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How the children in the elementary grades of the Waltham public schools respond to science activities

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Thesis

HOW THE CHILDREN IN THE ELEMENTARY GRADES
OF THE WALTHAM PUBLIC SCHOOLS
RESPOND TO SCIENCE ACTIVITIES

Submitted by

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In Partial Fulfillment of Requirements for
the Degree of Master of Education
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CHAPTER I
THE PROBLEM

Statement of the problem.-- Science education in the elementary school is undergoing conspicuous changes. Literature on the subject indicates a shift in emphasis from content mastery to the learning of problem-solving techniques for acquiring information. Content, important as it is, is no longer considered to be an end in itself, but rather a means or a tool for solving problems.

Writing in this vein, Blough and Huggett ^{1/} say:

"Science experiences are being built around the solving of problems which are significant to pupils rather than on the answering of unimportant questions that stress the recall of unrelated scientific facts."

This seems more in keeping with our present beliefs about the general goals of education. If, as Blough and Blackwood^{2/} claim, "children are to gain the ideals, understandings and skills essential to becoming good citizens," then science teaching must be geared to meet these goals.

^{1/} Glenn O. Blough and Albert J. Huggett, Methods and Activities in Elementary - School Science, The Dryden Press Publishers, New York, 1952, p. 8.

^{2/} Glenn O. Blough and Paul E. Blackwood, Teaching Elementary Science, Bulletin, 1948, Number 4, United States Department of Health, Education, and Welfare, Washington D.C., p. 9.

Children should practice being responsible citizens in the classroom by planning and carrying out their own activities, if they are to learn how to become better citizens.

The trend seems reasonable, too, when we consider the impact of science on the lives of children in school. Their need for understanding and appreciating their environment is apparent to everyone. It is also obvious that our children are in need of some scientific procedures for coping with the many problems and complexities of the advancing age of science in which they live.

The kinds of learning experiences that are provided in a classroom obviously determine how well the students will be equipped to solve problems in a scientific manner. It is only through a better understanding of children and how they learn that we can plan for the most effective types of learning situations or activities in our elementary schools. This, of course, will come as a result of continuous study of the needs, interests and abilities of children, as Blough and Huggett^{1/} have pointed out.

Purpose of the study.-- The writer plans to find out how children in the elementary grades respond to certain science activities.

1/ Glenn O. Blough and Albert J. Huggett, op. cit., p. 7.

Scope of the study.-- The study involves: (1) the compilation and construction of directions for engaging in a series of 18 science activities appropriate to the maturity level of the children in the elementary school; and (2) the construction of an inquiry form to be used as a record of the children's responses to the activities.

The thirteen elementary schools of Waltham are included in this survey. This represents a total of 5,034 children from grades one through six.

Definition of terms.-- The term activities is used to signify observations and experiments in which children participate.

Justification of the problem.-- Relating the child to his science curriculum is a relatively new idea in education. Many excellent studies have been made in this area, but there seems to be wide disagreement in regard to the facts and the conclusions drawn from them. Educators agree that further investigation into the subject is indicated.

Piaget^{1/} ^{2/} was a pioneer worker in this field. He contributed a technique for attacking problems about

1/ Jean Piaget, The Child's Conception of the World, Harcourt, Brace and Company, Incorporated, New York, 1929.

2/ Jean Piaget, The Child's Conception of Physical Causality, Harcourt, Brace and Company, Incorporated, New York, 1930.

children's thought processes with special reference to logical thinking. Although his methods and some of his results and conclusions have been criticized, his research still marks the beginning of investigations in this field.

In 1947, Oakes^{1/} believed that the time had not yet arrived to end investigations of the development of children's concepts concerning the universe in which they live.

He pointed out the differences in the conclusions of studies which have been undertaken when he said:

"Some investigators support Piaget's interpretation in regard to stages of development, though many found over-lapping of types of thinking both between age groups and in the thinking of the same child. As yet most of the data concern too few children to lend themselves to statistical treatment. A few investigators consider that there are real differences in kind between the thought processes in children and in adults; a majority support the view that such differences are of degree only. The present investigation is another expedition in the general quest."

Deutche,^{2/} in her study of the nature and development of children's concepts of causal relations, believes that research in children's thinking and our knowledge of the subject are limited. She states:

1/ Mervin E. Oakes, "Children's Explanations of Natural Phenomena," Teachers' College, Columbia University, Contributions to Education, No. 926, Bureau of Publications, Teachers' College, Columbia University, New York, 1947, p. 131.

2/ Jean M. Deutche, The Development of Children's Concepts of Causal Relations, The University of Minnesota Press, Minneapolis, 1937, p. 3.

"This is not to be explained by a lack of interest in the problem, nor by a lack of appreciation of its importance, but rather by the extreme difficulty of formulating experimental methods for investigation which meet the needs of the problem and will help us in answering our questions."

In a more recent report, Navarra^{1/} also writes of the differences of opinions among educators as to how children learn science. He believes that our methods of evaluation are crude and that a concerted effort should be devoted toward improving them, because they would be an important avenue through which we may understand the individual as he becomes involved with certain curriculum materials. He states that science materials seem particularly well adapted to this undertaking. "It is only as we understand the individual that we can help him achieve better what he is trying to do for himself."

McCollum^{2/} thinks that child development studies are

1/ John G. Navarra, "Scientific - From the Moment of Birth," Childhood Education, (December, 1955), 32:179-186.

2/ Clifford G. McCollum, "The Determination of Science Maturity As a Means of Improving the Program in Elementary Science," The Science Teacher, (October, 1953), 20:238-240.

not being used enough for relating the nature of the child to the science experiences he has in school. Although the importance of children's interests as one of the psychological bases of learning has been recognized by educators, the use of interest for education has not yet been fully accepted, according to Lee and Lee:^{1/}

"The use of interest for education has been a center of controversy for many years. Before its introduction the educational leaders had selected subject matter on the basis of what they believed the child should know when he grew up. He was supposed to sit and learn this by direct effort and force of will, and the harder it was for him the better training he received. The advocates of the use of interest believe that learning based on interest is more rapid, more efficient, and has many valuable concomitants. These two viewpoints have persisted, with varying emphasis, up to the present, with the doctrine of the use of interest gaining ground at an increasing rate."

The limitations of interests are still being investigated as may be shown by what Travers^{2/} says:

"Research points to the conclusions that, among adolescents and younger children, expressed interests tend to be transitory, and thus the fact that an activity is described today by such an individual as liked provides little basis for predicting whether it will be liked tomorrow."

^{1/} Murray J. Lee and Doris May Lee, The Child and His Curriculum, Appleton-Century-Crofts, Inc., 1950, p. 137.

^{2/} Robert M. Travers, Educational Measurement, The Macmillan Company, New York, 1955, pp. 291-2.

Measuring pupils' attitudes toward and interests in science material and phenomena has made progress, according to Greene, Jorgensen and Gerbrich,^{1/} but they feel that the task is a difficult one because the attitudes and interests which are considered to be desirable have not yet been defined very clearly.

It is hoped that this study will reveal to some extent what part interest plays in the learning process as revealed by the responses of children to science activities.

^{1/} Harry A. Greene, Albert N. Jorgensen, and J. Raymond Gerbrich, Measurement and Evaluation in the Elementary School, Longmans, Green and Company, New York, 1953, p. 504.

CHAPTER II

Review of Related Literature

As a result of research in the fields of child behavior and science, it has become increasingly evident that children respond naturally and favorably to science activities because of the many inherent characteristics of children. Many kinds of responses of children have been listed in many kinds of ways by educators. The writer will, of necessity, limit the review of the related literature to the more outstanding and pertinent responses which have been recorded, because of its breadth.

It is agreed by practically all educators that, even though children and science are naturally adapted to each other, the elementary school has a definite responsibility for developing and guiding these innate tendencies to their maximum potentialities.

The National Society for the Study of Education in Part I of the Forty-Sixth Yearbook^{1/} states:

"Every teacher knows that mere experience does not guarantee learning. A child may be present during the discussion and activities that take place in a classroom and yet learn nothing of positive or permanent value that the teacher intends he should learn.

1/ National Society for the Study of Education, Science Education in American Schools, Forty-Sixth Yearbook, 1947, Part I, The University of Chicago Press, Chicago, Illinois, p. 168.

" Children have unusual assortment of purposes in the field of scienceThese they bring with them to school. If they appear narrow or trivial, the teacher has the task of broadening them and of stimulating worthier ones.....The success encountered in seeking answers to his multitudinous questions will be adequate encouragement to a child to continue the quest."

Hubler's^{1/} comment about the subject is:

".....unless children have capable guidance, the materials and phenomena, which represent potential science learnings may become the basis of superstition and misunderstanding, of bias and needless apprehension. --- The mere existence of potential learnings in the environment is no guarantee of adequate adjustment without the help of adults, and the schools should be one source of help."

Blackwood^{2/} feels that science learnings can be included in the curriculum when teachers take into account the well known characteristics of children and how they learn.

It is agreed by the educators too, that interest ranks high on the list of traits with which children seem to be equipped.

Blough and Huggett^{3/} point out the natural curiosity of children in the following way:

1/ Clark Hubler, Working with Children in Science, Houghton Mifflin Company, Boston, 1957, p. 13.

2/ Paul E. Blackwood, "How Can Science Learnings Be Incorporated into the Elementary School Curriculum?", Science Education, (April, 1956), 40:211-212.

3/ Glen O. Blough and Albert J. Huggett, op. cit., p. 6.

"It seems a natural thing to wonder what makes a rainbow, how magnets can pick up nails, how a compass can point north, and how an airplane can stay up in the air. It appears natural, too, to try out things to see how they work, to experiment, to manipulate, to be curious, to ask questions, to seek answers. These tendencies, with which children seem to be equipped, make science a natural part of their education and a reasonable thing to include in their school experiences."

The ways in which children's interest in their environment is indicated are also described in the Elementary School Science Bulletin.^{1/} It states that if children "have had experiences with anything, they usually want to know more about it, especially if the experiences have been interesting and pleasant."

Mitchell, in Part I of the Forty-Sixth Yearbook^{2/} maintains that if children of the elementary school do not show the native drive for discovery, then adults should be held responsible and not the children themselves.

Croxton^{3/} also expresses the opinion that the "seemingly insatiable curiosity of children" must be cultivated instead of stifled. He has this to say about it:

1/ Paul E. Blackwood, (Editor), Elementary School Science Bulletin, March, 1957, Number 29, The National Science Teachers Association, A Department of the National Education Association, 1201 Sixteenth St., N.W., Washington 6, D.C.

2/ Forty-Sixth Yearbook, op. cit., p. 62.

3/ W. C. Croxton, "What Can the Elementary School Contribute in a Continuous Science Program?", Science Education, (January, 1939), 23:8-9.

"The child's interest possesses a freshness undulled by adult custom, coercion, and the substitution of much reading and reciting for direct experiencing."

Navarra^{1/} narrates that this drive to be inquisitive comes from an inner urge about which not too much is known. He contends that the "human activity" known as science has probably evolved from this drive.

Many educators support the theory that science learnings begin at birth and that these learnings are significant to those who are involved with the teaching of children.

Navarra^{2/} states that until recently many people believed that the learnings of the pre-school child were of little significance. Although the early learning process of the very young child has only begun to be investigated, he says:

".....even a casual observation of a child from birth through his second year indicates that most children are driven by an inquisitiveness - a type of 'poking-into-ness' which demands they look into, behind, and under most objects with which they come in contact."

This, claims Navarra,^{3/} is "basic rudimentary scientific activity."

1/ John G. Navarra, op. cit.

2/ Ibid.

3/ Ibid.

Lansdown and Gionti,^{1/} in writing about the scientific knowledge of the pre-school child, say

"They accumulate a vast quantity of information without our aid long before they come to school. Our problem as teachers and parents is to foster this curiosity and develop in the child a way to find answers on his own level."

Nelson,^{2/} in her study of how children in the intermediate grades acquire concepts of light and sound, found that, although some children have no formal instruction until after they leave the elementary school, it does not mean that their curiosity has been dulled. This curiosity, she claims, has "long been known to be a driving force in the teaching of principles of physical science." She further states that it was interesting to see the increased amount of interest and participation in science after instruction had taken place.

Stefaniak^{3/} found from his study of the inductive method of teaching that children possess scientific attitudes even before instruction, and that after instruction these attitudes improve. This is written as follows:

1/ Brenda Lansdown and Herman Gionti, "What Is Science Thinking?", Grade Teacher, (September, 1956), 74:22,98.

2/ Pearl A. Nelson, The Acquisition of Concepts of Light and Sound in the Intermediate Grades, Unpublished Doctoral Dissertation, Boston University, 1957, pp.162, 179.

3/ Edward W. Stefaniak, A Study of the Effectiveness of Two Methods of Teaching Science in Grades Four, Five and Six, Unpublished Doctoral Dissertation, Boston University, 1955, p. 103.

"There were great gains toward desirable attitudes in both groups [experimental group that did all the experiments and control group that saw all the experiments performed by Stefaniak himself] for all grades from pre-test to post-test. This was in contrast to an earlier study made by Curtis in which he concluded that attitudes could be developed to a great extent by teaching them directly, but that the gains without direct teaching were not especially noteworthy. Pre-tests also showed that middle grade pupils possessed scientific attitudes to a considerable degree, which was contrary to what Curtis found for he indicated that scientific attitudes were not possessed by general science students to any degree."

Deutsche^{1/} proved in her study that training, such as is given in the public schools is important in determining the causal explanations which children give. She says:

"Undoubtedly maturation and experience are limiting factors in the determination of causal thinking, but the answers to specific questions are more closely related to school experience and whatever that implies in the way of direct and indirect instruction and training. --- Causal thinking does not develop by stages."

In Hill's^{2/} study of children and their responses to science, it was shown that younger children reveal a desire for proof. However, this characteristic was much more evident in the questions of older children. They were more concerned with why and how things happened whereas the younger children seemed more concerned merely with identifying an object.

1/ Jean M. Deutsche, op. cit., p. 95.

2/ Katherine E. Hill, "Children's Contributions to Science Discussions," Teachers College, Columbia University, Contributions to Education, No. 931, Bureau of Publications, Teachers College, Columbia University, New York, 1947, p. 81.

Burnett,^{1/} too, maintains that children think causally, but he emphasizes that because they do not express themselves as well as adults do, it does not mean that they are not seeking meaningful relationships.

The emotional aspect of learning in science has been a neglected area in education, according to Craig.^{2/} He says that children often respond with fine feeling in a discussion in science and that it is frequently indicated by their facial expressions. He further states: "There is need for recognizing the constructive role they can play in the education of children in science in a democracy,"

The ability to solve problems in a scientific manner is an objective toward which many science programs are striving. West^{3/} discovered that, although children in the elementary grades are not able to use this method as effectively as more mature students,

"They do exhibit such elements of problem solving as: recognizing the problem to be solved, planning the attack upon the problem, searching for data, weighing evidence for soundness, making the best possible solution from evidence at hand, and testing the results of their solution."

1/ R. Will Burnett, Teaching Science in the Elementary School, Rinehart and Company, Inc., New York, 1956, p. 68.

2/ Gerald S. Craig, Science for the Elementary School Teacher, Ginn and Company, Boston, 1958, p. 12.

3/ Joe Young West, "A Technique for Appraising Certain Observable Behavior of Children in Science in Elementary Schools," Teachers College, Columbia University, Contributions to Education, No. 728, Bureau of Publications, Teachers College, Columbia University, New York, 1937, pp. 50-51.

West^{1/} was trying to find out in his study if children use open-mindedness in science education, because he was of the opinion that they do. He expressed this ability as a willingness to consider viewpoints other than the individual's own and in the event that these should prove to be more acceptable, to abandon ideas previously formed in favor of those which appear to be true. Although the pupils he observed were not using open-mindedness to any degree, he was of the opinion that opportunities were not given for engaging in this type of thinking.

Nelson^{2/} found that children show a willingness to change opinions after instruction takes place. This, she explains, exemplified the scientific method as well as critical mindedness, both of which should be encouraged.

Critical mindedness was another trait of children observed by West^{3/} in his study. He observed:

"The high percentage of responses to this item, 12.99, is interpreted as a health indication of its use in a constructive manner, since only three cases of criticism of a non-constructive nature were observed during the entire series of observations."

1/ Joe Young West, op. cit., p. 48.

2/ Pearl A. Nelson, op. cit., p. 179.

3/ Joe Young West, op. cit., pp. 47-48.

1.

Although it was formerly believed by some people, judging from the earlier courses of study, that children could not understand scientific principles, such writers as Craig,^{1/} Peterson,^{2/} and Freeman, Dowling, Lacy and Tippet^{3/} believe otherwise. They are of the opinion that children can go even further in their mental processes and are able to generalize on their own level of understanding. All six writers contend that schooling is more closely related to this ability than is intelligence.

It has been shown by Haupt's^{4/} study that the ability to generalize could be found at all grade levels from one to six, but that it was limited by the complexity of the concepts that were studied. This is in contrast to

1/ Gerald S. Craig, op. cit., p. 12.

2/ George M. Peterson, "An Empirical Study of the Ability To Generalize," Journal of Genetic Psychology, (1932), 6:90-114.

3/ Kenneth Freeman, Thomas Dowling, Nan Lacy, and James Tippet, Helping Children Understand Science, The John C. Winston Company, Philadelphia, 1954, pp. 170-175.

4/ George S. Haupt, "An Experimental Application of a Philosophy of Science Teaching in an Elementary School," Teachers College, Columbia University, Contributions to Education, No. 633, Bureau of Publications, Teachers College, Columbia University, New York, 1935, p. 98.

Croxton's^{1/} earlier report which claims that only children in the higher primary, intermediate and junior high grades are capable of generalizing.

Preston, in Part I of the Forty-Sixth Yearbook,^{2/} maintains that no artifice is needed for encouraging the participation of children in planning their activities. He says that it is characteristic of growth for them to want to do this and that when they have an opportunity for sharing, they show gradual and unhampered recognition of the need for pooling their thinking and dividing their work.

Hubler^{3/} writes that a child will work harder if he has a part in the planning and that this creates a stimulus to active thinking and learning.

That children like a repetition of experiences that interest them is a well known fact. This is substantiated by what Craig^{4/} says. He describes in detail instances of this characteristic of children and stresses the importance of the use of science classes as a means of clarifying a principle.

1/ W. C. Croxton, "Pupils' Ability to Generalize," School Science and Mathematics, (January, 1936), 36:627-634.

2/ Forty-Sixth Yearbook, op. cit., p. 65.

3/ Clark Hubler, op. cit., p. 41.

4/ Gerald S. Craig, op. cit., p. 11.

Craig^{1/} also tells that children use their imaginations and that the ability to do this helps them in the development of hypotheses. He says:

"Observations of children in normal, spontaneous activities will reveal that they frequently weave their imaginations into the real, everyday experiences of life. Yet an examination of that imagination will reveal a basis in experiences they have had, a basis in their own sensory experiences, or in experiences from stories they have heard or read."

Navarra^{2/} has shown that the beginning of developing hypotheses may begin as a result of anticipation in the early experience of children.

The children who took part in Nelson's^{3/} survey were asked questions relative to their sources of information. In all three grades, she learned the most important source of science information before and after instruction, was books, with people as a second choice.

Experimenters have found that children do not respond to scientific phenomena in a uniform pattern from grade to grade, but that a great amount of overlapping in abilities is to be expected.

1/ Gerald S. Craig, op. cit., p. 14.

2/ John Navarra, "The Development of the Scientific Concepts In a Young Child: A Case Study," Teachers College, Columbia University, Contributions to Education, Bureau of Publications, Teachers College, Columbia University, New York, 1955.

3/ Pearl A. Nelson, op. cit., p. 162.

The Forty-Sixth Yearbook of the National Society for the Study of Education^{1/} states:

"Research in every branch of education supplies overwhelming support to the expectation that children of a given age and grade classification will differ tremendously in terms of rate of growth and concepts already achieved."

In a study of science maturity of children, McCollum^{2/} found that the responses of children showed evidences of wide individual differences. Answers given by first graders were also given by sixth graders. He says that,

"Even the vocabulary used in identification and explanation in many instances extended throughout the range of grade levels. It was a changing frequency rather than a complete change in type of response that distinguished between grade levels."

Vinake,^{3/} in writing about the wide range of children's thinking, says:

"Children's concepts change with increasing age, but more in the form of a gradual progression than of definite stages. The change does not occur at the same rate for all. Indeed, some may never achieve the more advanced kinds of explanations at all, since even adults may display concepts similar to those of children. Further, no child at a particular age gives consistent responses of one type or another but instead may give many different types of responses, depending upon the situation."

1/ Forty-Sixth Yearbook, op. cit., p. 67.

2/ Clifford G. McCollum, op. cit.

3/ Edgar W. Vinake, The Psychology of Thinking, McGraw-Hill Company, Inc., New York, 1952, p. 116.

A quotation from Craig's^{1/} article on "Children and Science" says:

"Teachers should expect to find differences in the ways in which children respond to science and should not strive to make reactions identical. Some children are interested in physical and biological phenomena and can exercise leadership in science activities; others will display little or no leadership. --- Teachers must expect individual differences --- for the interplay of inheritance and environment makes for biological differences. Variation is a characteristic of life and adds to the richness of the characteristics of human beings and of all living things."

Does this mean that science instruction should be individualized or that classes must be grouped as they are for reading? According to Part I of the Forty-Sixth Yearbook of the National Society for the Study of Education^{2/} it does not. It is believed that science has ample breadth for providing benefit to all in a mixed group and that each child may achieve at his own level, even though the general objectives may be the same.

However, the modern school of thought believes that the reverse of the statement is true. Branley^{3/} feels that grouping for science is advisable. He maintains that since

1/ Gerald S. Craig, "Children and Science," Science Education, (April, 1956), 40:169-173.

2/ Forty-Sixth Yearbook, loc. cit.

3/ Franklyn M. Branley, "Group for Science," Grade Teacher, (September, 1956), 74:51, 101-102.

children are different in many respects, it would seem wise to recognize these differences and to attempt to meet the varying needs. He further states that interest-ability grouping is being tried in many schools throughout the country and is proving to be successful.

Gordon,^{1/} in writing about individual growth, says that frequently we have heard that children are different and we know that they are, but, she asks, do we really understand it and take it into account in helping children to learn?

"The behavior and growth, including the intellectual growth, of any child are the result of varied and complex factors - general health, --- cultural or sociological factors in the environment in which the child grows - the types and quality of opportunities for experience and learning --- and they include psychological factors - the emotional climate in which the child grows and through which he comes to learn who he is."

Although Craig^{2/} maintains that children should be grouped because of interest and ability differences, he has admitted that there should be some teaching-learning activities that are common to all children in a class. This, he has written, is in the interest of democracy and because of the vital importance of science in modern life.

^{1/} Julia Weber Gordon, "Individual Growth - The Basis for Curriculum Planning," The Instructor, (December, 1956), 46:16.

^{2/} Gerald S. Craig, op. cit., p. 21.

CHAPTER III

Plan of Investigation

After having procured permission from the School Superintendent and the Director of Elementary Education in Waltham to do research in the schools, the investigator wrote letters to the principals and teachers, explaining the purpose of the study and asking for their cooperation.

Construction of inquiry form. --- Twelve of the more outstanding responses of children to science activities which educators believe to be evident and valuable for consideration in a classroom of the elementary school were listed by the writer. Six items were written under each response in the following way:

| | |
|---------------------------|----------------------|
| _____ Entire class | _____ A few children |
| _____ Almost all of class | _____ One child |
| _____ About half of class | _____ No one |

These were mimeographed on two pages with instructions for checking the items. (See Appendix)

Compilation and construction of activities. --- The writer selected, from various sources, eighteen activities that are considered to be appropriate for children of the elementary grades. Directions for the activities were written by the investigator in the form of science experiments

(See Appendix), with the titles stated as problems to be solved and the usual headings of: materials needed, introduction (where it seemed advisable), procedure, and conclusions. In some cases the activities were already written in this form. One activity was planned for each two grades every month, making a total of three activities a month. This was planned for a period of six months, from December through May. The problems to be solved were as follows:

A. Level I - Grades One and Two

1. December - Why Are Shadows Sometimes Short and Sometimes Long?
2. January - How Does a Thermometer Work?
3. February - What Things Will Magnets Pick Up?
4. March - What Do Plants Need to Grow?
5. April - What Is a Bud?
6. May - What Makes Nails Rust?

B. Level II - Grades Three and Four

1. December - What Will Magnets Pick Up?
2. January - Is There Air in Water?
3. February - How Do We Get Day and Night?
4. March - What Will Rust?
5. April - How Do Plants Get Water?
6. May - What Makes Food Spoil?

C. Level III - Grades Five and Six

1. December - Does Air Have Force?
2. January - How Do the Constellations Help Us to Know That the Earth Is Round?
3. February - How Does Electricity Make Power?
4. March - What Is in Snow Besides Water?
5. April - What Are the Parts of a Flower?
6. May - Do Leaves of a Plant Give Off Water?

The writer felt justified in using the same activity for two levels, in some cases, because it did not seem likely that it would mean a repetition for higher grade children. Since science is such a new subject at the elementary school level, the writer is assuming that in Waltham, just as in many other communities, science experiences in the curriculum have been limited in scope.

This does not imply, however, that the same subject may not be used at more than one level. As Blough and Huggett^{1/} have emphasized, one broad area, such as the universe may be used at all grade levels, each year, and "each time an area of science --- is encountered, the new work builds on that previously experienced, adds to it, and increases in difficulty."

The physical and biological sciences are being advocated for elementary school children today with equal emphasis on

^{1/} Glenn O. Blough and Albert J. Huggett, op. cit., p. 52

both. According to educators, it is difficult to separate one from the other in this modern age of science.

Bengelsdorf^{1/} indicated this when he said:

"The study of technology and its impact upon modern society cuts across artificial boundaries which separate one science from another. --- The very word 'atomic' denotes the need for a greater expansion of those physical sciences which are only now beginning to dwarf those of a biological nature. We must not place less emphasis upon the study of nature but more upon the study of our physical world."

The subjects considered for the study by the investigator are, therefore, concerned with the biological, as well as the physical sciences.

Directions for engaging in each activity were duplicated for the 154 elementary grades in the city.

Method of distribution. --- The inquiry forms and directions for the activities were mailed to the principals each month by the writer. Principals were asked to distribute the material to the teachers in their buildings, They were further requested to collect the completed inquiry forms at the end of each month and return them to the writer in the enclosed, self-addressed envelopes.

Teachers were requested to use the activities as a part of their science programs and to check the responses made

1/ David Bengelsdorf, "The Elementary Teachers' Task in Science," The Science Teacher, (November, 1952), 19:264-266.

by the children to the activities on the inquiry forms provided for that purpose.

CHAPTER IV

ANALYSIS OF DATA

This chapter includes the tabulation of the responses of the children in the elementary grades of Waltham to the science activities which the writer outlined for each class. The responses have been listed on 36 tables by grades (one through six). Each table indicates what percentage of the classes of each grade responded to an activity. On the pages following each pair of tables there is a comparison of the tables.

Table 1. Percentage of First Grades Responding to Activity #1, "Why Are Shadows Sometimes Short and Sometimes Long?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 19 | 19 | 52 | 0 | 11 |
| 2. Were interested in the activity----- | 41 | 44 | 15 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 15 | 30 | 48 | 7 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 15 | 15 | 67 | 0 | 4 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 22 | 22 | 56 |
| 6. Suggested looking in books for information about principle involved----- | 4 | 0 | 0 | 26 | 19 | 52 |
| 7. Requested more of same type of activity----- | 0 | 11 | 48 | 0 | 11 | 30 |
| 8. Requested a repetition of the activity----- | 4 | 33 | 26 | 0 | 15 | 22 |
| 9. Suggested trying other activities to solve problem----- | 4 | 0 | 15 | 7 | 7 | 67 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 0 | 33 | 11 | 30 | 26 |
| 11. Understood principle as result of activity----- | 0 | 44 | 41 | 7 | 4 | 4 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 11 | 11 | 41 | 30 | 0 | 7 |

Table 2. Percentage of Second Grades Responding to Activity #1, "Why Are Shadows Sometimes Short and Sometimes Long?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 9 | 18 | 23 | 45 | 5 | 0 |
| 2. Were interested in the activity----- | 59 | 41 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 14 | 36 | 32 | 18 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 5 | 14 | 27 | 55 | 0 | 0 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 10 | 57 | 0 | 33 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 14 | 33 | 19 | 29 |
| 7. Requested more of same type of activity----- | 19 | 29 | 24 | 0 | 0 | 29 |
| 8. Requested a repetition of the activity----- | 14 | 19 | 29 | 0 | 5 | 33 |
| 9. Suggested trying other activities to solve problem----- | 5 | 14 | 24 | 5 | 14 | 38 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 52 | 0 | 24 | 14 |
| 11. Understood principle as result of activity----- | 9 | 55 | 27 | 0 | 5 | 5 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 23 | 36 | 23 | 18 | 0 | 0 |

The following data have been derived from Tables 1 and 2.

1. Most of the children in Grades One and Two told probable solutions to the problem involved in Activity #1, "Why Are Shadows Sometimes Short and Sometimes Long?".
2. Almost all of the children of both grades were interested in the activity.
3. Most of the children in both grades participated in a discussion about the activity and practically all of the classes told about their own experiences relating to the activity.
4. More second graders than first graders referred to books as a possible source of information about the activity.
5. Most of the children of Grade Two requested more of the same type of this activity while only about half of the first graders made the same request.
6. The majority of children in both grades requested a repetition of the same activity.
7. More second graders than first graders suggested other activities to solve the problem in the activity but these children were in the minority of both grades.
8. Most of the children in both grades could tell more about the principle involved in the activity than was anticipated and practically all

children in both grades understood the principle involved as a result of the activity.

9. There were some children in every second grade who were more interested in and curious about the natural phenomena of the world they live in as a result of the activity. All but seven percent of the first graders showed this same interest.

Table 3. Percentage of Third Grades Responding to Activity #1,
"What Will Magnets Pick Up?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 61 | 22 | 17 | 0 | 0 |
| 2. Were interested in the activity----- | 74 | 26 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 13 | 70 | 17 | 0 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 4 | 65 | 26 | 4 | 0 |
| 5. Mentioned books that tell about principle involved----- | 0 | 4 | 0 | 57 | 13 | 26 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 0 | 36 | 9 | 55 |
| 7. Requested more of same type of activity----- | 23 | 41 | 18 | 5 | 0 | 14 |
| 8. Requested a repetition of the activity----- | 9 | 27 | 36 | 5 | 14 | 9 |
| 9. Suggested trying other activities to solve problem----- | 9 | 26 | 22 | 22 | 4 | 17 |
| 10. Could tell more about principle involved than was anticipated----- | 4 | 0 | 57 | 13 | 9 | 17 |
| 11. Understood principle as result of activity----- | 22 | 51 | 13 | 4 | 0 | 9 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 29 | 29 | 19 | 19 | 0 | 5 |

Table 4. Percentage of Fourth Grades Responding to Activity #1, "What Will Magnets Pick Up?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 5 | 43 | 24 | 29 | 0 | 0 |
| 2. Were interested in the activity----- | 67 | 24 | 10 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 14 | 52 | 14 | 19 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 24 | 29 | 48 | 0 | 0 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 20 | 35 | 10 | 35 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 15 | 30 | 15 | 35 |
| 7. Requested more of same type of activity----- | 20 | 45 | 15 | 0 | 5 | 15 |
| 8. Requested a repetition of the activity----- | 26 | 11 | 21 | 5 | 11 | 26 |
| 9. Suggested trying other activities to solve problem----- | 5 | 15 | 40 | 10 | 5 | 25 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 52 | 0 | 24 | 14 |
| 11. Understood principle as result of activity----- | 19 | 38 | 33 | 5 | 0 | 5 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 21 | 37 | 26 | 11 | 0 | 5 |

The following facts have been derived from Tables 3 and 4.

1. Most of the children in Grades Three and Four told probable solutions to the problem involved in Activity #1, "What Will Magnets Pick Up?"
2. Practically all of the children were interested in the activity and most of the children in both grades took part in a discussion about the activity.
3. More children in Grades Three than in Grade Four related their own experiences to the activity.
4. More third graders than fourth graders mentioned books that told about the problems involved in the activity, but more fourth graders suggested looking in books for solutions to the problem.
5. The majority of children of both grades requested more of the same type of activity but there were more third graders who requested a repetition of the same activity.
6. Most of the children of both grades suggested other activities to solve the problem.
7. In the majority of the classes of both grades about half of the children could tell about the principle involved than was anticipated.

8. Almost all of the children understood the principle involved as a result of the activity.
9. Most of the children in both grades were more interested in the natural phenomena of the world about them as a result of the activity.

Table 5. Percentage of Fifth Grades Responding to Activity #1, "Does Air Have Force?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 12 | 32 | 48 | 8 | 0 |
| 2. Were interested in the activity----- | 92 | 4 | 4 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity- | 12 | 32 | 40 | 16 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 4 | 64 | 8 | 24 |
| 5. Mentioned books that tell about principle involved----- | 0 | 4 | 0 | 28 | 8 | 60 |
| 6. Suggested looking in books for information about principle involved | 0 | 0 | 8 | 20 | 8 | 64 |
| 7. Requested more of same type of activity----- | 28 | 16 | 20 | 0 | 8 | 28 |
| 8. Requested a repetition of the activity----- | 32 | 8 | 12 | 4 | 8 | 36 |
| 9. Suggested trying other activities to solve problem----- | 0 | 12 | 12 | 4 | 16 | 56 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 8 | 32 | 4 | 24 | 32 |
| 11. Understood principle as result of activity----- | 8 | 56 | 36 | 0 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 17 | 22 | 9 | 43 | 0 | 9 |

Table 6. Percentage of Sixth Grades Responding to Activity #1, "Does Air Have Force?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 35 | 24 | 35 | 6 | 0 |
| 2. Were interested in the activity----- | 83 | 17 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 39 | 56 | 6 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 6 | 78 | 6 | 11 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 50 | 6 | 44 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 6 | 17 | 28 | 50 |
| 7. Requested more of same type of activity----- | 28 | 22 | 39 | 0 | 0 | 11 |
| 8. Requested a repetition of the activity----- | 22 | 22 | 6 | 0 | 17 | 33 |
| 9. Suggested trying other activities to solve problem----- | 6 | 6 | 17 | 11 | 17 | 44 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 0 | 65 | 0 | 18 | 18 |
| 11. Understood principle as result of activity----- | 17 | 67 | 11 | 0 | 0 | 6 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 12 | 47 | 24 | 18 | 0 | 0 |

The following facts have been derived from Tables 5 and 6.

1. More children in Grade Five than in Grade Six could tell probable solutions to the problem involved in Activity #1, "Does Air Have Force?".
2. Practically the entire class of both grades were interested in the activity, but a greater percentage of fifth graders than sixth graders took part in a discussion about the activity. However, most of the children in both grades took part.
3. There were a few children in the classes of both grades who related the activity to their own experiences.
4. A larger percentage of sixth grade children than fifth graders referred to books in connection with the activity. The percentage of children who mentioned books was low for both grades, however.
5. Most of the children in both grades requested more of the same type of activity while about one half of the children in both grades requested a repetition of the same activity.
6. There were some children in both grades who suggested trying other activities to solve the problem, but the majority of children did not make suggestions.

7. More sixth graders than fifth graders could tell more about the principle involved in the activity than was anticipated, yet more fifth graders than sixth graders understood the principle involved as a result of the activity.
8. The majority of children of both grades were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 7. Percentage of First Grades Responding to Activity #2, "How Does a Thermometer Work?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 15 | 22 | 33 | 4 | 26 |
| 2. Were interested in the activity----- | 78 | 11 | 11 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 15 | 33 | 37 | 15 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 7 | 15 | 44 | 0 | 33 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 22 | 7 | 70 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 4 | 26 | 7 | 63 |
| 7. Requested more of same type of activity----- | 25 | 13 | 4 | 33 | 0 | 25 |
| 8. Requested a repetition of the activity----- | 20 | 20 | 4 | 36 | 0 | 20 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 0 | 28 | 8 | 64 |
| 10. Could tell more about principle involved than was anticipated----- | 4 | 0 | 12 | 32 | 8 | 44 |
| 11. Understood principle as result of activity----- | 12 | 52 | 16 | 8 | 0 | 12 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 21 | 21 | 17 | 33 | 0 | 8 |

Table 8. Percentage of Second Grades Responding to Activity #2,
"How Does A Thermometer Work?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 9 | 32 | 27 | 23 | 0 | 9 |
| 2. Were interested in the activity----- | 86 | 14 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 24 | 33 | 33 | 10 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 10 | 10 | 50 | 15 | 15 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 5 | 30 | 20 | 45 |
| 6. Suggested looking in books for information about principle involved----- | 5 | 14 | 5 | 29 | 14 | 33 |
| 7. Requested more of same type of activity----- | 35 | 5 | 15 | 20 | 0 | 25 |
| 8. Requested a repetition of the activity----- | 15 | 25 | 10 | 20 | 0 | 30 |
| 9. Suggested trying other activities to solve problem----- | 15 | 0 | 0 | 45 | 0 | 40 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 15 | 30 | 35 | 5 | 15 |
| 11. Understood principle as result of activity----- | 50 | 10 | 20 | 10 | 5 | 5 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 15 | 30 | 25 | 30 | 0 | 0 |

Tables 7 and 8 indicate the following data:

1. More second grade children than first graders told probable solutions to the problem involved in Activity #2, "How Does a Thermometer Work?"
2. More second grade children than first graders were interested in the activity and participated in a discussion about the activity. The difference in the responses, however, was not too significant.
3. More second graders related their own experiences to the activity than first graders, but in both cases they were in the minority.
4. More second graders than first grade children referred to books in connection with the activity, but the percentage was low for both grades.
5. There was no significant difference in the two grades in requesting more of the same type of activity or in requesting a repetition of the same activity. The majority of children in both grades made requests.
6. More second graders than first grade children could tell more about the principle involved in the activity than was anticipated and suggested other activities to solve the problem.

7. More second grade children understood the principle involved as a result of the activity.
8. Most of the children in both grades are more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 9. Percentage of Third Grades Responding to Activity #2, "Is There Air in Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 4 | 24 | 28 | 36 | 4 | 4 |
| 2. Were interested in the activity----- | 76 | 20 | 4 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 8 | 64 | 24 | 4 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 4 | 28 | 32 | 8 | 28 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 8 | 32 | 12 | 48 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 12 | 44 | 12 | 32 |
| 7. Requested more of same type of activity----- | 12 | 24 | 16 | 28 | 4 | 16 |
| 8. Requested a repetition of the activity----- | 9 | 13 | 9 | 17 | 0 | 52 |
| 9. Suggested trying other activities to solve problem----- | 0 | 8 | 8 | 32 | 4 | 48 |
| 10. Could tell more about principle involved than was anticipated----- | 4 | 8 | 28 | 28 | 16 | 16 |
| 11. Understood principle as result of activity----- | 40 | 48 | 4 | 8 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 17 | 42 | 21 | 17 | 0 | 4 |

Table 10. Percentage of Fourth Grades Responding to Activity #2, "Is There Air in Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 25 | 20 | 40 | 0 | 15 |
| 2. Were interested in the activity----- | 55 | 25 | 15 | 5 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 5 | 55 | 25 | 15 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 5 | 0 | 5 | 65 | 5 | 20 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 5 | 30 | 30 | 35 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 10 | 15 | 5 | 65 |
| 7. Requested more of same type of activity----- | 0 | 21 | 5 | 42 | 26 | 5 |
| 8. Requested a repetition of the activity----- | 0 | 10 | 5 | 10 | 0 | 75 |
| 9. Suggested trying other activities to solve problem----- | 0 | 5 | 5 | 37 | 16 | 37 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 10 | 45 | 0 | 35 |
| 11. Understood principle as result of activity----- | 37 | 42 | 11 | 11 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 6 | 50 | 17 | 22 | 0 | 6 |

The following data have been derived from Tables 9 and 10.

1. In both Grades Three and Four, the majority of classes had only a few children who told probable solutions to the problem involved in Activity #2, "Is There Air in Water?"
2. More children in Grade Three were interested in the activity and took part in a discussion of the activity than in Grade Four.
3. In 80 percent of the fourth grades and in 72 percent of the third grades there were children who related the activity to their own experiences.
4. More fourth graders than third graders mentioned books that told about the principle involved in the activity but more third graders suggested looking in books for solutions to the problem. In both cases, however, they were in the minority.
5. In the third grade there were more people who requested more of the same type of activity as well as a repetition of the same activity than there were in the fourth grade.
6. About half of the third grades had some children who suggested other activities to solve the problem involved in the activity, while a slightly higher percentage of fourth graders made suggestions.

7. More third grade children than fourth graders could tell probable solutions to the problem than was anticipated.
8. The children who understood the principle involved as a result of the activity were in the majority of both grades.
9. Both grades showed that most of the children were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 11. Percentage of Fifth Grades Responding to Activity #2, "How Do the Constellations Help Us to Know That the Earth Is Round?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 17 | 28 | 6 | 28 | 11 | 11 |
| 2. Were interested in the activity----- | 61 | 22 | 17 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 17 | 22 | 56 | 6 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 22 | 6 | 39 | 17 | 17 |
| 5. Mentioned books that tell about principle involved----- | 0 | 6 | 6 | 50 | 6 | 33 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 6 | 39 | 11 | 44 |
| 7. Requested more of same type of activity----- | 18 | 12 | 6 | 18 | 6 | 41 |
| 8. Requested a repetition of the activity----- | 6 | 12 | 6 | 18 | 6 | 53 |
| 9. Suggested trying other activities to solve problem----- | 0 | 24 | 6 | 6 | 12 | 53 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 18 | 6 | 41 | 12 | 24 |
| 11. Understood principle as result of activity----- | 29 | 12 | 29 | 29 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 31 | 13 | 25 | 31 | 0 | 0 |

Table 12. Percentage of Sixth Grades Responding to Activity #2, "How Do the Constellations Help Us to Know That the Earth Is Round?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 5 | 23 | 18 | 32 | 5 | 18 |
| 2. Were interested in the activity----- | 52 | 14 | 29 | 5 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 33 | 38 | 29 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 5 | 5 | 52 | 5 | 33 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 10 | 38 | 0 | 52 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 10 | 5 | 33 | 5 | 48 |
| 7. Requested more of same type of activity----- | 10 | 5 | 19 | 33 | 10 | 24 |
| 8. Requested a repetition of the activity----- | 0 | 0 | 5 | 14 | 5 | 76 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 10 | 14 | 5 | 71 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 5 | 52 | 10 | 24 |
| 11. Understood principle as result of activity----- | 48 | 33 | 19 | 0 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 5 | 48 | 10 | 38 | 0 | 0 |

The following facts have been derived from Tables 11 and 12.

1. Almost all of the classes of Grades Five and Six had children who told probable solutions to the problem involved in Activity #2, "How Do the Constellations Help Us to Know That the Earth Is Round?"
2. In both grades the majority of children were interested in the activity and took part in a discussion about the activity.
3. More fifth graders than sixth graders related the activity to their own experiences and also referred to books in connection with the activity.
4. More sixth graders requested more of the same type of activity while a larger percentage of fifth grade children requested a repetition of the same activity. However, 53 percent of the fifth grades and 76 percent of the sixth grades had no one requesting a repetition of the activity.
5. More fifth graders than sixth could tell more about the principle involved as a result of the activity and suggested other activities to solve the problem.
6. The majority of both grades showed that the children understood the principle involved as a result of the activity.

7. All of the classes showed that the children were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 13. Percentage of First Grades Responding to Activity #3,
"What Things Will Magnets Pick Up?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 4 | 33 | 22 | 33 | 0 | 7 |
| 2. Were interested in the activity----- | 85 | 15 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity- | 26 | 41 | 22 | 11 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 15 | 22 | 63 | 0 | 0 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 29 | 7 | 63 |
| 6. Suggested looking in books for information about principle involved | 4 | 4 | 7 | 26 | 7 | 52 |
| 7. Requested more of same type of activity----- | 19 | 23 | 11 | 27 | 4 | 15 |
| 8. Requested a repetition of the activity----- | 15 | 37 | 11 | 26 | 4 | 7 |
| 9. Suggested trying other activities to solve problem----- | 7 | 4 | 11 | 19 | 0 | 59 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 11 | 11 | 41 | 7 | 29 |
| 11. Understood principle as result of activity----- | 26 | 37 | 19 | 7 | 4 | 7 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 15 | 26 | 19 | 41 | 0 | 0 |

Table 14. Percentage of Second Grades Responding to Activity #3,
"What Things Will Magnets Pick Up?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 14 | 67 | 10 | 10 | 0 | 0 |
| 2. Were interested in the activity----- | 81 | 19 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity- | 19 | 71 | 5 | 5 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 5 | 29 | 38 | 24 | 5 | 0 |
| 5. Mentioned books that tell about principle involved----- | 0 | 5 | 24 | 14 | 19 | 38 |
| 6. Suggested looking in books for information about principle involved | 5 | 10 | 10 | 43 | 5 | 29 |
| 7. Requested more of same type of activity----- | 27 | 29 | 14 | 19 | 0 | 10 |
| 8. Requested a repetition of the activity----- | 14 | 19 | 24 | 24 | 0 | 19 |
| 9. Suggested trying other activities to solve problem----- | 14 | 10 | 5 | 48 | 0 | 24 |
| 10. Could tell more about principle involved than was anticipated----- | 14 | 29 | 19 | 33 | 0 | 5 |
| 11. Understood principle as result of activity----- | 48 | 24 | 5 | 24 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 48 | 14 | 27 | 10 | 0 | 0 |

The following data have been derived from Tables 13 and 14.

1. More children of Grade Two than of Grade One could tell probably solutions to the problem of Activity #3, "What Things Will Magnets Pick Up?"
2. More children in Grade One than in Grade Two showed an interest in the activity, although the majority of children in both grades were interested.
3. The second grade had more people taking part in a discussion about the activity than the first grade had, but both grades had some children of every class taking part.
4. More second graders than first graders related their own experiences to the activity.
5. A greater percentage of second grade children than first graders referred to books in connection with the activity.
6. More second graders requested more of the same type of activity, although many first graders made the same request.
7. A larger percentage of children in the first grade classes than in the second grades requested a repetition of the activity while many more second graders suggested trying other activities to solve the problem involved.
8. More second graders than first graders could (a) tell more about the principle involved than was antici-

pated, (b) understood the principle involved in the activity, and (c) were more interested in and curious about the natural phenomena of the world as a result of the activity.

Table 15. Percentage of Third Grades Responding to Activity #3,
"How Do We Get Day and Night?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 5 | 45 | 25 | 20 | 0 | 5 |
| 2. Were interested in the activity----- | 80 | 15 | 5 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 35 | 40 | 25 | 0 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 25 | 55 | 5 | 15 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 45 | 0 | 55 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 10 | 35 | 15 | 35 |
| 7. Requested more of same type of activity----- | 5 | 35 | 20 | 25 | 0 | 15 |
| 8. Requested a repetition of the activity----- | 0 | 0 | 10 | 20 | 5 | 65 |
| 9. Suggested trying other activities to solve problem----- | 0 | 5 | 10 | 10 | 5 | 70 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 25 | 25 | 40 | 5 | 5 |
| 11. Understood principle as result of activity----- | 50 | 25 | 25 | 0 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 20 | 45 | 20 | 15 | 0 | 0 |

Table 16. Percentage of Fourth Grades Responding to Activity #3, "How Do We Get Day and Night?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 5 | 25 | 25 | 40 | 0 | 5 |
| 2. Were interested in the activity----- | 75 | 15 | 10 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 25 | 15 | 45 | 15 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 11 | 5 | 58 | 5 | 21 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 10 | 40 | 15 | 35 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 5 | 45 | 5 | 40 |
| 7. Requested more of same type of activity----- | 15 | 10 | 10 | 30 | 5 | 30 |
| 8. Requested a repetition of the activity----- | 5 | 5 | 15 | 20 | 0 | 55 |
| 9. Suggested trying other activities to solve problem----- | 0 | 5 | 5 | 20 | 5 | 65 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 20 | 45 | 15 | 10 |
| 11. Understood principle as result of activity----- | 65 | 20 | 10 | 5 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 11 | 50 | 33 | 0 | 0 | 6 |

The following data have been derived from Tables 15 and 16.

1. More third graders than fourth graders told probable solutions to the problem involved in Activity #3, "How Do We Get Day and Night?". The majority of children in both grades gave suggestions, however.
2. In all classes of both grades most of the children were interested in the activity.
3. More children in Grade Three participated in a discussion about the activity than in Grade Four, yet, more fourth graders related their own experiences to the activity than third graders. The difference in percentage was slight.
4. Only about half the percentage of both grades made reference to books in connection with the activity.
5. A larger percentage of third graders requested more of the same type of activity, than fourth graders, while more fourth graders requested a repetition of the activity. This included only about 50 percent of the classes of the fourth grade.
6. A small percentage of both grades suggested trying other activities to solve the problem involved.
7. A slightly higher percentage of third graders than of fourth grades could tell more about the

principle involved than was anticipated.

8. The majority of children in both grades understood the principle involved and were more interested in and curious about the natural phenomena of the world as a result of the activity.

Table 17. Percentage of Fifth Grades Responding to Activity #3,
"How Does Electricity Make Power?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 14 | 24 | 14 | 38 | 5 | 5 |
| 2. Were interested in the activity----- | 48 | 38 | 14 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity- | 5 | 33 | 52 | 10 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 14 | 19 | 38 | 14 | 14 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 5 | 38 | 14 | 43 |
| 6. Suggested looking in books for information about principle involved | 0 | 5 | 5 | 43 | 14 | 33 |
| 7. Requested more of same type of activity----- | 10 | 24 | 14 | 24 | 0 | 29 |
| 8. Requested a repetition of the activity----- | 14 | 5 | 14 | 19 | 10 | 38 |
| 9. Suggested trying other activities to solve problem----- | 0 | 10 | 14 | 29 | 14 | 33 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 10 | 57 | 5 | 19 |
| 11. Understood principle as result of activity----- | 14 | 52 | 14 | 19 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 5 | 42 | 5 | 0 | 42 | 5 |

Table 18. Percentage of Sixth Grades Responding to Activity #3,
"How Does Electricity Make Power?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 30 | 15 | 50 | 5 | 0 |
| 2. Were interested in the activity----- | 85 | 15 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity- | 5 | 30 | 50 | 15 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 20 | 65 | 5 | 10 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 5 | 50 | 10 | 35 |
| 6. Suggested looking in books for information about principle involved | 0 | 0 | 20 | 20 | 15 | 45 |
| 7. Requested more of same type of activity----- | 15 | 25 | 15 | 40 | 0 | 0 |
| 8. Requested a repetition of the activity----- | 5 | 15 | 5 | 30 | 0 | 0 |
| 9. Suggested trying other activities to solve problem----- | 5 | 10 | 15 | 30 | 15 | 25 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 15 | 70 | 5 | 0 |
| 11. Understood principle as result of activity----- | 26 | 42 | 26 | 5 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 16 | 47 | 16 | 21 | 0 | 0 |

The following data have been derived from Tables 17 and 18.

1. A few children in the majority of the classes of both Grades Five and Six told probable solutions to the problem involved in Activity #3, "How Does Electricity Make Power?." The entire classes in 14 percent of the fifth grades told probable solutions, while no sixth grade had an entire class responding in this way.
2. More sixth grade children than fifth graders were interested in the activity, yet a slightly higher percentage of fifth grade children participated in a discussion about the activity.
3. The fifth grades had a greater percentage of children who related the activity to their own experiences than the sixth grades.
4. More sixth grade children mentioned books that tell about the principle involved in the activity, while more fifth grade children suggested looking in books for information about the principle involved.
5. More fifth graders than sixth grade children requested more of the same type of activity, and also requested a repetition of the same activity.
6. More sixth grade children suggested trying other activities to solve the problem involved than fifth graders.

7. More sixth graders than fifth grade children could tell more about the principle involved than was anticipated and understood the principle involved as a result of the activity.
8. More sixth grade children were more interested in and more curious about the natural phenomena of the world they live in as a result of the activity.

Table 19. The Percentage of First Grades Responding to Activity #4, "What Do Plants Need to Grow?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 8 | 24 | 36 | 32 | 0 | 0 |
| 2. Were interested in the activity----- | 48 | 36 | 8 | 8 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 12 | 36 | 44 | 8 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 12 | 64 | 4 | 20 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 8 | 16 | 4 | 72 |
| 6. Suggested looking in books for information about principle involved----- | 8 | 0 | 0 | 24 | 12 | 56 |
| 7. Requested more of same type of activity----- | 4 | 4 | 17 | 29 | 8 | 38 |
| 8. Requested a repetition of the activity----- | 4 | 0 | 17 | 21 | 4 | 54 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 0 | 25 | 4 | 71 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 4 | 13 | 52 | 9 | 21 |
| 11. Understood principle as result of activity----- | 33 | 50 | 4 | 0 | 4 | 9 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 25 | 17 | 17 | 38 | 0 | 4 |

Table 20. The Percentage of Second Grades Responding to Activity #4,
"What Do Plants Need to Grow?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 11 | 47 | 21 | 21 | 0 | 0 |
| 2. Were interested in the activity----- | 67 | 28 | 6 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 5 | 63 | 16 | 16 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 11 | 21 | 47 | 0 | 21 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 11 | 26 | 11 | 53 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 11 | 0 | 58 | 0 | 31 |
| 7. Requested more of same type of activity----- | 16 | 21 | 16 | 37 | 0 | 11 |
| 8. Requested a repetition of the activity----- | 5 | 16 | 11 | 16 | 5 | 47 |
| 9. Suggested trying other activities to solve problem----- | 6 | 11 | 0 | 22 | 0 | 61 |
| 10. Could tell more about principle involved than was anticipated----- | 11 | 26 | 5 | 53 | 0 | 5 |
| 11. Understood principle as result of activity----- | 42 | 58 | 0 | 0 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 37 | 31 | 11 | 21 | 0 | 0 |

The following data have been derived from Tables 19 and 20.

1. There were some children in both Grades One and Two who told probable solutions to the problem involved in Activity #4, "What Do Plants Need to Grow?" The percentage of second graders was slightly higher than that of first graders.
2. More second graders than first graders were interested in the activity, yet more first grade children took part in a discussion about the activity. Interest was high in both grades.
3. More second graders related their own experiences to the activity and mentioned books in connection with the activity. The percentage of grades referring to books was limited to a few children in the classes for the most part.
4. More second graders than first graders requested more of the same type of activity.
5. More second graders requested a repetition of the same activity but 47 percent of the classes made no request.
6. More second graders than first grade children suggested trying other activities to solve the problem but the percentage for both grades was low.
7. More second grade children than first graders could tell more about the principle involved and understood the principle as a result of the activity.
8. The majority of second graders were more interested in and curious about the natural phenomena

of the world they live in as a result of the activity. Only four percent of the first grade classes did not show this interest.

Table 21. Percentage of Third Grades Responding to Activity #4, "What Will Rust?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 17 | 33 | 17 | 28 | 6 | 0 |
| 2. Were interested in the activity----- | 72 | 28 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 22 | 44 | 33 | 0 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 6 | 0 | 35 | 53 | 0 | 6 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 6 | 33 | 6 | 55 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 6 | 11 | 44 | 0 | 39 |
| 7. Requested more of same type of activity----- | 6 | 39 | 17 | 22 | 0 | 17 |
| 8. Requested a repetition of the activity----- | 6 | 11 | 11 | 11 | 6 | 56 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 6 | 28 | 6 | 61 |
| 10. Could tell more about principle involved than was anticipated----- | 6 | 11 | 22 | 50 | 0 | 11 |
| 11. Understood principle as result of activity----- | 56 | 22 | 17 | 6 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 11 | 44 | 33 | 11 | 0 | 0 |

Table 22. Percentage of Fourth Grades Responding to Activity #4, "What Will Rust?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 5 | 37 | 26 | 16 | 0 | 16 |
| 2. Were interested in the activity----- | 74 | 21 | 5 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 47 | 47 | 5 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 11 | 32 | 42 | 11 | 5 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 32 | 11 | 58 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 6 | 0 | 33 | 6 | 56 |
| 7. Requested more of same type of activity----- | 5 | 26 | 16 | 16 | 5 | 32 |
| 8. Requested a repetition of the activity----- | 0 | 11 | 5 | 11 | 5 | 68 |
| 9. Suggested trying other activities to solve problem----- | 0 | 11 | 5 | 21 | 16 | 47 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 16 | 5 | 63 | 11 | 5 |
| 11. Understood principle as result of activity----- | 53 | 26 | 5 | 16 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 18 | 18 | 41 | 18 | 0 | 6 |

Tables 21 and 22 indicate the following results of Activity #3, "What Will Rust?"

1. More of the third grade classes had children who told probable solutions to the problem involved than fourth grade classes. However, the majority of both classes had some children who offered an hypothesis.
2. More third graders than fourth grade children were interested in the activity, took part in a discussion about the activity, and related their own experiences to the activity.
3. More third graders referred to books in connection with the activity. More than half of the children in Grade Four made no reference to books.
4. More third grade children requested more of the same type of activity to solve the problem involved and a repetition of the same activity. However, more than 50 percent of the classes made no request for a repetition.
5. More fourth grade children than third graders suggested trying other activities to solve the problem, but they were in the minority.
6. More third graders than fourth graders could tell more about the principle than was anticipated and understood the principle as a result of the activity.
7. The majority of both grades had children who were more interested in and curious about the

natural phenomena of the world they live in
as a result of the activity.

Table 23. Percentage of Fifth Grades Responding to Activity #4,
"What Is in Snow Besides Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 10 | 24 | 24 | 19 | 10 | 14 |
| 2. Were interested in the activity----- | 48 | 43 | 10 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 33 | 43 | 24 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 19 | 29 | 5 | 48 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 5 | 14 | 19 | 62 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 14 | 14 | 10 | 57 |
| 7. Requested more of same type of activity----- | 24 | 0 | 10 | 19 | 10 | 38 |
| 8. Requested a repetition of the activity----- | 0 | 5 | 10 | 5 | 10 | 71 |
| 9. Suggested trying other activities to solve problem----- | 0 | 10 | 5 | 5 | 14 | 67 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 5 | 52 | 10 | 24 |
| 11. Understood principle as result of activity----- | 43 | 29 | 10 | 19 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 10 | 52 | 10 | 19 | 0 | 10 |

Table 24. Percentage of Sixth Grades Responding to Activity #4,
"What Is in Snow Besides Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 11 | 32 | 37 | 16 | 5 | 0 |
| 2. Were interested in the activity----- | 63 | 26 | 11 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 42 | 42 | 16 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 5 | 16 | 42 | 21 | 16 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 32 | 5 | 63 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 5 | 5 | 32 | 0 | 58 |
| 7. Requested more of same type of activity----- | 11 | 21 | 5 | 26 | 0 | 37 |
| 8. Requested a repetition of the activity----- | 0 | 5 | 11 | 21 | 11 | 53 |
| 9. Suggested trying other activities to solve problem----- | 5 | 0 | 11 | 26 | 5 | 53 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 5 | 26 | 63 | 0 | 5 |
| 11. Understood principle as result of activity----- | 32 | 53 | 16 | 0 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 17 | 44 | 6 | 33 | 0 | 0 |

Tables 23 and 24 indicate the following results of Activity #4, "What Is in Snow besides Water?"

1. More sixth graders than fifth told probable solutions to the problem involved, were more interested in the activity and took part in a discussion about the activity. Interest was high for both groups.
2. More sixth graders related their own experiences to the activity.
3. More fifth grade children than sixth referred to books in connection with the activity, although the difference was slight.
4. In the fifth grade classes more children requested more of the same type of activity to solve the problem while more sixth graders requested a repetition of the same activity. In the latter request the percentage was low for both grades.
5. More children of the sixth grade suggested trying other activities to solve the problem, tell more about the principle involved, and understood the principle as a result of the activity.
6. Most of the children in both grades were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 25. Percentage of First Grades Responding to Activity #5,
"What Is a Bud?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 14 | 19 | 33 | 29 | 0 | 5 |
| 2. Were interested in the activity----- | 71 | 29 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 14 | 29 | 48 | 10 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 5 | 35 | 45 | 5 | 10 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 29 | 5 | 67 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 0 | 38 | 19 | 43 |
| 7. Requested more of same type of activity----- | 5 | 5 | 19 | 48 | 10 | 14 |
| 8. Requested a repetition of the activity----- | 10 | 0 | 10 | 24 | 5 | 52 |
| 9. Suggested trying other activities to solve problem----- | 0 | 5 | 0 | 24 | 10 | 62 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 10 | 14 | 52 | 5 | 19 |
| 11. Understood principle as result of activity----- | 14 | 57 | 24 | 5 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 24 | 38 | 29 | 10 | 0 | 0 |

Table 26. Percentage of Second Grades Responding to Activity #5,
"What Is a Bud?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------------|---------------------------|------------------------|--------------|-----------|
| | Entire Class | Almost All of Class | About Half of Class | A few Child- ren | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 6 | 31 | 31 | 31 | 0 | 0 |
| 2. Were interested in the activity----- | 56 | 37 | 0 | 6 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 6 | 50 | 19 | 25 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 6 | 37 | 44 | 6 | 6 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 47 | 7 | 47 |
| 6. Suggested looking in books for information about principle involved----- | 7 | 7 | 7 | 40 | 7 | 33 |
| 7. Requested more of same type of activity----- | 13 | 19 | 13 | 31 | 0 | 25 |
| 8. Requested a repetition of the activity----- | 6 | 13 | 6 | 37 | 13 | 25 |
| 9. Suggested trying other activities to solve problem----- | 6 | 6 | 0 | 37 | 0 | 50 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 13 | 47 | 33 | 7 | 0 |
| 11. Understood principle as result of activity----- | 37 | 50 | 13 | 0 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 31 | 44 | 13 | 13 | 0 | 0 |

Tables 25 and 26 indicate the following results of Activity #5, "What Is a Bud?"

1. A high percentage of both classes had children who told probably solutions to the problem involved.
2. More first grade children than second graders were interested in the activity, although the percentage was high for both grades.
3. More second grade children participated in a discussion about the activity.
4. There was no significant difference between the grades in relating their own experiences to the activity.
5. More second grade children than first graders made reference to books in connection with the activity. The percentage for this item was low.
6. There was little difference between the grades in suggesting that they look in books for solutions to the problem. A little less than half of the classes had no one making the suggestion.
7. A slightly higher percentage of second graders than first requested more of the same type of activity and more second grade children requested a repetition of the same activity.
8. In the second grade 50 percent of the classes had no one suggesting other activities to solve the problem and 62 percent of the first grade classes had no one.

9. More second grade children could tell more about the principle involved and were more interested in and curious about the world they live in as a result of the activity.

Table 27. Percentage of Third Grades Responding to Activity #5, "How Do Plants Get Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 24 | 47 | 18 | 6 | 6 | 0 |
| 2. Were interested in the activity----- | 53 | 35 | 0 | 6 | 6 | 0 |
| 3. Participated in discussion about the activity----- | 18 | 35 | 41 | 6 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 24 | 53 | 6 | 18 |
| 5. Mentioned books that tell about principle involved----- | 0 | 6 | 6 | 29 | 24 | 35 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 6 | 6 | 47 | 18 | 24 |
| 7. Requested more of same type of activity----- | 18 | 29 | 6 | 24 | 6 | 18 |
| 8. Requested a repetition of the activity----- | 0 | 13 | 0 | 25 | 0 | 63 |
| 9. Suggested trying other activities to solve problem----- | 0 | 6 | 13 | 29 | 0 | 53 |
| 10. Could tell more about principle involved than was anticipated----- | 6 | 12 | 24 | 53 | 6 | 0 |
| 11. Understood principle as result of activity----- | 35 | 53 | 6 | 6 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 12 | 53 | 18 | 12 | 0 | 6 |

Table 28. Percentage of Fourth Grades Responding to Activity #5, "How Do Plants Get Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 15 | 31 | 31 | 23 | 0 | 0 |
| 2. Were interested in the activity----- | 46 | 31 | 23 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 46 | 15 | 39 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 15 | 23 | 23 | 0 | 39 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 8 | 39 | 0 | 54 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 8 | 39 | 0 | 54 |
| 7. Requested more of same type of activity----- | 0 | 23 | 8 | 15 | 0 | 54 |
| 8. Requested a repetition of the activity----- | 0 | 0 | 8 | 17 | 0 | 75 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 8 | 42 | 8 | 50 |
| 10. Could tell more about principle involved than was anticipated----- | 15 | 0 | 23 | 39 | 8 | 15 |
| 11. Understood principle as result of activity----- | 58 | 33 | 0 | 8 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 25 | 17 | 17 | 33 | 8 | 0 |

Tables 27 and 28 indicate the following results of Activity #5, "How Do Plants Get Water?"

1. The third grade classes show that more children told probable solutions to the problem involved, were interested in the activity and took part in a discussion about the activity than fourth grade children.
2. More third grade children also related the activity to their own experiences.
3. More third graders referred to books in connection with the activity.
4. More children of Grade Three than of Grade Four requested more of the same type of activity as well as a repetition of the same activity, but in the latter case the percentage was low.
5. There was no significant difference between the grade in the percentage of children who suggested trying other activities to solve the problem involved in the activity. The percentage of responses was low.
6. More third grade children than fourth graders knew more about the principle involved than was anticipated.
7. More fourth graders than third understood the principle involved, and were more interested in and curious about the natural phenomena of the world they live in as a result of the activity. In the latter item, however, the difference was not significant.

Table 29. Percentage of Fifth Grades Responding to Activity #5,
"What Are the Parts of a Flower?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 6 | 13 | 13 | 44 | 6 | 19 |
| 2. Were interested in the activity----- | 44 | 56 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 11 | 28 | 56 | 6 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 6 | 0 | 39 | 50 | 0 | 6 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 39 | 28 | 33 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 11 | 28 | 11 | 50 |
| 7. Requested more of same type of activity----- | 11 | 6 | 28 | 17 | 0 | 39 |
| 8. Requested a repetition of the activity----- | 11 | 0 | 0 | 33 | 0 | 56 |
| 9. Suggested trying other activities to solve problem----- | 6 | 11 | 11 | 28 | 11 | 33 |
| 10. Could tell more about principle involved than was anticipated----- | 6 | 6 | 0 | 50 | 6 | 33 |
| 11. Understood principle as result of activity----- | 28 | 33 | 22 | 17 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 22 | 39 | 17 | 22 | 0 | 0 |

Table 30. Percentage of Sixth Grades Responding to Activity #5,
"What Are the Parts of a Flower?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 7 | 7 | 71 | 0 | 14 |
| 2. Were interested in the activity----- | 40 | 40 | 7 | 13 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 43 | 43 | 14 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 29 | 36 | 7 | 29 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 43 | 0 | 57 |
| 6. Suggested looking in books for information about principle involved | 0 | 7 | 14 | 14 | 14 | 50 |
| 7. Requested more of same type of activity----- | 0 | 21 | 21 | 7 | 7 | 43 |
| 8. Requested a repetition of the activity----- | 7 | 21 | 14 | 7 | 7 | 43 |
| 9. Suggested trying other activities to solve problem----- | 0 | 7 | 29 | 21 | 0 | 43 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 0 | 29 | 43 | 0 | 29 |
| 11. Understood principle as result of activity----- | 29 | 21 | 36 | 7 | 0 | 7 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 21 | 36 | 21 | 14 | 0 | 7 |

Tables 29 and 30 indicate the following results of Activity #5, "What Are the Parts of a Flower?"

1. More fifth grade children than sixth (a) told probable solutions to the problem involved, (b) were interested in the activity, (c) took part in a discussion about the activity, and (d) told about their own experiences relating to the principle involved.
2. A few children in 43 percent of the sixth grade classes and in 39 percent of the fifth grade classes mentioned books that told about the principle involved.
3. A slightly higher percentage of fifth graders than of sixth grade children suggested looking in books for solutions to the problem. In both grades 50 percent made no suggestions.
4. More fifth graders than sixth requested more of the same type of activity while more sixth grade children requested a repetition of the same activity.
5. More fifth grade children than sixth suggested trying other activities to solve the problem and could tell more about the principle involved in the activity.
6. More fifth graders than sixth understood the principle involved and were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 31. Percentage of First Grades Responding to Activity #6,
"What Makes Nails Rust?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 11 | 26 | 16 | 42 | 5 | 0 |
| 2. Were interested in the activity----- | 68 | 21 | 11 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 21 | 37 | 26 | 16 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 16 | 42 | 42 | 0 | 0 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 16 | 5 | 79 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 0 | 26 | 5 | 68 |
| 7. Requested more of same type of activity----- | 5 | 0 | 26 | 32 | 5 | 32 |
| 8. Requested a repetition of the activity----- | 0 | 11 | 5 | 26 | 11 | 47 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 5 | 32 | 5 | 58 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 16 | 32 | 32 | 5 | 16 |
| 11. Understood principle as result of activity----- | 37 | 47 | 11 | 0 | 0 | 5 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 28 | 28 | 22 | 22 | 0 | 0 |

Table 32. Percentage of Second Grades Responding to Activity #6,
"What Makes Nails Rust?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 24 | 35 | 18 | 6 | 18 | 0 |
| 2. Were interested in the activity----- | 65 | 35 | 0 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 0 | 65 | 24 | 12 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 6 | 35 | 41 | 12 | 6 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 6 | 29 | 12 | 53 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 6 | 6 | 24 | 12 | 53 |
| 7. Requested more of same type of activity----- | 0 | 29 | 6 | 35 | 0 | 29 |
| 8. Requested a repetition of the activity----- | 0 | 18 | 18 | 18 | 0 | 47 |
| 9. Suggested trying other activities to solve problem----- | 0 | 6 | 13 | 19 | 13 | 50 |
| 10. Could tell more about principle involved than was anticipated----- | 12 | 6 | 35 | 35 | 0 | 12 |
| 11. Understood principle as result of activity----- | 35 | 47 | 6 | 12 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 44 | 19 | 13 | 19 | 0 | 6 |

Tables 31 and 32 indicate the following data as a result of Activity #6, "What Makes Nails Rust?"

1. More children of the second grade than of the first grade told probable solutions to the problem involved in the activity and were interested in the activity.
2. There was no significant difference between the two grades in taking part in a discussion about the activity.
3. More first graders than second graders told about their own experiences relating to the activity.
4. More than half of the classes of both grades made no reference to books in connection with the activity. However, more second grade children than first did make reference to books.
5. More second graders than first requested more of the same type of activity as well as a repetition of the same activity.
6. Less than half of the classes of both grades suggested trying other activities to solve the problem.
7. More second graders than first could tell more about the principle involved than was anticipated although the difference between the two has little significance.
8. More first grade children than second understood the principle as a result of the activity.

9. The majority of children in both grades were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 33. Percentage of Third Grades Responding to Activity #6, "What Makes Food Spoil?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 7 | 20 | 33 | 27 | 0 | 13 |
| 2. Were interested in the activity----- | 56 | 38 | 6 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 13 | 44 | 44 | 0 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 6 | 31 | 38 | 6 | 19 |
| 5. Mentioned books that tell about principle involved----- | 0 | 6 | 0 | 31 | 13 | 50 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 13 | 44 | 13 | 31 |
| 7. Requested more of same type of activity----- | 13 | 27 | 13 | 20 | 7 | 20 |
| 8. Requested a repetition of the activity----- | 0 | 7 | 13 | 20 | 7 | 53 |
| 9. Suggested trying other activities to solve problem----- | 0 | 14 | 7 | 43 | 0 | 36 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 13 | 20 | 40 | 7 | 20 |
| 11. Understood principle as result of activity----- | 13 | 40 | 33 | 7 | 0 | 7 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 20 | 20 | 33 | 27 | 0 | 0 |

Table 34. Percentage of Fourth Grades Responding to Activity #6, "What Makes Food Spoil?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 38 | 13 | 38 | 0 | 13 |
| 2. Were interested in the activity----- | 69 | 25 | 6 | 0 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 6 | 38 | 44 | 13 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 19 | 19 | 50 | 0 | 13 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 44 | 6 | 50 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 0 | 0 | 63 | 6 | 31 |
| 7. Requested more of same type of activity----- | 0 | 19 | 31 | 19 | 13 | 19 |
| 8. Requested a repetition of the activity----- | 0 | 0 | 13 | 25 | 0 | 63 |
| 9. Suggested trying other activities to solve problem----- | 0 | 0 | 13 | 44 | 6 | 38 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 0 | 13 | 50 | 13 | 25 |
| 11. Understood principle as result of activity----- | 25 | 25 | 31 | 19 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 13 | 40 | 40 | 7 | 0 | 0 |

Tables 33 and 34 indicate the following data as a result of Activity #6, "What Makes Food Spoil?"

1. There was no significant difference between Grades Three and Four in (a) telling probable solutions to the problem involved in the activity, (b) being interested in the activity, or (c) taking part in a discussion about the activity.
2. More third graders than fourth grade children told about their own experiences that related to the activity.
3. A slightly higher percentage of third graders than of fourth grade children referred to books in connection with the activity. Fifty percent of both grades had no one who mentioned books that tell about the principle involved.
4. More third graders than fourth grade children requested more of the same type of activity as well as a repetition of the same activity.
5. More third graders suggested trying other activities to solve the problem and could tell more about the principle involved than was anticipated.
6. There was no significant difference in the number of children in both grades who understood the principle as a result of the activity. Most of the children in both grades had the understanding.

7. More fourth grade children than third graders were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

Table 35. Percentage of Fifth Grades Responding to Activity #6,
"Do Leaves of a Plant Give Off Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 12 | 0 | 24 | 41 | 0 | 24 |
| 2. Were interested in the activity----- | 29 | 35 | 18 | 18 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 12 | 18 | 41 | 29 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 6 | 6 | 6 | 24 | 18 | 41 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 0 | 12 | 6 | 82 |
| 6. Suggested looking in books for information about principle involved----- | 6 | 6 | 0 | 29 | 0 | 59 |
| 7. Requested more of same type of activity----- | 0 | 6 | 12 | 47 | 6 | 29 |
| 8. Requested a repetition of the activity----- | 0 | 6 | 0 | 18 | 0 | 76 |
| 9. Suggested trying other activities to solve problem----- | 0 | 6 | 0 | 25 | 19 | 50 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 6 | 0 | 53 | 6 | 35 |
| 11. Understood principle as result of activity----- | 24 | 12 | 35 | 24 | 6 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 13 | 25 | 6 | 50 | 0 | 6 |

Table 36. Percentage of Sixth Grades Responding to Activity #6,
"Do Leaves of a Plant Give Off Water?"

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | 0 | 20 | 40 | 33 | 7 | 0 |
| 2. Were interested in the activity----- | 60 | 27 | 7 | 7 | 0 | 0 |
| 3. Participated in discussion about the activity----- | 7 | 53 | 20 | 20 | 0 | 0 |
| 4. Told about own experiences relating to principle involved----- | 0 | 0 | 20 | 40 | 0 | 40 |
| 5. Mentioned books that tell about principle involved----- | 0 | 0 | 7 | 20 | 7 | 67 |
| 6. Suggested looking in books for information about principle involved----- | 0 | 7 | 7 | 33 | 13 | 40 |
| 7. Requested more of same type of activity----- | 7 | 20 | 20 | 33 | 0 | 20 |
| 8. Requested a repetition of the activity----- | 0 | 13 | 0 | 27 | 0 | 60 |
| 9. Suggested trying other activities to solve problem----- | 0 | 13 | 7 | 13 | 20 | 47 |
| 10. Could tell more about principle involved than was anticipated----- | 0 | 13 | 20 | 60 | 0 | 7 |
| 11. Understood principle as result of activity----- | 33 | 47 | 7 | 13 | 0 | 0 |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | 50 | 36 | 0 | 14 | 0 | 0 |

Tables 35 and 36 indicate the following data as a result of Activity #6, "Do Leaves of a Plant Give Off Water?"

1. A slightly higher percentage of sixth graders than fifth grade children told probable solutions to the problem involved.
2. More sixth graders were more interested in the activity than fifth graders.
3. The difference in the percentage of classes of both grades in participating in a discussion about the activity was not significant. In both grades the majority of children took part.
4. There was little difference between the two grades in the children relating their own experiences to the activity.
5. More sixth graders than fifth referred to books in connection with the activity, although the percentage was low for both grades.
6. More sixth graders than fifth grade children requested more of the same type of activity as well as a repetition of the same activity.
7. More sixth graders than fifth suggested trying other activities to solve the problem involved in the activity, could tell more about the principle involved than was anticipated, understood the principle involved, and were more interested in and curious about the natural phenomena of the world they live in as a result of the activity.

CHAPTER V
SUMMARY AND CONCLUSIONS

This study was undertaken for the purpose of finding out how the children of the elementary grades in Waltham respond to science activities. Directions for engaging in certain activities were sent to the 154 classrooms in the city. This includes 5034 children. Although every class did not take part in the study, a majority of the children in the school system is represented.

Summary of the tables. -- In Tables 37, 38, 39, 40, 41, and 42 the responses made by most of the classes to all six activities have been checked. These are arranged by grades.

In comparing the responses of all of the grades to all of the activities it was found that:

1. In the majority of the classes of the second, third and fourth grades, almost all of the children told probable solutions to the problems involved in the activities. In most of the classes of the first, fifth and sixth grades, a few children offered hypotheses.

2. In most of the classes of all grades the entire classes were interested in the activities.

3. In the second, third and fourth grades, almost all of the children in most of the classes participated in a discussion about the activities, while in most of the classes

of Grades One, Five and Six, about half of the children participated in a discussion.

4. In all six grades most of the classes had only a few children who told about their own experiences relating to the activities.

5. In all six grades the majority of the classes had no one who mentioned books that tell about the principles involved in the activities.

6. In most of the second and third grade classes, a few children mentioned books that tell about the principles involved in the activities, while no class of the other four grades had children responding in this way.

7. In Grade three most of the classes had almost all the children request more of the same type of activity. In most of the First and Sixth grade classes a few of the children made this request. In the majority of the second, fourth and fifth grade classes no one made the request.

8. In all six grades the majority of classes had no children who requested a repetition of the activity.

9. In the majority of the classes of all six grades no child suggested trying other activities to solve the problems involved in the activities.

10. In most of the second and sixth grade classes almost all of the children could tell more about the principles involved in the activities than was anticipated. In all other grades most of the classes had only a few children who could tell more about the principles involved.

11. In most of the fourth grades the entire classes understood the principles involved as a result of the activities, while, almost all of the children in the majority of the classes of the other five grades understood the principles involved.

12. In most of the third, fourth and sixth grade classes almost all of the children were interested in and curious about the natural phenomena of the world about them as a result of the activities. In the first grade the majority of classes had a few children who responded in this way. In Grades Two and Five the classes were divided in their responses. In the second grades the majority of the classes had either the entire classes responding to this item or almost all of the classes, while in the fifth grades the majority of responses were made by almost all of the classes or by a few children.

Conclusions:

It is believed that, for the most part, the responses to the activities were favorable. However, it seems that more children should have taken part in telling about their own experiences relating to the activities.

It is also believed that more children should have referred to books in connection with the activities. It is possible, of course, that since science is such a new subject at this level, the number of books available to the students is limited.

More children probably should have made requests for a repetition of the activities as well as requests for more of the same type of activities.

More children should have suggested trying other activities to solve the problem involved. Perhaps with more experience the children would have made more suggestions.

Judging from the oral and written comments of the teachers, the children were enthusiastic about this kind of experiences and were eager for more. It was reported that many children were originating experiments at home, and were bringing materials to school to try some experiments in the classrooms. Several teachers remarked about the greater interest in science books as a result of the activities.

The teachers themselves said that they appreciated having specific directions for carrying out the activities as well as new ideas for their science programs. They were pleased with the interest of the children in the activities and were amazed at the information some children possessed in certain science areas. It was a surprise to several teachers to find that so many of the children could solve problems in a scientific way.

In a few instances where the experiments did not work, the teachers substituted their own activities to solve a problem. The writer realizes that Activity #2 for Grades One and Two was difficult to work out and perhaps might need a substitute to solve the problem.

For some classes the activities were a repetition because some of the subjects had been studied earlier in the year.

Suggestions for further research:

This study could be repeated in any other community. It could also be undertaken on a wider scale with several communities taking part.

The study might be done in a community where science has been made a part of the elementary school curriculum and where a course of study has been developed on an empirical basis. A comparison of the responses of the children in both communities could then be made.

This study could be used as a basis for developing a science curriculum in the elementary school. The study could be extended by using several activities for each grade level and by giving teachers the experience of using these activities in their classrooms. Gradually a course of study could be set up with appropriate activities designated for each grade level.

A testing program could be undertaken, in conjunction with the activities. Teachers could construct their own tests and these tests could be compiled for use in the schools.

Table 37. How the Majority of the First Grades Responded to the Six Activities.

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | | | | x | | |
| 2. Were interested in the activity----- | x | | | | | |
| 3. Participated in discussion about the activity----- | | | x | | | |
| 4. Told about own experiences relating to principle involved----- | | | | x | | |
| 5. Mentioned books that tell about principle involved----- | | | | | | x |
| 6. Suggested looking in books for information about principle involved----- | | | | | | x |
| 7. Requested more of same type of activity----- | | | | x | | |
| 8. Requested a repetition of the activity----- | | | | | | x |
| 9. Suggested trying other activities to solve problem----- | | | | | | x |
| 10. Could tell more about principle involved than was anticipated----- | | | | x | | |
| 11. Understood principle as result of activity----- | | x | | | | |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | | | | x | | |

Table 38. How the Majority of the Second Grades Responded to the Six Activities.

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | | x | | | | |
| 2. Were interested in the activity----- | x | | | | | |
| 3. Participated in discussion about the activity----- | | x | | | | |
| 4. Told about own experiences relating to principle involved----- | | | | x | | |
| 5. Mentioned books that tell about principle involved----- | | | | | | x |
| 6. Suggested looking in books for information about principle involved----- | | | | x | | |
| 7. Requested more of same type of activity----- | | | | x | | |
| 8. Requested a repetition of the activity----- | | | | | | x |
| 9. Suggested trying other activities to solve problem----- | | | | | | x |
| 10. Could tell more about principle involved than was anticipated----- | | | | x | | |
| 11. Understood principle as result of activity----- | | x | | | | |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | | x | | | | |

Table 39. How the Majority of the Third Grades Responded to the Six Activities.

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | | x | | | | |
| 2. Were interested in the activity----- | x | | | | | |
| 3. Participated in discussion about the activity----- | | x | | | | |
| 4. Told about own experiences relating to principle involved----- | | | | x | | |
| 5. Mentioned books that tell about principle involved----- | | | | | | x |
| 6. Suggested looking in books for information about principle involved----- | | | | x | | |
| 7. Requested more of same type of activity----- | | x | | | | |
| 8. Requested a repetition of the activity----- | | | | | | x |
| 9. Suggested trying other activities to solve problem----- | | | | | | x |
| 10. Could tell more about principle involved than was anticipated----- | | | | x | | |
| 11. Understood principle as result of activity----- | | x | | | | |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | | x | | | | |

Table 40. How the Majority of the Fourth Grades Responded to the Six Activities.

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | | x | | | | |
| 2. Were interested in the activity----- | x | | | | | |
| 3. Participated in discussion about the activity----- | | x | | | | |
| 4. Told about own experiences relating to principle involved----- | | | | x | | |
| 5. Mentioned books that tell about principle involved----- | | | | | | x |
| 6. Suggested looking in books for information about principle involved----- | | | | | | x |
| 7. Requested more of same type of activity----- | | | | | | x |
| 8. Requested a repetition of the activity----- | | | | | | x |
| 9. Suggested trying other activities to solve problem----- | | | | | | x |
| 10. Could tell more about principle involved than was anticipated----- | | | | x | | |
| 11. Understood principle as result of activity----- | x | | | | | |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | | x | | | | |

Table 41. How the Majority of the Fifth Grades Responded to the Six Activities.

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | | | | x | | |
| 2. Were interested in the activity----- | x | | | | | |
| 3. Participated in discussion about the activity----- | | | x | | | |
| 4. Told about own experiences relating to principle involved----- | | | | x | | |
| 5. Mentioned books that tell about principle involved----- | | | | | | x |
| 6. Suggested looking in books for information about principle involved----- | | | | | | x |
| 7. Requested more of same type of activity----- | | | | | | x |
| 8. Requested a repetition of the activity----- | | | | | | x |
| 9. Suggested trying other activities to solve problem----- | | | | | | x |
| 10. Could tell more about principle involved than was anticipated----- | | | | x | | |
| 11. Understood principle as result of activity----- | | x | | | | |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | | x | | x | | |

Table 42. How the Majority of the Sixth Grades Responded to the Six Activities.

| RESPONSES | Parts of Classes Responding | | | | | |
|--|-----------------------------|---------------------|---------------------|----------------|-----------|--------|
| | Entire Class | Almost All of Class | About Half of Class | A few Children | One Child | No One |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Told probable solutions to the problem----- | | | | x | | |
| 2. Were interested in the activity----- | x | | | | | |
| 3. Participated in discussion about the activity----- | | | x | | | |
| 4. Told about own experiences relating to principle involved----- | | | | x | | |
| 5. Mentioned books that tell about principle involved----- | | | | | | x |
| 6. Suggested looking in books for information about principle involved----- | | | | | | x |
| 7. Requested more of same type of activity----- | | | | x | | |
| 8. Requested a repetition of the activity----- | | | | | | x |
| 9. Suggested trying other activities to solve problem----- | | | | | | x |
| 10. Could tell more about principle involved than was anticipated----- | | x | | | | |
| 11. Understood principle as result of activity----- | | x | | | | |
| 12. Are more interested in and curious about natural phenomena of world as result of activity--- | | x | | | | |

APPENDIX

I N Q U I R Y F O R M

Activity No. _____

Grade _____

Check one for each question.

1. How many children in the class told probable solutions to problem before the activity took place?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

2. How many children were interested in the activity?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

3. How many children participated in a discussion about the activity?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

4. How many children told about their own experiences that had to do with the principle involved?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

5. How many children mentioned books that tell about the principle involved?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

6. How many children suggested looking in books for more information about the principle involved?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

7. How many children requested more of the same type of activity?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

8. How many children requested that the same activity be repeated?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

9. How many children suggested trying other experiments to solve the problem?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

10. How many children could tell a great deal more about the principle involved than was anticipated?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

11. How many children understood the principle involved as a result of the activity?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

12. How many children are more interested in and curious about the natural phenomena of the world they live in as a result of the activity?

| | |
|--|---|
| <input type="checkbox"/> Entire class | <input type="checkbox"/> A few children |
| <input type="checkbox"/> Almost all of class | <input type="checkbox"/> One child |
| <input type="checkbox"/> About half of class | <input type="checkbox"/> No one |

Activity #1

Grades 1 and 2

Why Are Shadows Sometimes Short and Sometimes Long?

Introduction

Let the children tell what they know about shadows. Ask if anyone could suggest how the class could find out more about them. Perhaps someone will suggest going outdoors to look at their own shadows.

Procedure

Take the class outdoors and let them measure and compare their shadows two or three times during a day.

Conclusions

The children should discover the sun's apparent journey across the sky. Some children may even realize the earth's rotation.

This activity could be tried again during the year to help the children understand the relationship of the sun to our seasons.

Blough, Glenn O. and Albert J. Huggett, Elementary School Science and How to Teach It, the Dryden Press Publishers, New York, 1952, p. 155.

Activity #1

Grades 3 and 4

What Will Magnets Pick Up?

Things Needed Magnet (bar, horseshoe, or U type).

small objects made of various materials.

Introduction

Magnets will pick up some things and will not pick up others. The best way to find out which things they will pick up, is to try picking them up with a magnet.

Directions

As in most experiments involving magnets, you can use a bar, a horseshoe, or a U-shape magnet. Place several objects on the table and see which ones the magnet will pick up. Tabulate

| Object | Composition | Does Magnet pick it up? | |
|-------------|-------------|-------------------------|----|
| | | Yes | No |
| Paper clips | iron | X | |
| Copper | copper | | X |

In similar manner, try glass, thumbtacks, nail, screws, file, rubber bands, brass paper fasteners, etc.

Conclusion

The things magnets pick up contain iron. There are other things magnet will pick up (nickel), but iron is the only common metal that will be picked up by a magnet.

Stefaniak, Edward W., A Study of the Effectiveness of Two Methods of Teaching Science in Grades Four, Five and Six, Unpublished Doctoral Dissertation, University of Boston, Boston, Massachusetts, 1955.

Grades 5 and 6

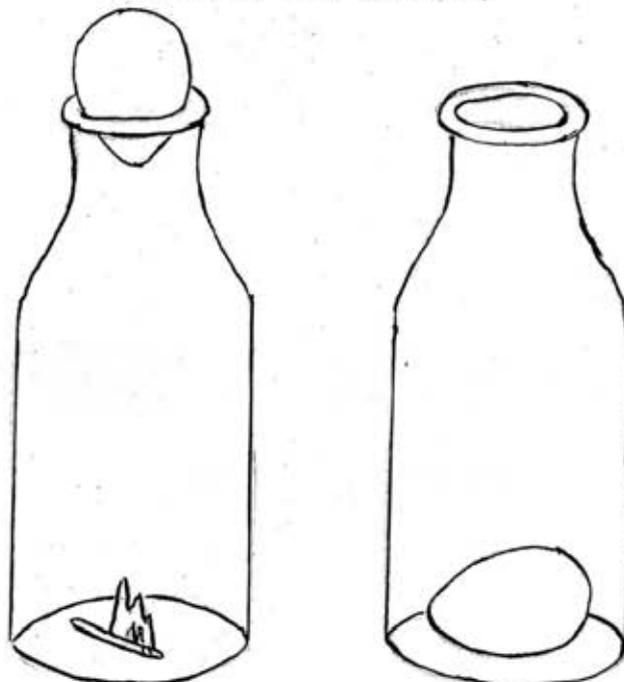
Does Air Have Force?

Things needed: --- A hard boiled egg (minus shell), a small wad of paper, a milk bottle, a match.

Procedure ---Light the small wad of paper, drop it into the milk bottle and rest the egg in the mouth of the bottle.

The egg may bounce up and down once or twice but will not fall through. The paper soon burns out. Then the egg goes slowly down through the neck of the bottle and drops with a "plump".

Next turn the bottle up so that the egg is resting at the lower end of the neck of the bottle. The egg is still too large to fall through the neck. Hold the mouth of the bottle to your lips. Blow as hard as you can into the bottle. If you blow hard enough the egg will come out.



Conclusions. --- The burning paper heats the air in the bottle. The air expands and some of it is forced out. The escaping air may make the egg bounce a little.

As the paper burns, it uses up oxygen from the air. The fire goes out when the oxygen is used up. The materials it produces as it burns, takes up less space than the oxygen.

As soon as the fire has gone out, the air inside the bottle begins to cool and contract. Because the air is contracting and because the oxygen in it has been used up, the air on the inside of the bottle is pressing on the egg with less force than the air on the outside. The air on the outside therefore pushes the egg into the bottle.

When you blow hard into the bottle, you force so much air into it that the pressure inside is greater than the pressure outside. The air inside therefore pushes the egg out.

Activity #2

Grades 1 and 2

How Does a Thermometer Work?

Things needed

Some modeling clay, an ink bottle, some ink, a soda straw, a large pan, some water.

Introduction

Discuss what the children already know about a thermometer.

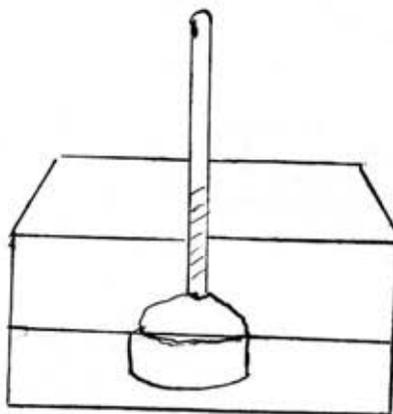
Procedure

The following directions may be written on the board to be followed after the materials have been assembled.

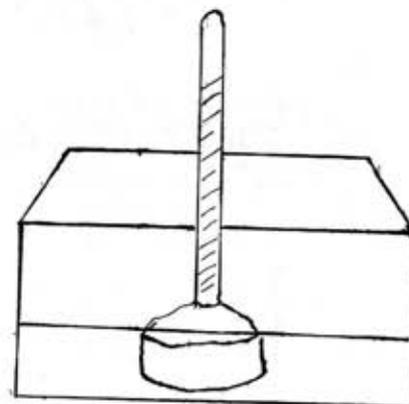
Fill the bottle with ink.
 Put some clay around the straw.
 Push the straw into the bottle.
 Be sure the clay is tight.
 Put your thermometer in cold water.
 Put your thermometer in hot water.
 What happens?
 Can you tell why?

Conclusions

The mercury in a thermometer goes up when it is warm and down when it is cold.



cold water



hot water

Activity #2

Grades 3 and 4

Is There Air in Water?

Materials needed

A glass, some water.

Introduction

Air is all around you. Air gets into your eyes and ears. When you open your mouth to eat, air goes in with the food. You breathe air all the time. You walk through air whenever you move. There is air around you everywhere. You need air to live. Your body is made for a life in the air. Fish need air to live, too. Where do they get it?

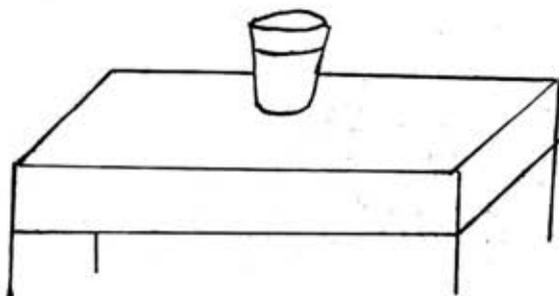
Procedure

Set a glass of water aside on a table. Do not move it for three or four hours. Then look at it. What do you see on the inside of the glass?

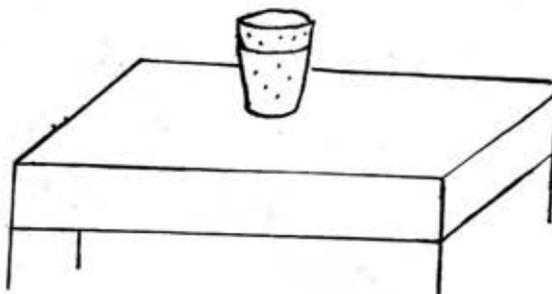
Conclusions.

The little bubbles that you see are air bubbles in the water.

The air in water is used by plants and animals which live in water. Fish breathe the air in water. Fish could not live in water if it had no air in it for them to breathe. Water plants use the air in water as they grow.



Water in glass

Three or four
hours later

Grades 5 and 6

How Do the Constellations Help Us to Know That the Earth Is Round?

Materials needed

One card with a picture of the Big Dipper and the North Star made on it and another card with a picture of the Southern Cross on it, globe, little doll.

Introduction

You can recognize a group of stars by the pattern it makes in the sky. This pattern is called a constellation. The most familiar constellation is the Big Dipper. The Southern Cross is another constellation.

Procedure

Place the card with the Southern Cross on it on a table. Hold the globe over the card. Hold the card with the Big Dipper on it over the globe. Be sure that the north pole points toward the north star. Place the little doll on the globe where Waltham is. If the doll could see, which constellation would it see? Now stand the doll on Australia. Which constellation is visible from there?

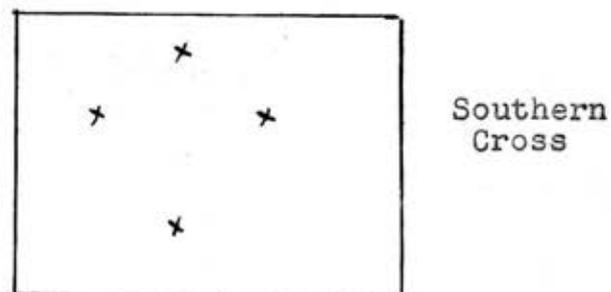
Conclusions

There are many other groups of stars, scattered everywhere in space. As you travel from place to place, you see a different set of stars.

In the Southern Hemisphere you see a different set of stars from those in the Northern Hemisphere. This could never happen if the earth were flat.

Follow-up

If you could stay awake all night, you would see that the sky is like a huge wheel. All the stars seem to wheel slowly through the sky - all but one star. That one is the North Star, at the center of the great starry wheel. The turning of the earth makes the stars seem to move.



Activity #3

Grades 1 and 2

What Things Will Magnets Pick Up?

Materials needed.

Magnet (bar, horseshoe or U type), small objects made of various materials.

Introduction.

Magnets will pick up some things and will not pick up others. The best way to find out which things they will pick up, is to try picking various objects up with a magnet.

Procedure.

Place several objects on a table and see which ones the magnet will pick up. Objects such as paper clips, thumb tacks, paper, rubber bands, nails, a file and brass paper fasteners may be used.

Divide the objects into two groups and label each group in the following way:

- A. Things a Magnet Will Pick Up.
- B. Things a Magnet Will Not Pick Up.

Conclusions.

Magnets attract some things but do not attract other things.

Activity #3

Grades 3 and 4

How Do We Get Day and Night?

Materials needed.

Globe, flashlight or some other light.

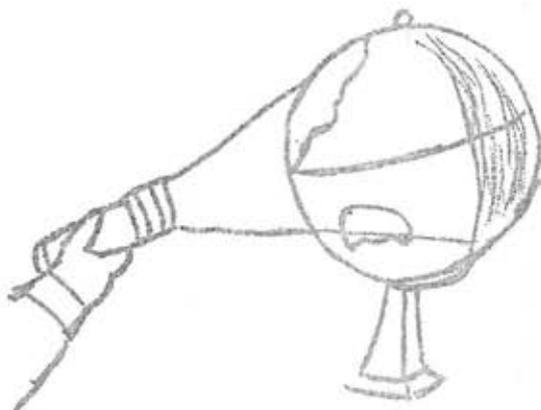
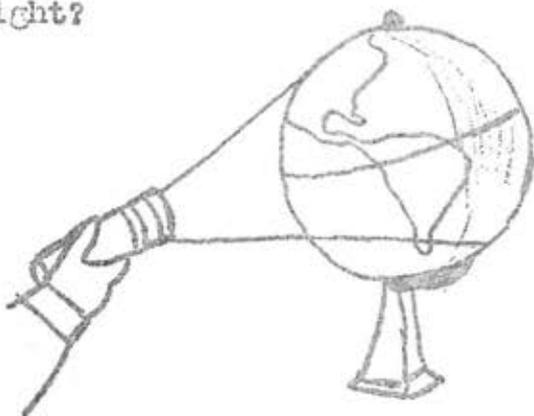
Procedure.

Darken the room and hold the flashlight near the globe. Look at the globe. You see that only part of it is lighted. How much of it is lighted?

Remember that the flashlight is the sun and that the globe is the earth. Make a large chalk mark on the globe to show where you live on the earth. Turn the globe from west to east all the way around once on its axis. Do this slowly. What happens to the place where you live? Is it light part of the time and then dark part of the time? When the chalk mark is lighted, you are having daytime. When it is dark, you are having night-time.

Conclusions.

When the place on earth where you live faces the sun, you have daytime. When it faces away from the sun, you have night-time. You remember that the earth rotates once in twenty-four hours. So during every twenty-four hours we have daytime once and night-time once.



Activity #3

Grades 5 and 6

How Does Electricity Make Power?

Materials needed.

Piece of covered wire about two feet long, an iron nail, a dry cell, an iron tack.

Introduction.

Electricity can make the power to move things. Electricity moves the hands of an electric clock. It moves the machinery in a vacuum cleaner, in an electric fan, in your electric train, and in many other things.

Let's see how electricity can make things move.

Procedure.

Wrap the wire around the nail. Take off the covering from each end of the wire. Join one end to one of the screws of the dry cell. Place the iron tack on something smooth, such as a piece of paper, with one end of the nail near it. Then touch the other end of the wire to the other screw of the dry cell. What happened?

Conclusions.

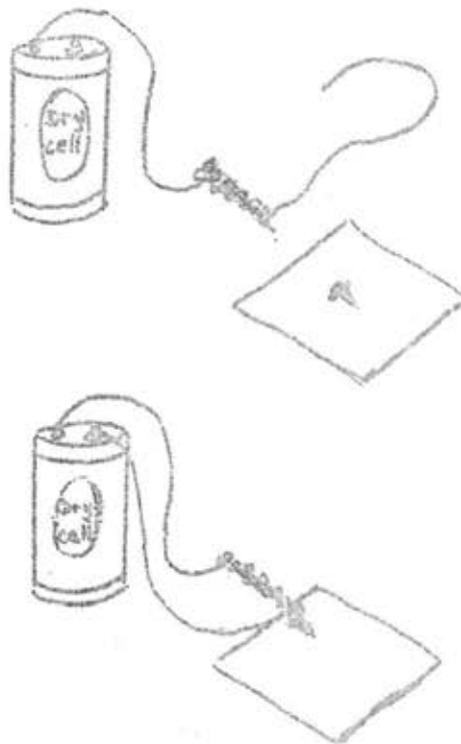
The electricity in the wire made the tack move.

The nail wrapped with wire is a special kind of magnet. It is called an electromagnet, because electricity makes it work like a magnet.

In your home and school many electromagnets are at work. You can see them in an electric bell. They move a piece of iron back and forth, to strike a bell.

There are electromagnets in an electric motor. They make a piece of iron spin around and around. The spinning iron turns the blades of a fan, or the hands of a clock, or the wheels of a train, or other machines that run by electricity. Can you think of others?

Schneider, Herman and Nina, Science Far and Near, D.C. Heath and Company, Boston, Mass., 1954 Pp.269-271



Activity 4

Grades 1 and 2

What do Plants Need to Grow?

Materials Needed:

Two plants that are the same kind and same size.

Procedure:

Put one plant in the sunshine and the other one where it is dark. Water both plants every day. After a week, look at both plants.

What happened to the plant in the sunlight?

What happened to the other plant? Can you tell why

this happened?

Conclusion:

Plants need sunshine to grow.



Plant in the
sunshine



Plant in the
dark

Activity #4

Grades 3 and 4

What Will Rust?

Materials needed:

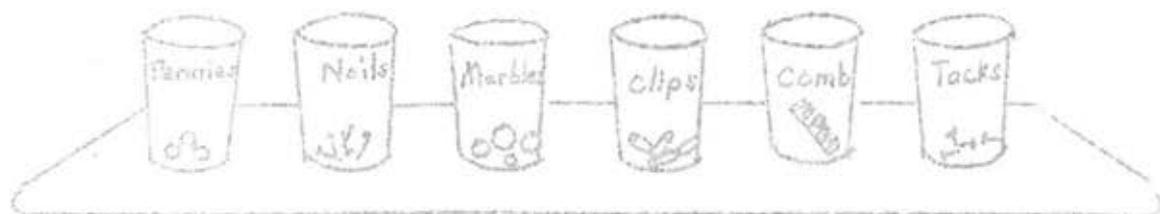
Six glasses or jars, pennies, nails, marbles, paper clips, a comb, tacks, water.

Introduction.

Some things rust when they get wet. Other things will not rust in water.

Procedure.

Put water in six glasses and place them on a table. Put these things in the glasses: pennies, nails, marbles, paper clips, a comb and tacks.



Leave the six glasses, without moving them, until the next day. What will happen to the paper clips? What will happen to the comb and to the pennies? What will happen to the other things?

The next day look at the things in each glass. What changes can you see? Which things rusted? Can you tell from this experiment which things have iron in them?

Conclusions.

Some things made of iron will rust in places where water gets on them. Water changes iron to rust.

Graig, Gerald S. and Marguerite W. Lombach. Science Everywhere
Glan & Co., N.Y. 1954, P.51

Activity #4

Grades 5 and 6

What Is In Snow Besides Water?

Materials needed.

A large beaker or some other straight-sided vessel several inches deep, snow.

Procedure.

Fill the vessel level full of newly fallen snow. Then stand it in a warm place so that the snow will melt. When all of the snow has melted, measure the depth of the water in the vessel. You will find that the water comes only about a tenth of the way to the top of the vessel. Why?



snow

melted
snowConclusions.

A great deal of air is caught between the snowflakes in any layer of newly fallen snow. Some snow is much fluffier than other snow; but even in a layer of dry, powdery snow, there is a great deal of air space. There is so much air in snow that on the average ten inches of snow has only about as much water in it as one inch of rain.

This experiment helps to explain why farmers are glad to have snow on their winter wheatfields. Although snow is cold, it makes a good blanket because of the many pockets of air in it. It keeps the young plants from getting as cold as they would get if they did not have such a blanket.

Activity 35

grades 1 and 2

What Is a Bud?Materials

Some buds, a container with water in it.

Introduction

What is beginning to grow outdoors now that spring is here?
(Flowers, leaves)

Are you going to find out how some of these flowers and leaves grow by looking at some buds.

Procedure

[Try to find some buds in the school yard or ask the children to bring some to school.]

Take apart a big bud. Find the scales around the bud. What do you see inside? (Leaves)

What do you think happens to the scales in the spring?
(They open and fall off).

What do you think happens to the leaves? (They begin to grow)

Put some buds in some water and watch them for a few days.
What do you think will happen?

Conclusion

Leaves and flowers grow from buds.



Activity 45

Grades 3 and 4

How Do Plants Get Water?Materials Needed

Two plants of the same kind and size, a piece of wax paper,

Procedure

Cover the soil around one plant with wax paper. Sprinkle water on the leaves of this plant. Sprinkle water on the soil of the other plant. Do this every day. Then see what happens. Which plant begins to dry up and die?

Conclusion

The plant that gets water only on the leaves does not grow well. Soon it dries up, because the plant does not get enough water through its leaves. Plants get water through the roots in the soil. So you see, plants need water in the soil. When it rains, water gets into the soil.



Plant with
water in soil



Plant with
water on leaves

WHAT ARE THE PARTS OF A FLOWER?

Materials needed. Many different spring flowers such as daffodils, hyacinths, lilies and tulips. Also blossoms from trees such as apple, cherry, peach and pear. A magnifying glass.

Introduction. We grow flowers in our gardens because flowers are beautiful, and we enjoy looking at them. But flowers are more important to us and to plants for a different reason. They make seeds from which more plants of the same kind will grow.

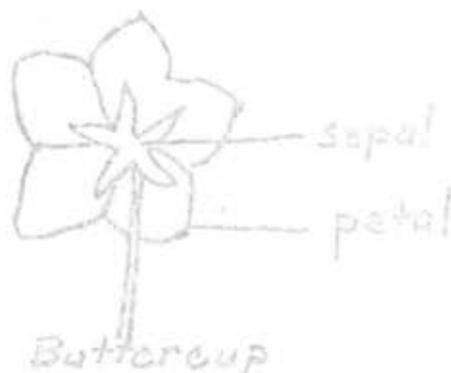
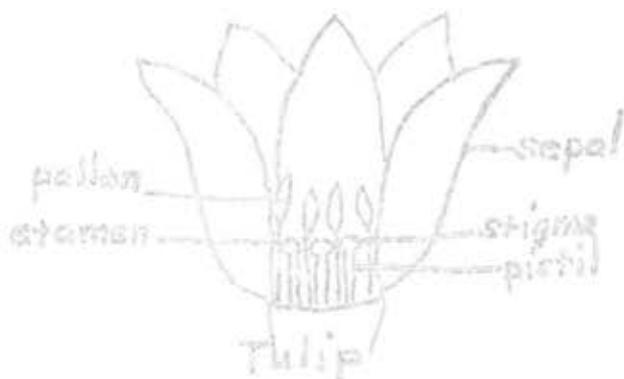
Before you can understand how flowers make seeds, you need to learn what parts a flower has.

Procedure. Put a large diagram of a flower on the board with its parts labeled. Let the children examine the flowers to find these parts. Look at pollen through a magnifying glass.

Description of parts

- Petal - Usually brightly colored.
- Sepal - Usually green but some flowers have a different color such as a tulip.
- Pistil - Stalk in center of flower.
Some flowers have more than one
- Stamen - Circle of slender parts around pistil.
Longer than pistils in some flowers and shorter in others.
Some flowers don't have any.
- Pollen - On top of stamen.
- Stigma - On top of pistil.

Pollen grains must land on the stigma. The sticky stigma helps the flowers get pollen.



Ranchman, W. L., Williams, H. L., and Blough, G. O., Discovering Our World (3), Scott, Foresman and Company, New York, 1952
pp. 242-243

Activity #6

Grades 1 and 2

What Makes Nails Rust?

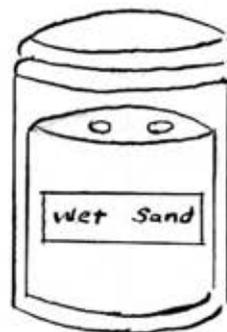
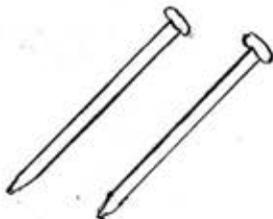
Materials needed.

Two wide mouthed jars, some wet sand, some dry sand, four large nails.

Procedure.

The following directions may be put on the board to be followed after the materials have been assembled.

Fill a jar with dry sand.
Fill a jar with wet sand.
Put two nails in each jar.
Look at the nails every day.
What happens?

Conclusions.

Nails rust when they get wet.

If metal toys are left out in the rain or snow, what will happen to them? (They will rust.)

We paint things made of iron to keep them from rusting. Can you think of things that are made of iron that stay out in the rain and snow? Have they been painted?

Thurber, Walter A., Exploring Science, Allyn and Bacon, New York, 1955, p. 120.

Activity #6

Grades 3 and 4

WHAT MAKES FOOD SPOIL?

Materials needed.

Two slices of bread, a small dish, a magnifying glass.

Introduction.

Long ago people did not know how to keep food from spoiling. They tried one way and then another. Little by little they found out what makes food spoil and how to keep it from spoiling. This experiment will show us how food spoils.

Procedure.

Expose a slice of bread and put it in a dish. Let it stay in the open air for an hour. Did anything happen to the bread?

Cover the bread and put it in a warm, dark place for a few days.

Do you see something fuzzy on the bread? Look at it through a magnifying glass. What do you see?



Conclusions.

The bread mold is a plant. How can you tell? (Many little branches and roots) The dark, round things are full of tiny dots called spores.

Spores are something like seeds. When the spores are tiny they fall out. If a wind catches them, they are carried away until they fall somewhere. These spores are too tiny to see, but the air is full of them.

If spores from bread mold fall on bread or some food like bread, they begin to grow. Then the food has been spoiled by mold.

Can you tell why we keep food covered?

Activity #6

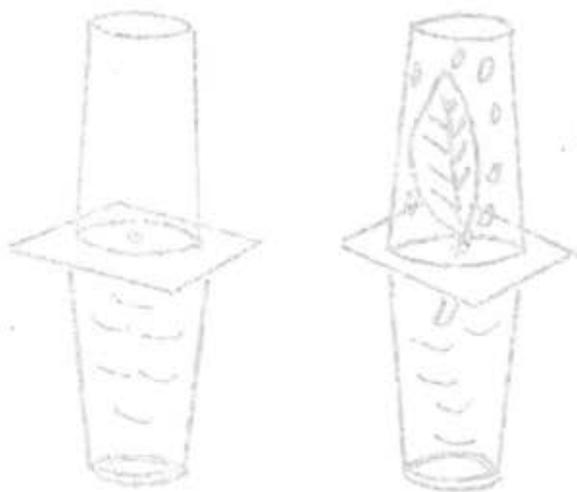
Grades 5 and 6

Do Leaves of a Plant Give Off Water?Materials needed.

Four glasses, water, a leaf of a plant, two pieces of cardboard.

Procedure.

Take a large leaf from a geranium or other plant in the classroom. Put water into a drinking glass. Cut a hole in a piece of cardboard big enough for the petiole (stem) of the leaf to slip through. Place the cardboard across the top of the glass and arrange the leaf so that the petiole is in the water and the blade is above the cardboard. Set a second glass over the blade of the leaf. Now set up a similar piece of apparatus, but do not put a leaf in this one. Observe the inside of both upper glasses. What happened?

Conclusion.

The glass with the leaf inside contains droplets of water. The other glass does not.

Leaves do give off water.

Elough, Glenn C. and Albert J. Buggett. Elementary School Science and How to Teach It. The Dryden Press Publishers, N. Y., 1952, pp. 243-45

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