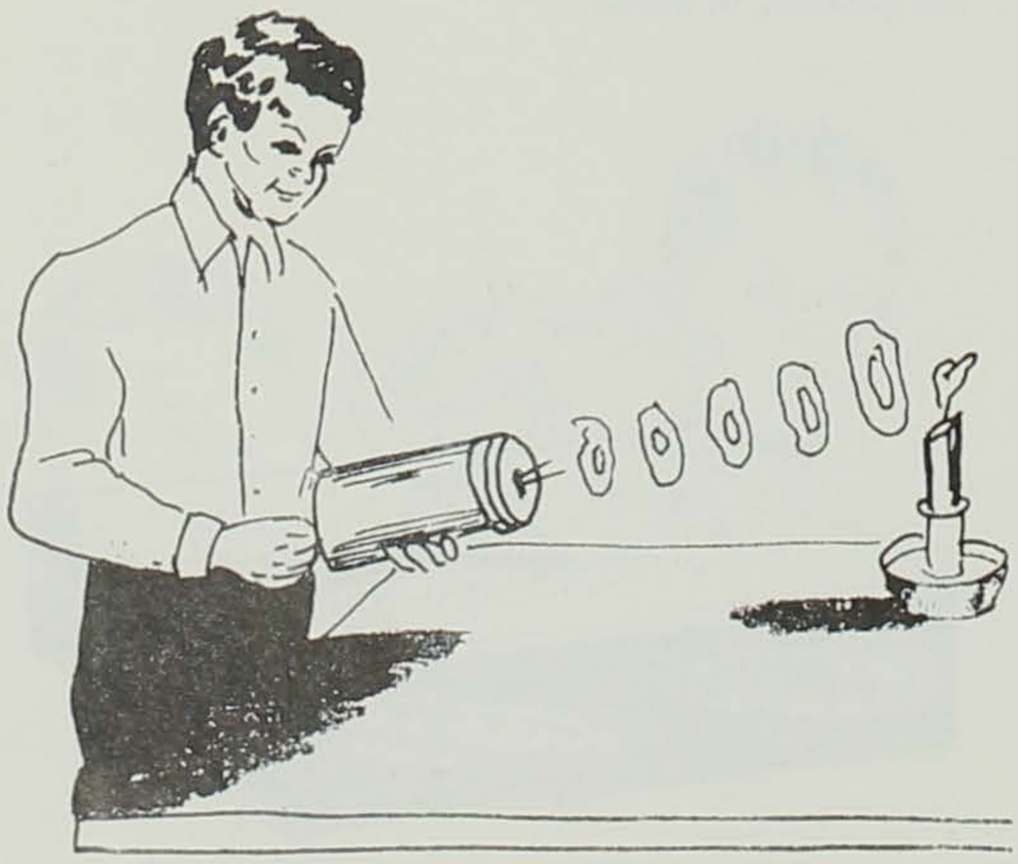
Expected Outcome:

The sound rings will put out the candle. Use of smoke gives an idea of the sound rings.

Scientific Explanation:

Tapping the bottom of box sets up vibrations producing the sound rings. They are forced out the small hole with considerable force.

Note: Scientists have been experimenting with "sound rings." Some have been produced that can knock a person down at a distance of twenty feet. Some scientists think they could be used to carry the smoke from factories into the upper atmosphere reducing the "smog" problem.



MOVEMENT OF WATER WITHIN A PLANT

(Grade 2 — Unit 4)

Materials:

ink or food coloring (two colors)
glass
water
celery or white carnation

Procedure:

Put a piece of celery in a glass of colored water. Allow to stand for several hours. Observe. Split a stalk of celery from bottom about halfway to top. Put one end of bottom in glass of red-colored water, and other end in glass of blue-colored water. Observe. Try same experiment with white carnations.

Expected Outcome:

Red-colored water will move through vascular tissue into veins of leaves. Carnations will become red or red and blue.

Scientific Explanation:

Experiment illustrates vascular system of plant and specialization of conducting tissues.

WHY ROOTS GROW DOWN

(Grade 2 — Unit 4)

Materials:

two pieces of glass (about 3" by 3")
seeds (radish or grass seeds work well)
blotting paper
rubber bands
water

Procedure:

Put a piece of blotting paper between two pieces of glass. Put one or two seeds on blotting paper. Stand in dish of water. Let roots start to grow. After they have started, turn glass pieces one quarter of way around. After several days move roots another quarter turn. Observe.

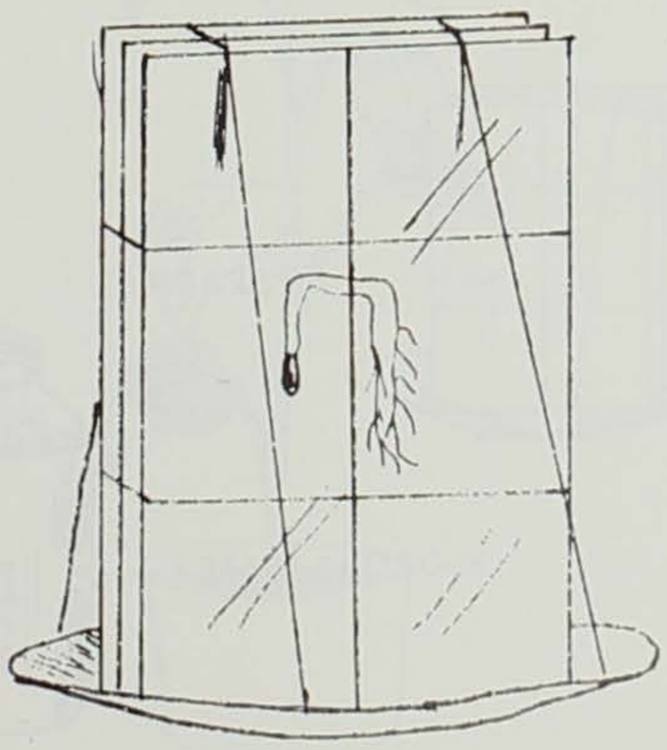
Expected Outcome:

Roots will change direction so that they always grow downward.

Scientific Explanation:

Growth pattern results from two factors: (1) gravity — the roots will tend to grow downward toward gravitational attraction, (2) water — roots will grow toward source of water.

Note: Try experiment with water source at top or sides of glass.



PLANT TRANSPIRATION

(Grade 2 — Unit 4)

(Grade 3 — Unit 4)

Materials:

drinking glass
flowers and leaves
cellophane or "Saran Wrap"
rubber band

Procedure:

Place fresh flowers and leaves in a dry glass. Cover top of glass with a piece of cellophane held tightly in place by a rubber band. Put glass in sunlight. Observe.

Expected Outcome:

After several hours the inside of glass will be thickly covered with water droplets.

Scientific Explanation:

Plants are constantly giving off water from their leaves in form of water vapor. The process is called transpiration.

HOW TO SEE THE WATER IN A ROOT

(Grade 2 — Unit 4)

Materials:

fresh carrot
glass
water
red ink or food coloring

Procedure:

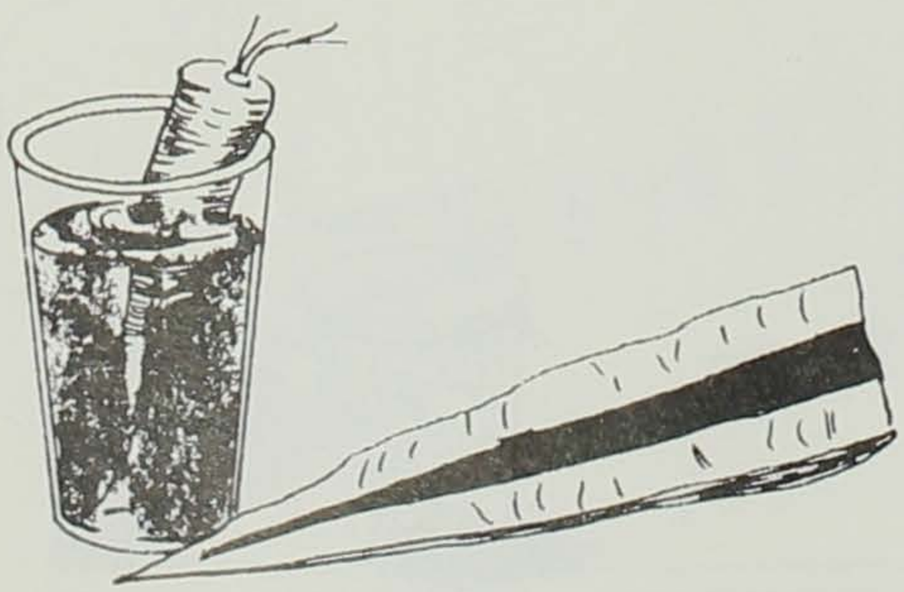
Cut off leafy top of carrot. Stand carrot in glass of water colored with ink. Let carrot stay in colored water overnight. Cut carrot lengthwise in two equal parts. Note results.

Expected Outcome:

You should see lines of red where the colored water has traveled up the veins. What tissue had conducted the water.

Scientific Explanation:

A carrot is a large root. It will continue to absorb water through its system of veins as long as it is not too dry.



SPROUTING SEEDS

(Grade 2 — Unit 4)

Materials:

rubber bands
two pieces of glass (about 3" by 3")
saucer
blotting paper
jar
seeds (radish or grass seeds work well)

Procedure:

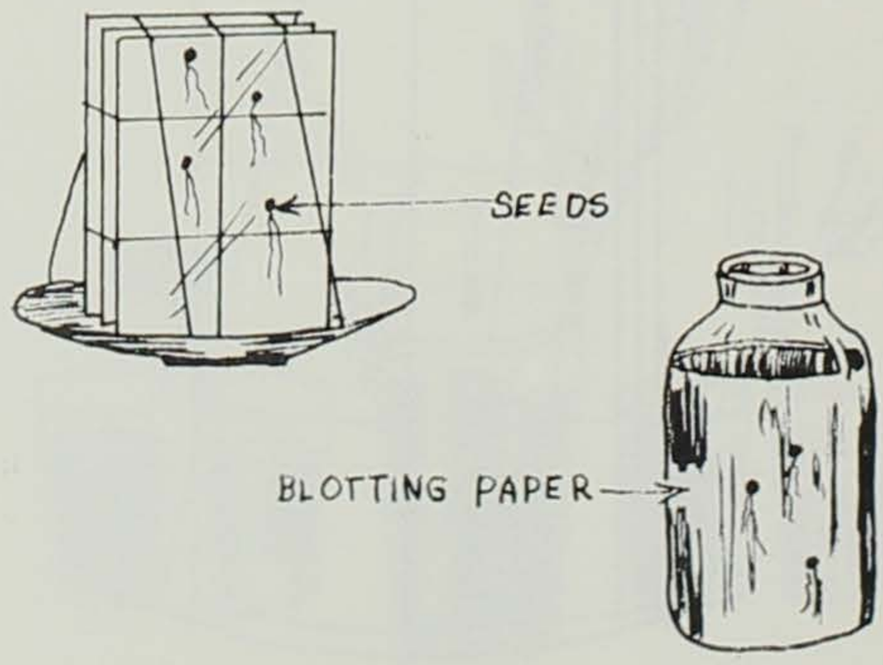
Cut out a piece of blotting paper the same size as glass. Place paper on one piece of glass and set several small seeds on it. Put second piece of glass on top of blotting paper and seeds and fasten frame together with rubber bands. Put glass pieces upright in a saucer or shallow tin pan. Pour a little water into saucer. Put in a warm place. The same procedure can be followed using a bottle. Note roots.

Expected Outcome:

In several days seeds will begin to grow.

Scientific Explanation:

At first seeds do not need the minerals of the earth because they contain stored food materials. If they are to continue to grow, they must be planted in soil. Roots grow downward because they grow toward force of gravity.



TESTING THE NEED OF PLANTS FOR AIR AND SUNLIGHT

(Grade 2 — Unit 4)

Materials:

plant with large leaves
petroleum jelly
black construction paper
paper clips

Procedure:

Cut out figures of paper and clip to one or two leaves. Cover both sides of one leaf with petroleum jelly. Observe several days. Remove black paper. Observe.

Expected Outcome:

Leaves will turn yellow under black paper. Leaf covered with petroleum jelly will die.

Scientific Explanation:

Air and sunlight are needed for proper plant function. Without them chlorophyl disappears. Without sunlight, most plants cannot manufacture food. The leaves also have small pores through which there is an exchange of gases, especially oxygen and carbon dioxide. When the petroleum jelly clogs these pores, the leaf will die because the living cells do not receive an adequate supply of oxygen.

TESTING FOR PROTEINS

(Grade 2 — Unit 4)

Materials:

lime or washing soda
copper sulfate ($CuSo_4$)
water
tablespoons
glass
food samples

Procedure:

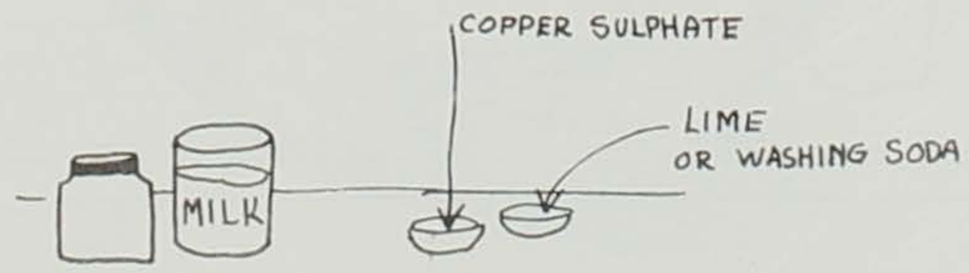
Dissolve as much copper sulfate as possible in a tablespoon of water. In another tablespoon of water dissolve as much lime or washing soda as possible. Put a few drops of each solution in milk. Note any changes. Test other food samples with these solutions.

Expected Outcome:

When solutions of copper sulfate and lime are combined in the presence of protein, violet color is produced.

Scientific Explanation:

Change in color is due to chemical change produced by the combining of the copper sulfate, lime, and protein.



TESTING FOR STARCH

(Grade 2 — Unit 4)

(Grade 2 — Unit 6)

Materials:

iodine
samples of various foods
eye dropper

Procedure:

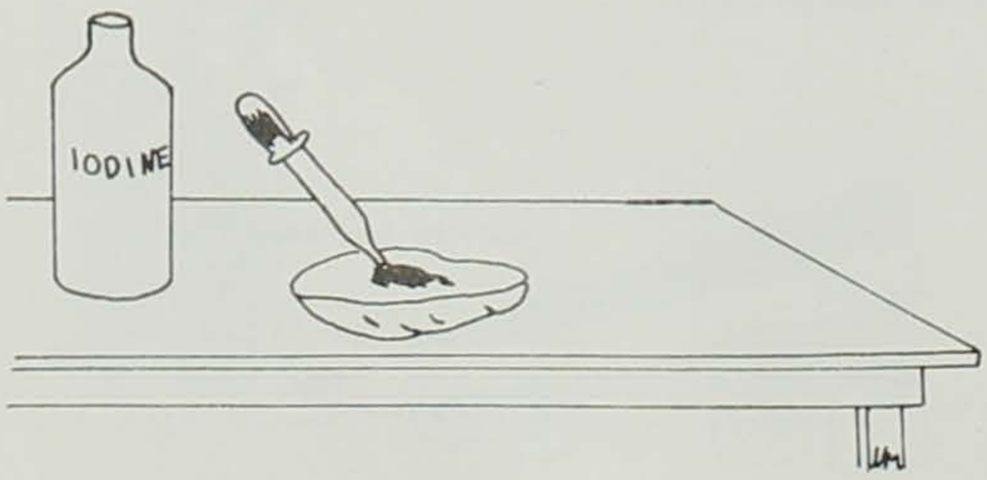
Prepare slices of the food. Test each specimen by putting a drop iodine on it. Observe results.

Expected Outcome:

Some food will turn purplish blue. Others will be reddish brown.

Scientific Explanation:

Those foods that contain a large quantity of starch will turn purplish blue because of a chemical reaction produced by starch and iodine.



AFFECT OF GRAVITY UPON PLANTS

(Grade 2 — Unit 4)

(Grade 3 — Unit 4)

Materials:

three newly sprouted plants in flower pots
wire or string
water

Procedure:

Turn one pot on its side (see illustration). Hang one plant upside down (see illustration). Set another plant in normal position to act as a control. Observe growth changes.

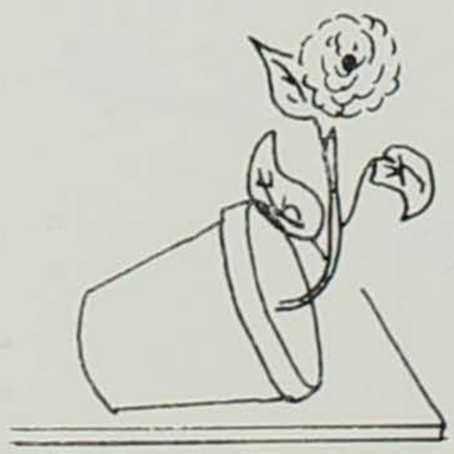
Expected Outcome:

Stem and leaves should turn upward, and roots should turn downward.

Scientific Explanation:

Roots grow toward force of gravity while stems grow against it. How does plant react to light.

Note: Place paper over top of pot and around plant to keep soil from falling out of the flower pot.



EVAPORATION OF WATER

(Grade 2 — Unit 6)

Materials:

two pans
water
heat source

Procedure:

Fill two pans part full of water. *Mark water level. Put one pan in a cool spot and other pan on radiator or in sun. Observe for a day or two.

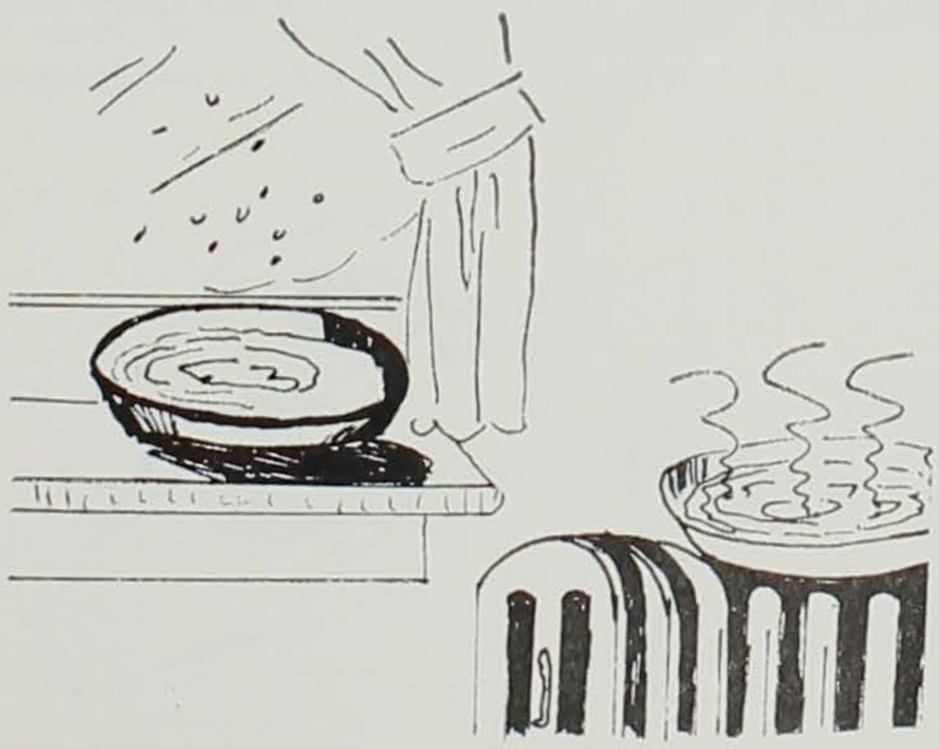
Expected Outcome:

Water level in pan near heat will go down faster than pan in cool place.

Scientific Explanation:

Heat causes molecules of water to move rapidly. Many are changed to vapor and taken up by air. Evaporation takes place in both pans, but heat causes it to occur more rapidly in one pan.

***Note:** Be sure the same amout of water is in each pan.



REMOVING OXYGEN FROM THE AIR

(Grade 2 — Unit 6)

Materials:

drinking glass or jar
steel wool
bowl or pan

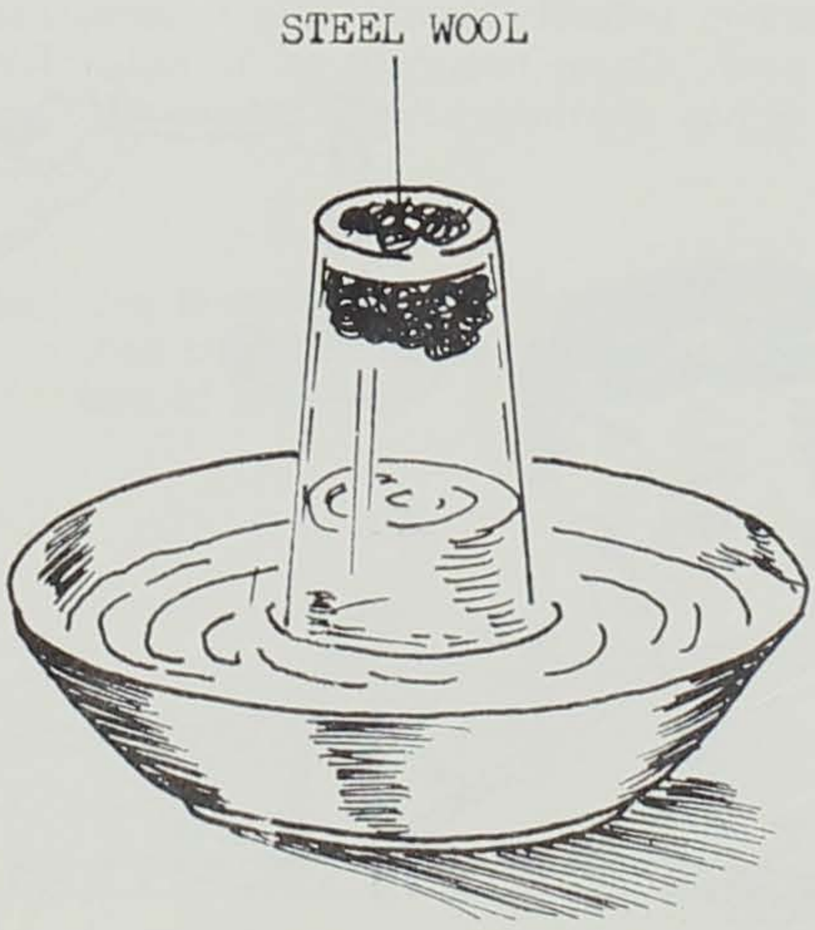
Procedure:

Thoroughly wash steel wool to remove any oily film. Moisten steel wood and wedge it in bottom of the glass. Partially fill bowl with water. Invert glass and place it in bowl. Carefully mark the point to which water rises in glass. A colored rubber band placed around the glass works well for this purpose. Allow to stand for several days. Note change in water level.

Scientific Explanation:

Iron combines with oxygen to produce iron rust. As oxygen is removed from air in glass, the pressure inside the glass is reduced. The greater pressure on the outside forces water up into glass.

Note: The experiment may be repeated to verify the rise in the water level.



INCOMPLETE COMBUSTION: CARBON FORMATION

(Grade 2 — Unit 6)

Materials:

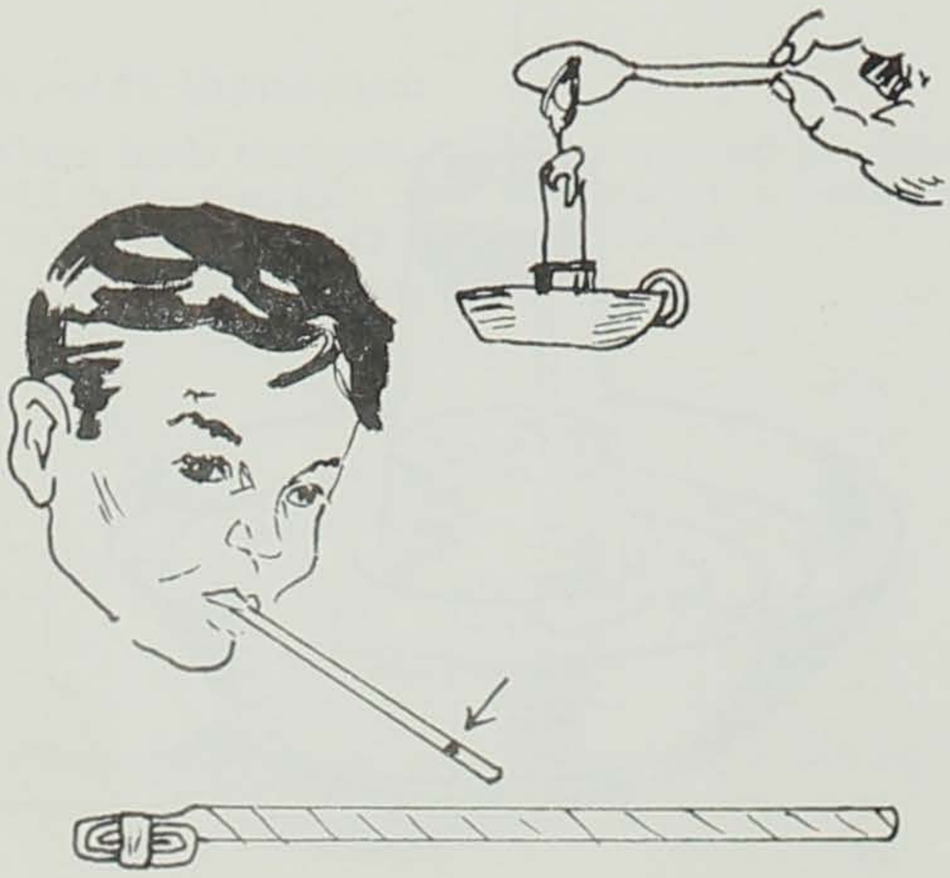
soda straws
candle
old spoon
matches

Procedure:

Collect carbon from candle by holding spoon over flame. Build homemade blowtorch by flattening one end of a straw and bending flat part back on itself three times. Fasten folds with gummed tape. Make pinhole in straw near folds (see diagram). Hold straw close to candle flame and blow through it so that air is forced through pinhole against flame. This makes flame shoot to one side. Hold spoon so that flame strikes carbon.

Scientific Explanation:

Carbon is incompletely burned by candle flame and is deposited upon spoon. Air from straw adds oxygen to flame in same way that a regular blowtorch works. The increase in oxygen increases temperature of flame burning carbon on spoon.



BOILING WATER IN PAPER CONTAINER

(Grade 2 — Unit 6)

Materials:

paper container
several matches
water

Procedure:

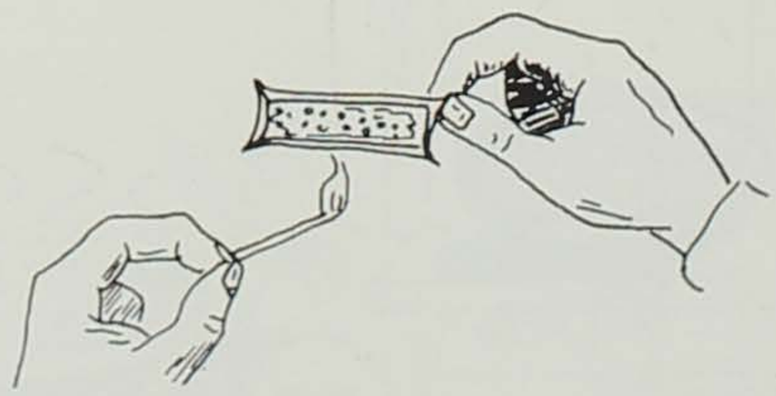
Turn up side and ends of a heavy piece of paper to make a small tray with raised edges. Fill tray half full of water. Hold candle or match under the paper container.

Expected Outcome:

Water in cardboard tray should boil without card burning.

Scientific Explanation:

Water cools card by absorbing heat and keeps card from getting hot enough to burn. More than 212 degrees Fahrenheit, which is the boiling point of water, would be needed to set card on fire. Any further heat applied to it is used to change water into steam, and steam carries off extra heat.



CAUSING STEEL TO BURN

(Grade 2 — Unit 6)

Materials:

steel wool
candle
wooden stick
steel bar

Procedure:

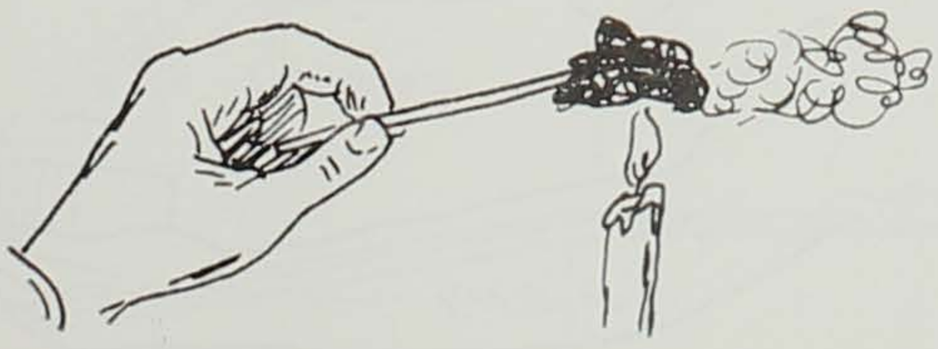
Try burning steel bar with candle. After attempting this, roll up a small amount of steel wool and place on end of stick. Hold over candle flame.

Expected Outcome:

The steel bar will get hot but will not burn. Steel wool should start to burn giving off small sparks.

Scientific Explanation:

Steel has high kindling point. However, steel wool burns because of the small threads, large amount of oxygen present, and greater surafce compared to steel bar. There is enough oxygen present to support the combustion of steel wool.



EXPANSION OF HEATED METAL

(Grade 2 — Unit 6)

Materials:

brass curtain rod or piece of stiff copper wire
large flat cork or a matchbox
several long nails
two small corks
two glasses
candle

Procedure:

Stick rod through center of flat cork or matchbox. Push two long nails into side of cork so that it will pivot on them. At each end of rod put on cork. Rest this seesaw on bottoms of two glasses and insert pins or tacks into small corks until seesaw balances. Light candle and place under one end of rod until balance of rod changes. Remove candle and observe results.

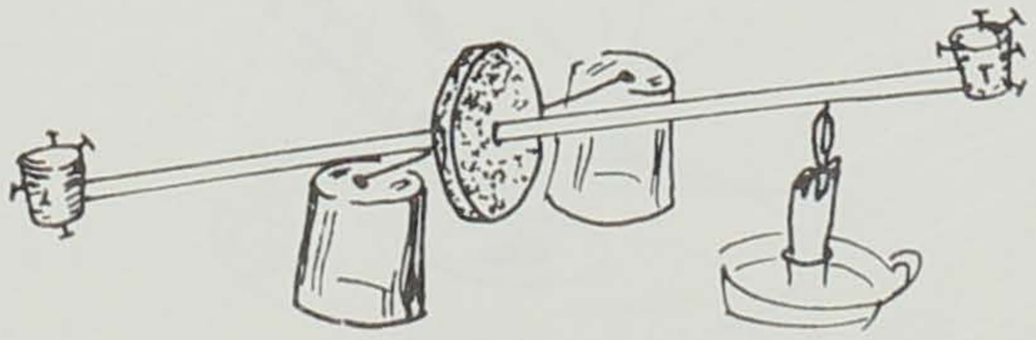
Expected Outcome:

The heat will cause the seesaw to move.

Scientific Explanation:

Heat causes rod to expand. Heated end slowly falls because of its increased length. When you remove the candle, the rod contracts and is again balanced.

Note: Use brass or copper tube or wire rather than steel because they are better conductors of heat.



CHEMICAL REACTION WITH COPPER

(Grade 2 — Unit 6)

Materials:

penny
salt
dish
cleaner

Procedure:

Clean and shine penny with cleaner or steel wool. Place in a dry saucer. Sprinkle salt on penny and moisten slightly. Allow to sit for about an hour. Observe.

Expected Outcome:

Penny will no longer be shiny. It will be dull in color. The salt will be colored bright green.

Scientific Explanation:

Pennies are made of copper mixed with tin. The salt and water set up a chemical reaction with the copper in the penny. The salt is green because some copper has combined with it. Penny is dull because it has corroded.

THE PRINCIPLE OF THE LEVER

(Grade 2 — Unit 7)

Materials:

stiff board (Fulcrum)
triangular piece of wood (see diagram)
toy wheelbarrow
weights

Procedure:

Place board over fulcrum and put weight on one end of board. Experiment with weight of different distance from fulcrum. Experiment with a wheelbarrow to determine best location for weight. Lift weight with arm (see illustration) and discuss force, weight, and fulcrum.

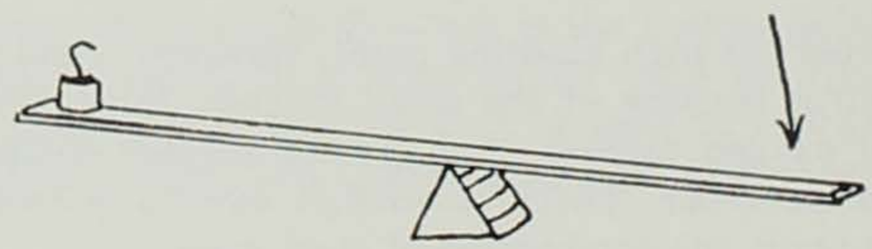
Expected Outcome:

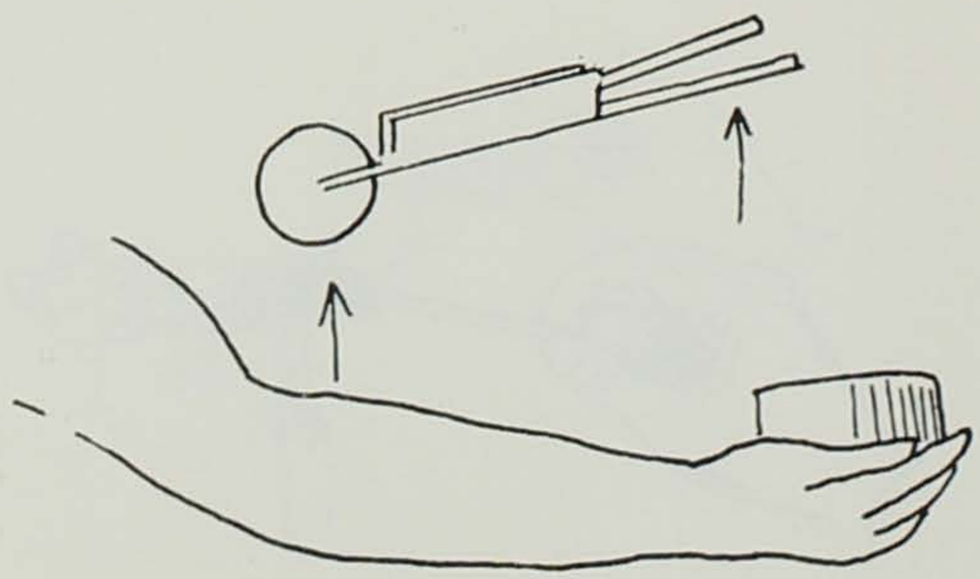
Lever allows lifting of heavy objects with great ease when they are close to the fulcrum.

Scientific Explanation:

The advantage of a lever depends on small effort, large weight and distance from fulcrum. Long effort arm in relation — to short resistance arm allows a heavy object to be lifted with less effort. Distance is sacrificed in order to lift heavier weights.

NOTE: Actual objects such as seesaws and full size wheelbarrows are excellent to use.





A PRINCIPLE OF INCLINED PLANE

(Grade 2 — Unit 7)

Materials:

board, two feet long
board, four feet long
spring scale
cord
toy wagon

Procedure:

Load toy wagon with some weight. Weigh wagon and load with spring scale. Set short board up to a low table. Haul wagon up inclined plane created by board. Note force required to move wagon. Put longer board on table and haul load up this inclined plane. Note force required.

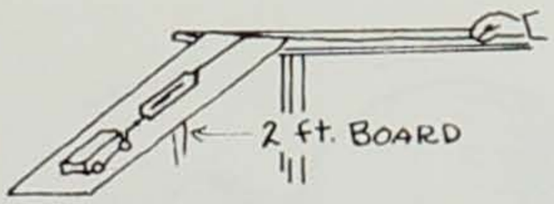
Expected Outcome:

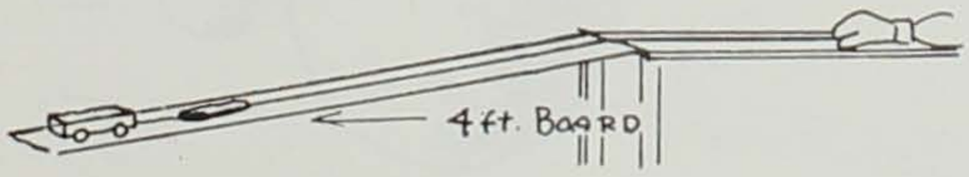
Less force should be required when inclined plane is used. The longer inclined plane should take less force than the short one.

Scientific Explanation:

Using inclined planes sacrifices distance in order to reduce force required. Using the longer board the distance is increased but force is reduced. Since load must travel further, same amount of work is required.

Note: Principle is usually used in lifting objects too heavy to lift by direct means. A simple equation — Work = Force X Distance may be used with upper grade children. This formula disregards friction.





A PRINCIPLE OF PULLEYS

(Grade 2 — Unit 7)

Materials:

2 pulleys
string
weights
spring scale

Procedure:

Lift weight without the aid of pulleys noting force required. Arrange pulleys as shown in diagram. Lift weight with pulleys noting force required.

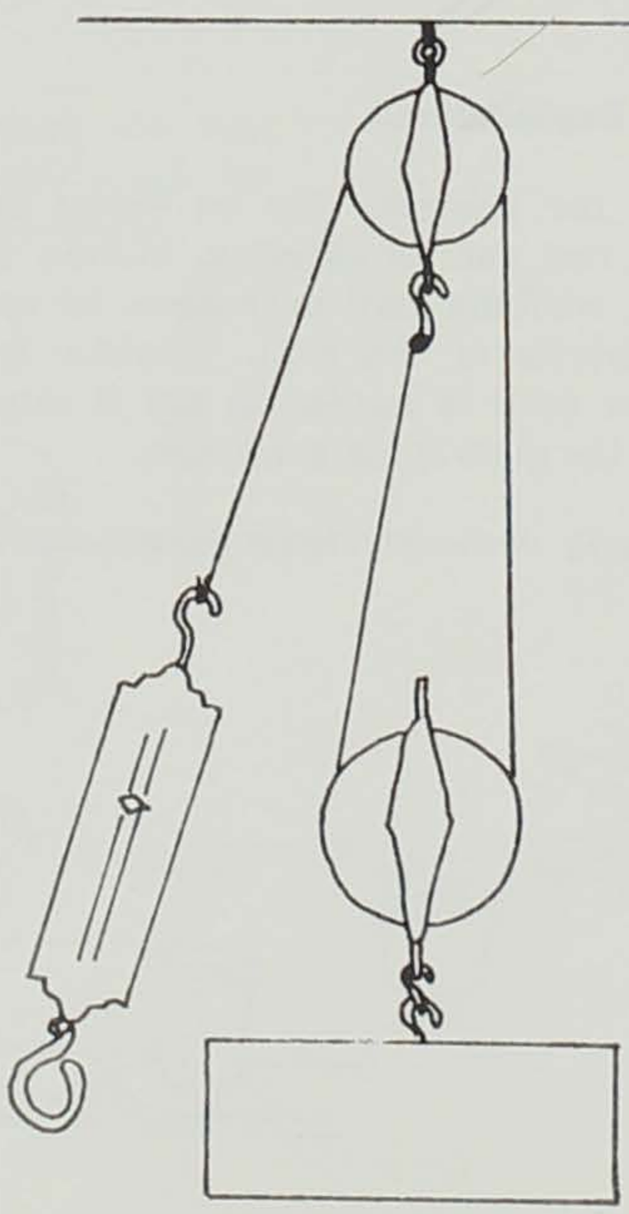
Expected Outcome:

About one-half the effort will be required to lift weight with the pulley.

Scientific Explanation:

As with inclined plane, distance is being sacrificed for force. With pulleys as illustrated it is possible to lift twice the weight that could be lifted without them.

Note: Friction between pulleys and cord will reduce the 2 to 1 ration slightly.



FORCE OF INERTIA

(Grade 2 — Unit 7)

Materials:

drinking glass
coin
thin smooth card
piece of writing paper
water

Procedure:

Set card on top of glass and place coin on top of card over mouth of glass. Snap card with middle finger. Observe. Fill glass with water. Place on paper about two inches from end. Grasp other end of paper and pull rapidly.

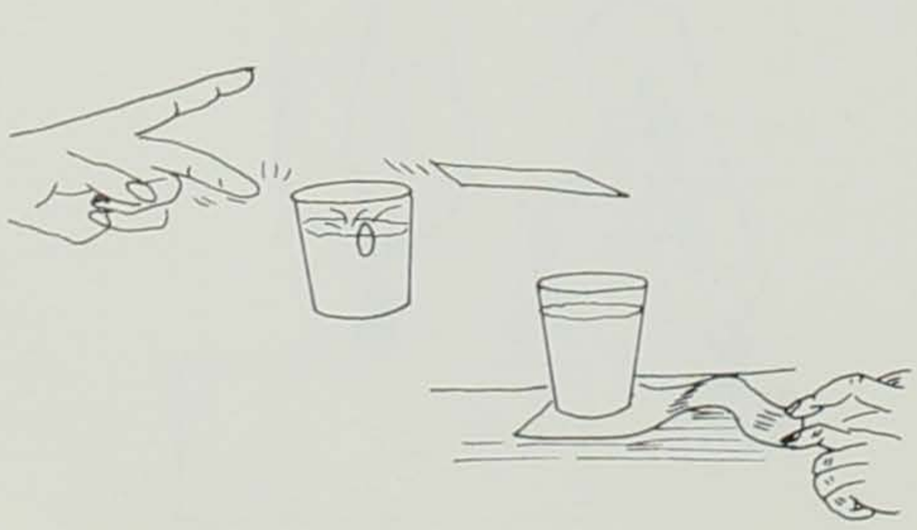
Expected Outcome:

Coin should drop into glass and glass should remain in place when paper is pulled out from under it.

Scientific Explanation:

Inertia is the tendency for an object at rest to remain at rest and an object in motion to remain in motion. Striking card overcomes its inertia but not the inertia of the coin. Tumbler is heavier than paper so it is harder to put it into motion. Inertia of the glass is not overcome.

Note: These demonstrations take some practice.



ECLIPSE OF THE SUN AND MOON

(Grade 3 — Unit 1)

Materials:

globe
light source (a powerful flashlight works well)
baseball or tennis ball

Procedure:

Set globe in front of light. Revolve ball around earth in orbit of the moon.

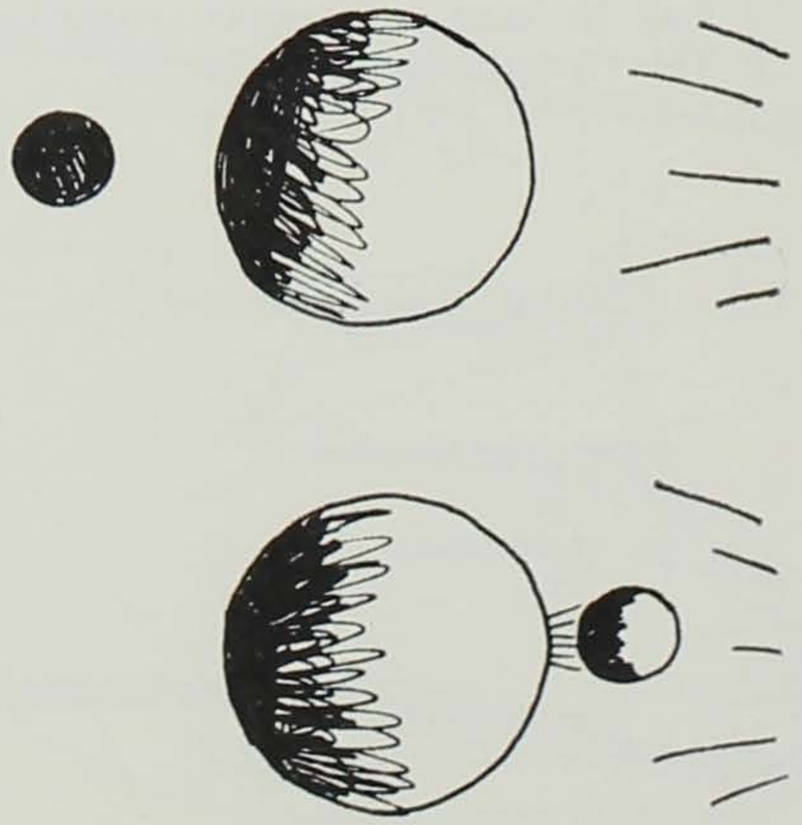
Expected Outcome:

When moon falls within shadow of globe, a lunar eclipse occurs (see first drawing). When moon comes between sun and earth, there is a solar eclipse visable to only a small area on earth.

Scientific Explanation:

Earth coming between moon and sun causes a lunar eclipse because moon shines only by light reflected from sun. Shadow of moon causes a solar eclipse (if moon is between earth and sun), which is of short duration and can be seen only in a small area because of the sun's vast size compared with the smallness of moon.

Note: An eclipse does not occur often because the sun, moon, and earth are seldom in a line on the same plane. Scientists can accurately predict eclipses years in advance.



ELECTRICITY PRODUCES MAGNETISM

(Grade 3 — Unit 3)

Materials:

board
dry cell
compass
insulated wire (about four feet long)
thumbtacks

Procedure:

Wind middle of wire around a drinking glass twelve times. Slip off coil of wire, rest it on board, and fasten down two free strands with thumbtacks. Put compass on wood, opposite center of coil. Turn wood so coil points north and south. Scrape insulation off ends of wire. Connect ends to terminals of dry cell.

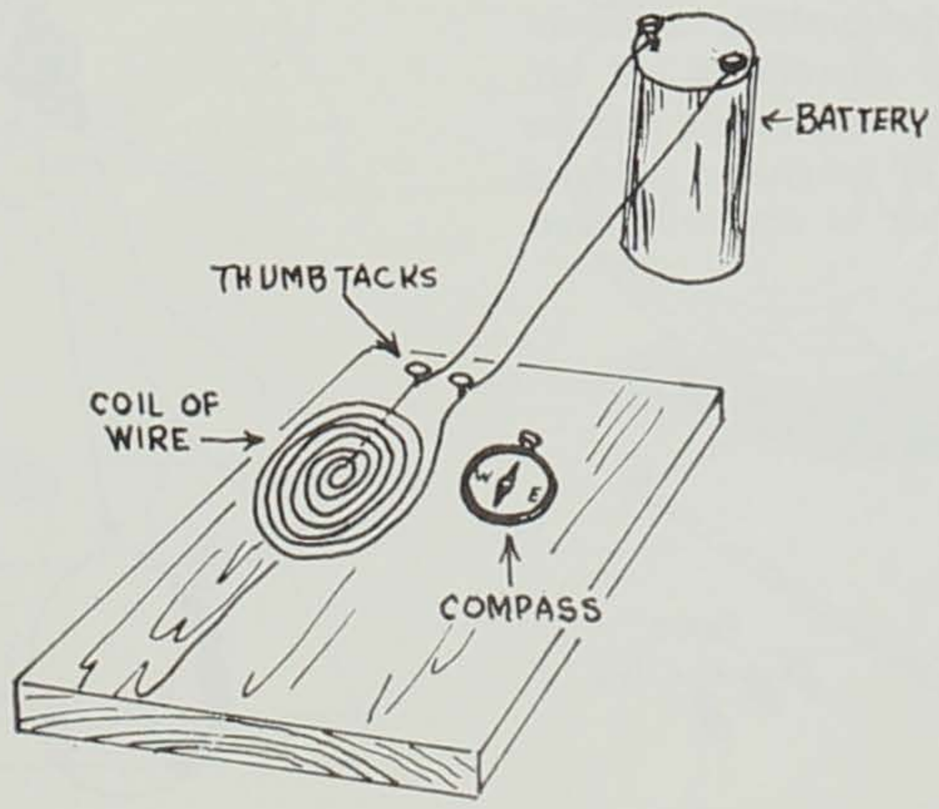
Expected Outcome:

Compass needle should swing to one side.

Scientific Explanation:

The electrical current produces a magnetic field. Electricity produces magnetism.

Note: The principle of this experiment was discovered about one hundred years ago by Hans Oersted, a Danish school teacher.



THE ELECTROMAGNET

(Grade 3 — Unit 3)

Materials:

dry cell
iron nail or bolt
five yards of insulated wire
small nails or paper clips

Procedure:

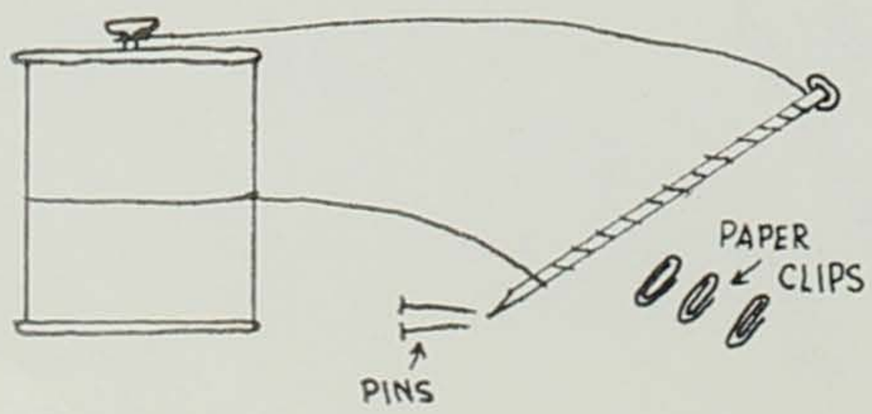
Try to pick up paper clips with bolt. Wrap bolt with wire (see illustration). Scrape insulation off about one inch on each end and connect ends to dry cell. Try to pick up paper clips with bolt. Disconnect one end of wire when magnet is holding several objects. Increase the number of turns around the bolt. Compare magnets strength.

Expected Outcome:

Bolt will not originally show any magnetic force. When current is applied bolt will act as a magnet. When current is disconnected, objects will fall off. Strength of magnet will be increased when number of turns are increased.

Scientific Explanation:

A magnetic field is formed about a conductor when current electricity is passing through it. When a conductor is wrapped around a soft iron core, the magnetic field becomes stronger. Strong magnetism of electromagnet depends on electric current flowing through wire. When current is cut off, electromagnet loses magnetism. Increasing number of turns increases strength of magnetic field, as will an increase in the number of dry cells used.



STATIC ELECTRICITY

(Grade 3 — Unit 3)

Materials:

two ballons
woolen cloth

Procedure:

Blow up two balloons and tie each with a piece of string about eighteen inches long. Rub each balloon with cloth. Hold balloons by strings, one in each hand, and try to make them touch each other. Observe.

Expected Outcome:

The balloons will not touch. They will repel each other.

Scientific Explanation:

Rubbing balloons with wool cloth transfers some electrons from cloth to balloons giving each balloon a positive charge. Like charged objects repel each other. Thus, the balloons repel each other.

STATIC ELECTRICITY — ATTRACTION

(Grade 3 — Unit 3)

Materials:

tissue paper
pocket comb (hard rubber if possible)
woolen cloth
ping pong ball

Procedure:

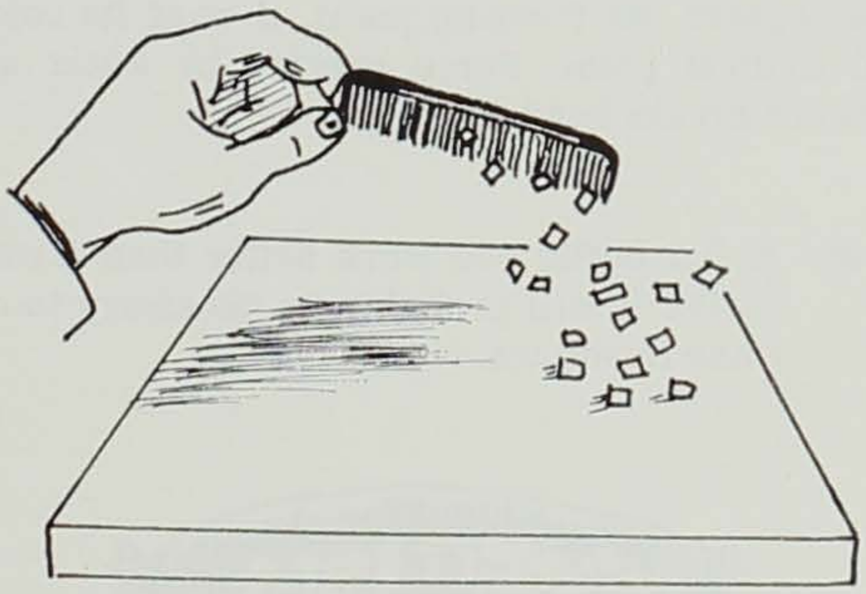
Charge comb by running it through hair or rubbing it with cloth. Tear tissue paper into small bits and bring comb near to paper. Charge comb and move it toward ping pong ball. Observe.

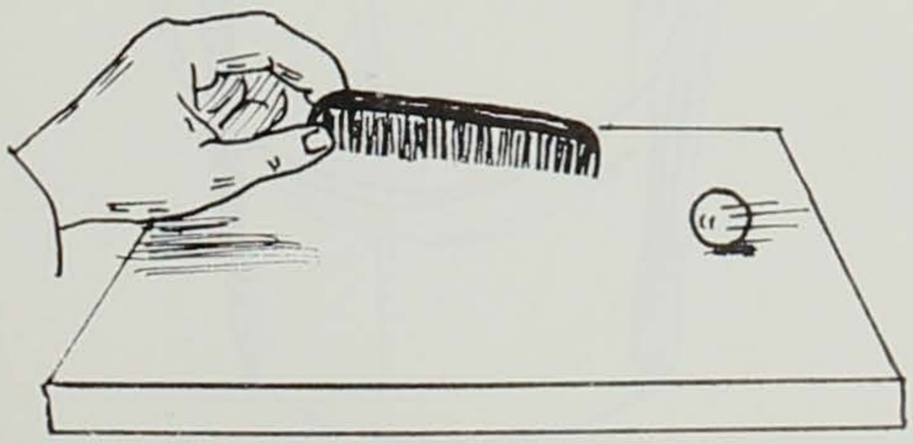
Expected Outcome:

Paper will jump at comb and cling to it. Ping pong ball with roll toward comb.

Scientific Explanation:

Rubbing comb with wool cloth will transfer some electrons from it to comb giving comb a positive charge. Paper and ping pong ball are neutrally charged, but there is enough difference in number of electrons to cause the attraction. The paper and ping pong balls act as positively charged objects.





CHEMICAL CHANGES AND ELECTRICITY

(Grade 3 — Unit 3)

Materials:

lemon
thin copper wire
steel paper clip

Procedure:

Insert wire and straightened paper clip into lemon about one-half inch apart. Touch tongue with both wires. Note taste.

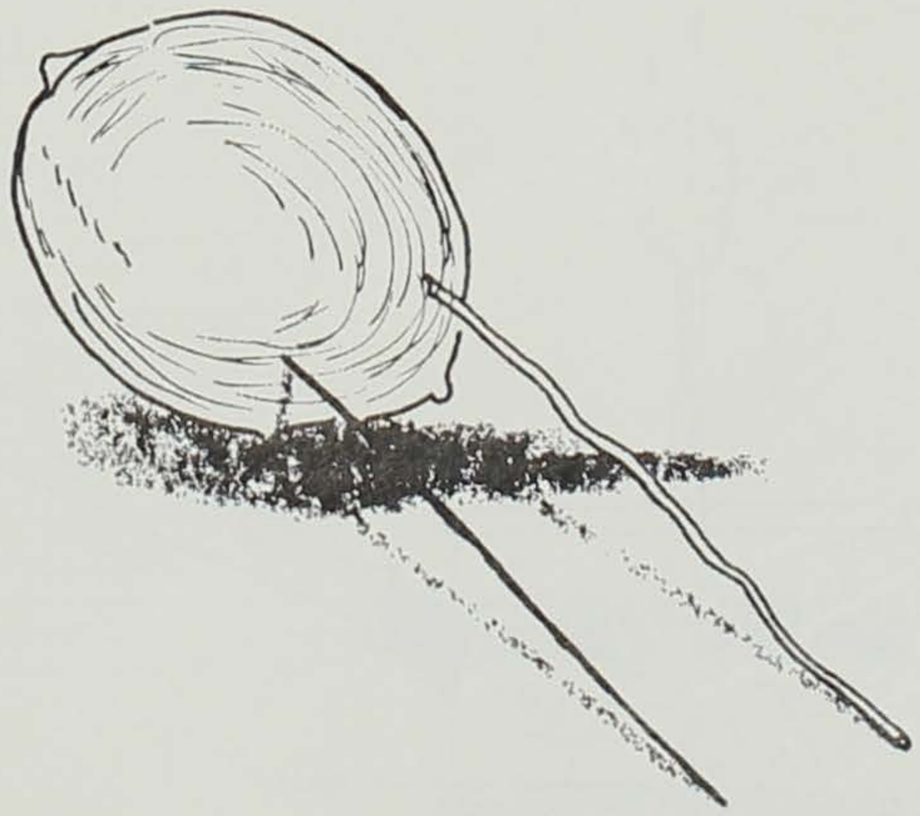
Expected Outcome:

Resulting taste should be sharp and bitter. You should feel a slight tingle.

Scientific Explanation:

The taste and tingle are caused by the current of electricity generated by battery formed by two different conducting materials and acid in lemon.

Note: You do not actually taste electricity. The taste is produced by chemical change caused by electricity.



THE PRINCIPLE OF THE GEYSER

(Grade 3 — Unit 2)

Materials:

tin or pyrex funnel
saucepan
heat source
nail

Procedure:

Put funnel in saucepan with mouth down and add enough water to cover funnel's wide tapering part. Place nail under rim of funnel so that water can flow underneath it. Put saucepan on stove and heat.

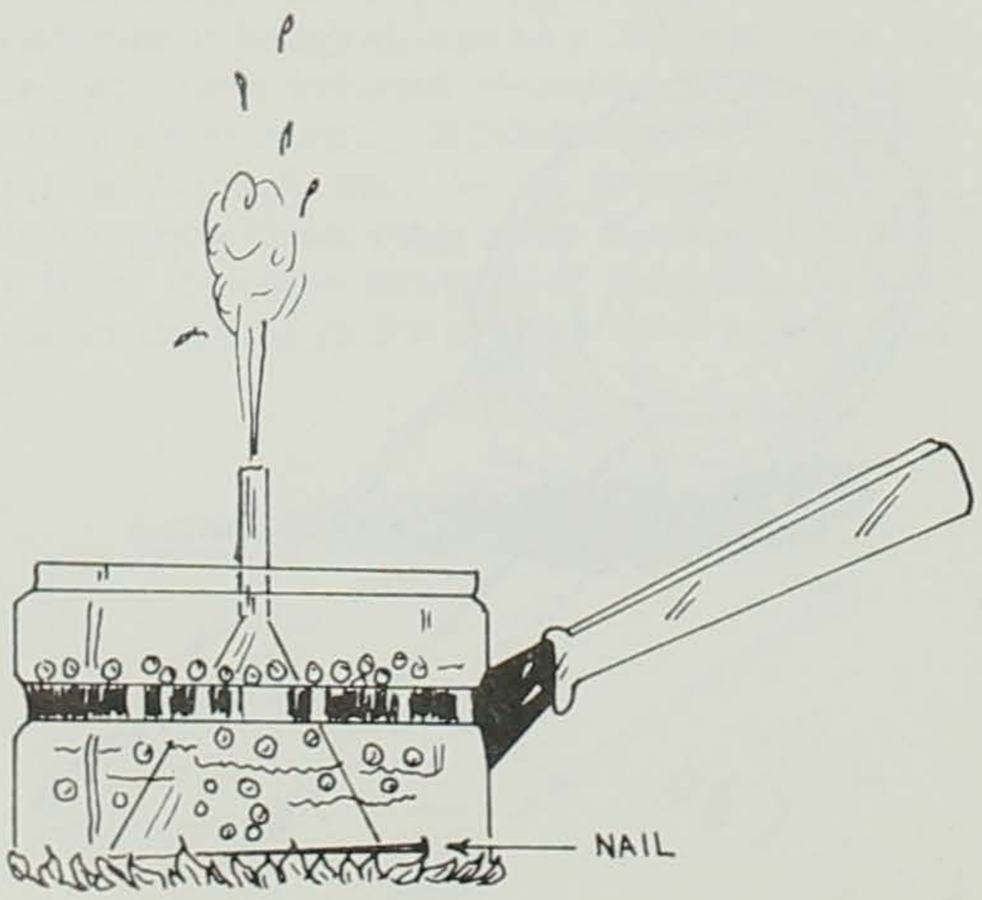
Expected Outcome:

Water will bubble from funnel acting as a geyser.

Scientific Explanation:

As water heats and turns into steam, bubbles of steam will form near bottom of pan near funnel. They will rise and expand. Bubble inside funnel will push water up ahead of it, and this water will finally be pushed out of top of tube making "geyser" erupt.

Note: Care should be taken so that students are not burned by escaping steam and hot water. Compare to a coffee percolator.



USE OF EXPANSION TO BREAK MATERIAL

(Grade 3 — Unit 2)

Materials:

bucket
25 lb. ice
rock salt
small glass bottle with screw top

Procedure:

Fill bucket with chopped ice and salt. Completely fill bottle with water and screw on cap. Put bottle in bucket of ice.

Expected Outcome:

Water in bottle should freeze, breaking bottle.

Scientific Explanation:

When water is cooled, it contracts and becomes heavier until it reaches thirty-nine degrees Fahrenheit. Then water expands. When it reaches thirty-two degrees, its freezing point, it is at its coldest and lightest point. Force exerted by water as it expands breaks bottle.

Note: A flat bottle will work better than a round bottle. It will probably be necessary to continue to add ice.